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The journal's target audience includes Emergency Medicine experts, School members who conduct scientific studies and work in the Emergency Medicine field, researchers, experts, assistants, practicing physicians and other health sector professionals.

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Editorial and publication processes of the journal are shaped in accordance with the guidelines of the international organizations such as the International Council of Medical Journal Editors (ICMJE), the World Association of Medical Editors (WAME), the Council of Science Editors (CSE), the Committee on Publication Ethics (COPE), the European Association of Science Editors (EASE). The journal is in conformity with Principles of Transparency and Best Practice in Scholarly Publishing (doaj.org/best-practice).

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Review Articles: Reviews which are prepared by authors who have extensive knowledge on a particular field and whose scientific background has been translated into high volume of publication and higher citation potential are taken under review. The authors may be invited by the journal. Reviews should be describing, discussing and evaluating the current level of knowledge or topic used in the clinical practice and should guide future studies. Please check Table 1 for limitations for Review Articles.

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Table 1. Limitations for each manuscript type.

Type of manuscript	Word limit	Abstract word limit	Reference limit	Table limit	Figure limit
Original Article	5000 (Structured)	200	50	6	7 or total of 15 images
Review Article	5000	200	50	6	10 or total of 20 images
Case Report	1500	200	10	No tables	10 or total of 20 images
Letter to the Editor	500	N/A	5	No tables	No media
Scientific letter	900	N/A	10	No tables	2 or total of 4 images
Clinical Imaging/ Visual Diagnosis	400	N/A	5	No tables	3 or total of 6 images
History	900	N/A	10	No tables	3 or total of 6 images
Publication ethics	900	N/A	10	No tables	No media

Tables

Tables should be included in the main document, presented after the reference list and they should be numbered consecutively in the order they are referred to within the main text. A descriptive title must be placed above the tables. Abbreviations used in the tables should be defined below the tables by footnotes (even if they are defined within the main text). Tables should be created using the "insert table" command of the word processing software and they should be arranged clearly to provide an easy reading. Data presented in the tables should not be a repetition of the data presented within the main text but should be supporting the main text.

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Figures, graphics and photographs should be submitted as separate files (in TIFF or JPEG format) through the submission system. The files should not be embedded in a Word document or the main document. When there are figure

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subunits, the subunits should not be merged to form a single image. Each subunit should be submitted separately through the submission system. Images should not be labelled (a, b, c, etc.) to indicate figure subunits. Thick and thin arrows, arrowheads, stars, asterisks and similar marks can be used on the images to support figure legends. Like the rest of the submission, the figures too should be blind. Any information within the images that may indicate an individual or institution should be blinded. The minimum resolution of each submitted figure should be 300DPI. To prevent delays in the evaluation process all submitted figures should be clear in resolution and large in size (minimum dimensions 100x100 mm). Figure legends should be listed at the end of the main document.

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When a drug, product, hardware, or software mentioned within the main text product information, including the name of the product, producer of the product, city of the company and the country of the company should be provided in parenthesis in the following format: "Discovery St PET/CT scanner (General Electric, Milwaukee, WI, USA)"

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Limitations, drawbacks and shortcomings of original articles should be mentioned in the "Discussion" section before the conclusion paragraph.

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Book Section: Sherry S. Detection of thrombi. In: Strauss HE, Pitt B, James AE, editors. Cardiovascular Medicine. St Louis: Mosby; 1974.p.273-85.

Books with Single Author: Cohn PF. Silent myocardial ischemia and infarction. 3rd ed. New York: Marcel Dekker; 1993.

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Scientific or Technical Report: Smith P. Golladay K. Payment for durable medical equipment billed during skilled nursing facility stays. Final report. Dallas (TX) Dept. of Health and Human Services (US). Office of Evaluation and Inspections: 1994 Oct. Report No: HHSIGOE 169200860.

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Editorial

Dear Readers,

Here we present the June 2016 issue of the Eurasian Journal of Emergency Medicine. Based on the fact that "The main objective of the journals is to be read", we have started to publish new types of articles with this latest issue that will be of interest to our readers. One of them is an "EM Practice Update". In this section which we have created with the proposal of our valuable Editor Dr. Ayesha Musabbah Al-memari, authors will share their opinion about special subjects by presenting an article from the recent literature. We have also started to publish frank and independent "Invited Paper"s prepared by invited experts from the field. The first "Invited Paper" was prepared by Prof. Oktay Eray, titled 'Comments on Etomidate Usage in the Emergency Department' and it is available in this issue.

We hope you will also be interested in the study titled 'Properties of Turkey-related Publications in International Emergency Medical Journals' which is included in the June 2016 issue. In this study, the characteristics of the papers sent to emergency medicine journals from Turkey were investigated using the search engine PubMed. As a result of this investigation countries that have contributed to the literature of emergency medicine, including Turkey, were ranked and a bird's-eye view of the trends in all emergency medicine journals were discussed. The contribution of Turkey is increasing day by day in studies conducted in the field of emergency medicine, but the number of citations of these publications receive are not at the desired level. We believe that in the near future Turkey will be in a better position among other countries that contributed to the emergency medicine literature.

With best regards,

Editor in Chief
Mustafa Serinken

EURASIAN JOURNAL OF EMERGENCY MEDICINE

Effect of Spinal Immobilization with a Long Backboard and Cervical Collar on the Vital Signs

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Abstract

Aim: The aim of this study was to research the effect of a long backboard (LBB) and cervical collar (CC) devices on neck and/or back pain and changes in the vital signs of healthy subjects.

Materials and Methods: This study was conducted in the emergency department of a training and research hospital with 45 healthy adult volunteers. All the volunteers were asked to lie down on the LBB, and a CC was applied. All the vital signs, including respiratory rate (RR), heart rate (HR), oxygen saturation (SO_2), blood pressure (BP) and visual analog scores (VAS) were measured and recorded for all the volunteers at 0, 5, and 30 min.

Results: Significant increases in VAS and significant decreases in systolic BP were detected (p-values were <0.001 and 0.01, respectively). However, in terms of diastolic BP, RR, HR, and SO_2, no significant changes were detected.

Conclusion: Physicians should be aware that spinal immobilization with LBB and CC can cause significant changes in some vital signs, such as SBP and VAS. However, data on this topic is limited; therefore, there is a need for further studies involving a larger cohort population. *(Eurasian J Emerg Med 2016; 15: 65-8)*

Keywords: Spinal immobilization, long backboard, cervical collar, vital signs, visual analog score

Introduction

Trauma is the leading cause of death among non-elderly individuals worldwide, and it has a high mortality and morbidity rate in general (1). Some major concerns related to trauma, particularly among emergency physicians, include the failure to manage spinal injuries and shock, especially hemorrhagic shock in multi-trauma patients. Therefore, immobilization of the spine and a close evaluation of the patient's vital signs during the management of trauma patients are crucial and routinely recommended, especially in blunt trauma patients (2). Close following of the vital signs is recommended by the Advanced Trauma Life Support guidelines for the diagnosis of hemorrhagic shock in the early stages. The vital signs can be affected by several parameters, such as pain, anxiety, medication, and spinal cord injury (2, 3).

Spinal immobilization is achieved using a long backboard (LBB) and a combination of rigid or semi-rigid cervical collar (CC) in most emergency medicine systems worldwide (4, 5). Although LBB and CC are commonly recommended by international guidelines for spinal immobilization of blunt trauma patients, evidence of the effectiveness of these devices is limited (6-8). In addition, several studies have shown that both devices may cause several side effects, such as pain, anxiety, increased intracranial pressure, decreased pulmonary function, and skin ulcers (9-11). However, to the best of our knowledge, the number of studies on the effects of spinal immobilization on vital signs is limited.

In this study, we aimed to research the effect of LBB and CC devices on neck and or back pain and changes in the vital signs of healthy subjects.

Materials and Methods

This study was conducted in the emergency department of a training and research hospital with 45 healthy adult volunteers. This study was approved by the local ethics committee of Keçiören Training and Research Hospital/B.10.4.İSM.4.06.68.49 and conducted over a 2-month period in 2015. Written informed consent was obtained from all subjects before procedures were performed.

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Volunteer population

Forty-five healthy adult volunteers who had not taken any analgesic drugs within a period of at least 24 h were included in this study; volunteers were between 20 and 30 years of age, and the study included both male and female (non-pregnant) participants. Volunteers with a body mass index of >30 kg/m^2, those experiencing pain of any kind, and those with medical conditions that prevent the application of LBB or CC were excluded. Before the study was conducted, all the volunteers underwent systemic physical examination. Volunteers who had an abnormal physical examination or vital sign findings were excluded from the study.

Measurements and application of LBB and CC

All the volunteers were asked to sleep for at least 8 h the night before the study and to fast for at least 2 h before the measurements of vital signs were taken. All the measurements were taken between 10 and 11 AM. After a 30-min resting period and a brief physical examination, all the volunteers were asked to lie down on the LBB, and a CC was applied to find the required size according to the volunteers (Figure 1). All the vital signs, including respiratory rate (RR), heart rate (HR), oxygen saturation (SO_2), and blood pressure (BP), were then measured for all the volunteers. All the vital signs, excluding RR, were measured by Nihon Kohden BSM-2301K® on the right upper extremity of the volunteers and RR was measured manually by the physician. In addition, to evaluate pain related to the spinal immobilization, a visual analog score (VAS) was taken. The VAS ranged from 0 to 100, with 0 being "no pain" and 100 being "worst possible pain." All the measurements were taken at the beginning of the study and repeated during the 5th and 30th minutes of the study. If the patient reported side effects, they were recorded.

Figure 1. Applying a long backboard and cervical collar for spinal immobilization

Statistical analyses

Statistical analyses were performed using the Statistical Package for the Social Sciences 15.0 (SPSS Inc; Chicago, IL, USA). The Kolmogorov–Smirnov test was used to assess the normal distribution of all the parameters related to the volunteers. Non-parametric data of the volunteers were expressed as the number, percentage, median values, and inter-quartile-range (IQR) (25%–75%). Dependent non-parametric samples were analyzed by using Friedman and Wilcoxon tests. For more two-dependent group comparisons, Bonferroni correction was used. The 95% confidence intervals (95% CIs) were also calculated whenever appropriate, and a p-value less than 0.05 was considered statistically significant.

Results

Of all the volunteers, 24 (53.5%) were male and 21 (46.5%) were female. The median age of the patients was 29 years (IQR: 26–30), the median weight was 70 kg (IQR: 61–79), and the median height was 168 cm (IQR: 164–175). The median systolic BP values of patients at minutes 0, 5, and 30 were 117 mmHg (IQR: 110–131), 110 mmHg (IQR: 105–120), and 110 mmHg (IQR: 104–125), respectively. The median VAS values of patients at minutes 0, 5, and 30 were 0 mm (IQR: 0–0), 0 mm (IQR: 0–20), and 10 mm (IQR: 0–40), respectively. When the findings at minutes 0, 5, and 30 were compared in terms of systolic BP (SBP) and VAS, significant increases in VAS (this significant increasing was detected from minute 0 to minute 5 and from minute 5 to minute 30) and significant decreases in SBP (this significant decrease was detected only from minute 0 to minute 5) were detected, and the p-values of these differences were <0.001 and 0.01, respectively (a new alpha level was calculated as 0.016 after the Bonferroni Correction). However, in terms of diastolic BP, RR, HR, and SO_2, no significant changes were detected. All the findings for the vital signs and VAS are shown in Table 1.

Discussion

In this study, we researched the effect of spinal immobilization through the use of CC and LBB on the vital signs as well as on neck and back pain. To the best of our knowledge, there is only one other study on the direct effect of spinal immobilization on vital signs. We believe that our study yielded two important results. First, spinal immobilization significantly increases neck and back pain, especially 30 min after application. Second, spinal immobilization significantly decreases SBP, and this decrease was detected 5 min after application. We believe that the second result is especially important because emergency physicians usually follow the vital signs (especially blood

Table 1. All vital signs and visual analog scores of volunteers at the 0th, 5th, and 30th min (median-IQR)

	0 min	5th min	30th min	p value
Systolic blood pressure (mmHg)	117 (110–131)	110 (105–120)	110 (104–125)	0.01
Diastolic blood pressure (mmHg)	70 (64–79)	70 (64–77)	71 (60–79)	0.89
Heart rate (beat/min)	77 (70–91)	76 (70–86)	77 (70–83)	0.10
Breath rate (breath/min)	20 (18–24)	20 (17–24)	20 (18–24)	0.56
Oxygen saturation (%)	96 (95–97)	96 (95–97)	96 (95–97)	0.66
Visual analog score (mm)	0 (0–0)	0 (0–20)	10 (0–40)	<0.001

pressure) of patients with severe trauma to ensure an early diagnosis of hypovolemic shock. In two previous studies conducted by Guly et al. (12) on testing vital signs to estimate the stage of hypovolemic shock in trauma patients, SBP was reported to be 8–15 mmHg lower in stage 4 shock patients than in stage 1 shock patients and SBP was 4–7 mmHg lower in stage 3 shock patients than in stage 1 shock patients (3). In our study, SBP decreased by nearly 7 mmHg as a result of spinal immobilization. We believe that this decrease could be a confounding factor in the diagnosis and management of hemorrhagic shock in trauma patients. Of course, it is considered that our study utilized a very small and narrow age-limited population; thus, our results may not be enough to support precise judgments. However, we believe that physicians should be aware that spinal immobilization with LBB and CC can cause significant changes in SBP levels, especially in the first 5 min.

Neck and/or back pain is the most commonly reported side effect of spinal immobilization with LBB and CC. Other side effects include anxiety, increased intracranial pressure, decreased pulmonary function, and skin ulcers (13, 14). Pain is not usually limited to regions of contact with LBB; spinal immobilization can also cause cervical spine or lower back pain due to the non-ergonomic position (7). In addition, these pains have been reported to persist for up to 24 h after only 1 h of LBB, and they can provoke unnecessary radiological exams (9, 15). In a previous study, Cordell et al. (16) reported that the use of LBB causes increased pain in the neck and lumbar areas. Another study conducted by Edlich et al. (17) reported that the VAS of volunteers increased nearly six-fold after 30 min of LBB use. We also found that VAS levels increased during the 5th and 30th minutes of LBB use. These two previous studies reported that using a mattress-attached spine board decreased the VAS of volunteers when compared to LBB without the use of a mattress. We believe that using a mattress with LBB can be effective for preventing pain related to LBB, especially if the patients need to lie down on the spine board for an extended period of time.

There have been several studies on the effects of spinal immobilization on pulmonary function, and these studies have shown that forced expiratory volume in 1 s (FEV_1) and forced vital capacity (FVC) levels significantly decreased at the 5th and 30th minutes (18-20). In our study, secondary indicators of pulmonary function, breath rate, and oxygen saturation were also assessed, and it was shown that they were not affected by spinal immobilization. However, it should not be overlooked that our study population consisted of healthy volunteers. Therefore, if this study were repeated with patients suffering from pulmonary disease (such as chronic obstructive pulmonary disease, asthma, or pulmonary contusion), the results might be different.

To the best of our knowledge, our study is only the second study to evaluate changes in vital signs due to spinal immobilization. Although our study identified a significant decrease in SBP as a result of spinal immobilization, in the first study conducted by Bruijns et al. (21) (in which 53 healthy subjects were enrolled), the authors reported no significant change in the vital signs, including SBP. Therefore, we believe that there is a need for further studies involving a larger cohort population.

Study limitations

Our study has some limitations. First, our study involved a very small and narrow age-limited population. Therefore, our results may not be enough to support precise judgments. Second, we evaluated only healthy subjects. If this study is conducted again with different patient populations such as hemorrhagic shock, hypertension diseases, or elderly patients, these results may be varied. Third, we evaluated only the effect of both LBB and CC; thus, it is not certain which of these caused the change in SBP levels (LBB or CC).

Conclusion

Physicians should be aware that spinal immobilization with LBB and CC can cause significant changes in some vital signs, such as SBP and VAS. However, data on this topic are limited; therefore, there is a need for further studies involving a larger cohort population.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Keçiören Training and Research Hospital (B.10.4.İSM.4.06.68.49).

Informed Consent: Written informed consent was obtained from volunteers who participated in this study.

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References

1. Patton GC, Coffey C, Sawyer SM, Viner RM, Haller DM, Bose K, et al. Global patterns of mortality in young people: systematic analysis of population health data. Lancet 2009; 374: 881-92. [CrossRef]
2. ATLS Subcommittee; American College of Surgeons' Committee on Trauma; International ATLS working group. Advanced trauma life support (ATLS®): the ninth edition. J Trauma Acute Care Surg 2013; 74: 1363-6.
3. Guly HR, Bouamra O, Little R, Dark P, Coats T, Driscoll P, et al. Testing the validity of the ATLS classification of hypovolemic shock. Resuscitation 2010; 81: 1142-7. [CrossRef]
4. Kwan I, Bunn F, Roberts I. Spinal immobilization for trauma patients. Cochrane Database Syst Rev 2001; 2: CD002803.
5. Kreinest M, Goller S, Rauch G, Frank C, Gliwitzky B, Wölfl CG, et al. Application of Cervical Collars - An Analysis of Practical Skills of Professional Emergency Medical Care Providers. PLoS One 2015; 10: e0143409.
6. Walters BC, Hadley MN, Hurlbert RJ, Aarabi B, Dhall SS, Gelb DE, et al. Guidelines for the management of acute cervical spine and spinal cord injuries: 2013 update. Neurosurgery 2013; 60: 82-1. [CrossRef]
7. National Association of EMS Physicians, American College of Surgeons Committee on Trauma. EMS spinal precautions and the used of the long backboard. Prehosp Emerg Care 2013; 17: 392-3. [CrossRef]
8. Deasy C, Cameron P. Routine application of cervical collars-what is the evidence? Injury 2011; 42: 841-2.
9. March J, Ausband S, Brown L. Changes in physical examination caused by use of spinal immobilization. Prehosp Emerg Care 2002; 6: 421-4. [CrossRef]
10. Mobbs RJ, Stoodley MA, Fuller J. Effect of cervical hard collar on intracranial pressure after head injury. ANZ J Surg 2002; 72: 389-91. [CrossRef]
11. Ham HW, Schoonhoven LL, Galer AA, Shortridge-Baggett LL. Cervical collar-related pressure ulcers in trauma patients in intensive care unit. J Trauma Nurs 2014; 21: 94-102. [CrossRef]

12. Guly HR, Bouamra O, Spiers M, Dark P, Coats T, Lecky FE, et al. Vital signs and estimated blood loss in patients with major trauma: testing the validity of the ATLS classification of hypovolaemic shock. Resuscitation 2011; 82: 556-9. [CrossRef]
13. Kwan I, Bunn F. Effects of pre hospital spinal immobilization: a systematic review of randomized trials on healthy subjects. Prehosp Disaster Med 2005; 20: 47-53.
14. Barney RN, Cordell WH, Miller E. Pain associated with immobilization on rigid spine boards. Ann Emerg Med 1989; 18: 918.
15. Lerner EB, Billittier AJ, Moscati RM. The effects of neutral positioningwith and without padding on spinal immobilization of healthy subjects. Prehosp Emerg Care 1998; 2: 112-6. [CrossRef]
16. Cordell WH, Hollingsworth JC, Olinger ML, Stroman SJ, Nelson DR. Pain and tissue-interface pressures during spine-board immobilization. Ann Emerg Med 1995; 26: 31-6. [CrossRef]
17. Edlich RF, Mason SS, Vissers RJ, Gubler KD, Thacker JG, Pharr P, et al. Revolutionary advances in enhancing patient comfort on patients transported on a backboard. Am J Emerg Med 2011; 29: 181-6. [CrossRef]
18. Walsh M, Grant T, Mickey S. Lung function compromisedby spinal immobilization. Correspondence. Ann Emerg Med 1990; 19: 615-6. [CrossRef]
19. Totten VY, Sugarman DB. Respiratory effects of spinal immobilization. Prehosp Emerg Care 1999; 3: 347-52. [CrossRef]
20. Ay D, Aktaş C, Yeşilyurt S, Sarıkaya S, Cetin A, Ozdoğan ES. Effects of spinal immobilization devices on pulmonary function in healthy volunteer individuals. Ulus Travma Acil Cerrahi Derg 2011; 17: 103-7. [CrossRef]
21. Bruijns SR, Guly HR, Wallis LA. Effect of spinal immobilization on heart rate, blood pressure and respiratory rate. Prehosp Disaster Med 2013; 28: 210-4. [CrossRef]

EURASIAN JOURNAL OF EMERGENCY MEDICINE

The Predictive Effect of the Neutrophil-to-Lymphocyte Ratio (NLR) on the Mortality of Acute Ischemic Stroke and its Subtypes: a Retrospective Cross-Sectional Study

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Abstract

Aim: In this study, we aimed to evaluate the association between the neutrophil-to-lymphocyte ratio (NLR) and short-term mortality in cases of acute ischemic stroke (AIS) and its subtypes in emergency departments (EDs).

Materials and Methods: This retrospective cross-sectional investigation included 164 patients presenting to the ED with AIS. The demographic characteristics of the patients, hemogram test results at presentation, co-morbidities, AIS subtype, arrival time at the ED (time between symptoms initiation to ED presentation, in hours), National Institutes of Health Stroke Scale (NIHSS) scores, modified Rankin Scale (mRS) scores, and the length of hospital stay (LHS) were recorded on a data collection form. The clinical outcome was assessed by the NIHSS score on admission, mRS scores at discharge, and on the number of days of hospitalization. Blood samples were analyzed by optical laser light scatter analysis methods (Abbott, cell-dyn Ruby 3700, USA).

Results: Among the study cohort, 134 patients were discharged with a status of cured or surviving, whereas 30 patients did not survive. NLR ratios were higher among the patients who later expired than among the patients who were discharged (p=0.011). Mortality was the highest among cases with an undetermined origin. The WBC and neutrophil count differed significantly among the stroke subtype classifications (p=0.009 and 0.008, respectively), although NLR did not vary significantly among the stroke subtypes (p=0.070). The median LHS was 5 (1–116) days and did not differ significantly among the subtype groups (p=0.877).

Conclusion: Higher NLR is associated with an increased mortality rate in patients with AIS but is not a good predictor for AIS subtypes.
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Keywords: Neutrophil to lymphocyte ratio, acute ischemic stroke, mortality

Introduction

A stroke is generally defined as any disease process that results in a loss of blood flow to the brain, causing permanent (1) focal neurologic syndromes. Strokes are the second most common cause of death after coronary artery disease (2) and are a major cause of disability worldwide (3-6) and a major contributor to the global burden of disease in western countries (7). Acute ischemic stroke (AIS) is one of the most common types of stroke presenting at emergency departments (EDs).

Disruption of the blood–brain barrier causes leukocyte infiltration and a release of pro-inflammatory cytokines following AIS. Recent studies have demonstrated that peripheral leukocyte levels increase following cerebrovascular ischemia. The initial peripheral leukocyte count following a stroke can help predict stroke severity, disability rates at discharge, and final infarct volume (2). Some publications suggest that the leukocyte count at the time of admission is predictive of the likelihood of ischemic stroke and the impact of any resulting neurologic disability on daily living activity (8).

Recent studies suggest that peripheral white blood cells and other inflammatory processes play an important role in the pathophysiology of AIS (3, 9). The neutrophil-to-lymphocyte ratio (NLR) is a parameter of inflammation (2, 10) that is easy to obtain, economical (2), and widely available (11) and has emerged recently as an independent useful prognostic marker to predict the mortality and prognosis of some cardiovascular and neurologic diseases (2, 9-12).

In recent years, several studies have been published investigating the relationship between NLR and stroke (ischemic or hemorrhagic) mortality and prognosis. No previous study, however, has evaluated the relationship between AIS and NLR in the cases of stroke stratified by subtype in ED patients. We examined the relationship between NLR at the time of ED presentation and the short-term mortality in patients with AIS and its diagnostic subtypes.

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Materials and Methods

This study is a retrospective cross-sectional investigation conducted with 164 AIS patients presenting to the University Education and Research Hospital ED with AIS between July 2015 and February 2016 who were eligible for participation in the study.

The study data were reviewed retrospectively from hospital records using the International Classification of Diseases-10 (ICD-10) codes for AIS. The demographic characteristics of the patients, hemogram test results on admission, co-morbidities, AIS subtype diagnosis, arrival time at the ED [time between the start of symptoms and arrival at the ED (hours)], National Institutes Of Health Stroke Scale (NIHSS) scores, modified Rankin Scale (mRS) scores, length of hospital stay (days), etiology, the "trial of org 10172 in acute stroke treatment" (TOAST) classification, definitive diagnosis, and clinical outcome were recorded retrospectively on a data collection form in accordance with the Declaration of Helsinki. The outcome was assessed by the NIHSS score on admission, mRS (mRS, 0=no symptoms at all, 6=death) scores at discharge, and the length of hospitalization. Patients were referred for the study by the attending emergency physician. The patients with incomplete or missing data such as medical, demographic, clinical, laboratory, and radiologic data; a history of prior stroke attack or who had already been receiving treatment for stroke from another center; all types of hemorrhagic stroke, such as subarachnoid, subdural, epidural, intraparenchymal, and intraventricular hemorrhages; fever at presentation; any malignancy; chronic inflammatory disease, for example connective tissue disorders such as vasculitis, rheumatoid arthritis, systemic lupus erythematosus, renal, and hepatic insufficiency; pancreatitis; organ transplantation; immunosuppressive etiologies; and hemoglobinopathies were excluded from the study because NLR may be affected.

Blood samples were evaluated using optical laser light scatter analysis methods (Abbott, cell-dyn Ruby 3700, USA).

Statistical analysis

The study data were analyzed using MedCalc Statistical Software version 12.7.0.0. The Shapiro–Wilk test was used to determine normality. Continuous variables are shown as the mean ± SD or median (min-max) where applicable. Categorical data are reported as the number of cases and percentages. Mean differences among the groups were analyzed by one-way ANOVA, and the Kruskal–Wallis test was used to compare medians. Categorical data were analyzed by the Pearson's chi-square or Fisher's exact test, where appropriate. A p value <0.05 was considered statistically significant.

Results

The study included 164 [79 females (48.2%) and 85 males (51.8%)] AIS patients. The mean age of the study participants was 71.9±9.3 years (min: 52 years, max: 89 years). Demographic characteristics, co-morbidities, TOAST classification, mRS scores, median NIHSS scores, and median arrival time at the ED are given in Table 1.

Among the patients, 134 were discharged as cured or surviving, while 30 patients died. The mean age of the dead subjects was 76.1±10.9 years, and the mean age of the surviving patients was 70.8±13.3 years; this difference was statistically significant (p=0.044). The mean NIHSS score among the dead patients was significantly elevated relative to the surviving patients (p<0.001). The WBC, neutrophil count, and NLR ratios were elevated among the dead patients compared to the surviving patients (p=0.009, p<0.001, and p=0.011, respectively), whereas the lymphocyte count was higher among the surviving patients than among the dead subjects (p=0.005). The highest rate of mortality occurred in cases of AIS of an undetermined origin (UDO) according to the TOAST classification (p<0.001). There were no statistically significant differences between the groups according to gender, co-morbidity, or length of hospital stay. The clinical characteristics of the subjects including death and survival status are summarized in Table 1.

According to the TOAST classification of the subjects, 15 (9.1%) were diagnosed with large-artery disease (LAD), 15 (9.1%) were diagnosed with cardioembolism (CE), 25 (15.2%) had small-artery disease (SAD), and 109 patients (66.5%) were classified as UDO. Mortality occurred in UDO (n=28) and CE stroke subtypes (p=0.000). The WBC and neutrophil count differed significantly among AIS subgroups (p=0.009 and p=0.008, respectively), but NLR was not significantly different among the AIS subtypes (p=0.070) (Table 2).

Discussion

This study examined the association between the NLR and mortality in ED patients with AIS and its subtype. Elevated NLR was associated with increased hospital mortality rates in cases of AIS but was not correlated with specific AIS subtypes. Elevated leukocyte and neutrophil counts and decreased lymphocyte counts were found in the deceased subjects compared to surviving subjects.

Recently, a number of scoring systems and biochemical markers have been developed to predict stroke prognosis and mortality (5, 11). Currently, the NLR is one of most widely used inflammatory markers (2, 10). The neutrophil count, lymphocyte count, and NLR can be easily obtained from the WBC count (5). The NLR is a simple, inexpensive, and easily available prognostic marker for some inflammatory diseases (11, 13).

Inflammatory activity develops within 6–24 h after the vascular pathology and plays an important role in ischemic damage (4). High NLR ratios may be associated with vascular inflammation in both acute coronary diseases and in AIS, and the size of the infarct volume is proportional to the NLR ratio, independent of the etiology (2, 4, 9, 13). In one study, an NLR threshold value of 5.0 was found to be predictive of mortality (4, 9). Another study conducted among intracerabral hemorrhagic patients demonstrated that patients with an NLR of 7.35 had a higher rate of mortality (11). In the present study, the mean NLR value was 2.7±1.5 for surviving patients and 12.1±4.5 among non-surviving subjects.

Neutrophils may contribute to indirect cerebral injury by occluding cerebral microvessels, leading to an extension of the infarct or by the release of neurotoxic substances and inflammatory mediators into the penumbra and focal ischemic brain (8, 9, 11, 14). Similar to earlier publications, WBC and neutrophil counts were elevated among dead subjects compared to surviving patients, with the greatest elevation occurring in CE subtype AIS. In general, increased serum WBC and neutrophil counts have been associated with poor outcomes in many disease conditions (5, 8). An elevated neutrophil count is an early indicator of ischemic brain damage (9) and is associated with a poor prognosis at 3 months, larger infarct volumes, and increased stroke severity in the early stage of ischemia (4, 14). The neutrophil response to vascular injury occurs within approximately 6–12 h in rat models (14) and

Table 1. Demographic and clinical characteristics of subjects regarding death and survival status

Variables	Surviving (n=134)	Dead (n=30)	p	Total (n=164)
Age (years) ±SD	70.8±13.3	76.1±10.9	0.044†	71.9±9.3
Gender, n (%)				
Female	63 (79.7)	16 (20.3)	0.551$	79 (48.2)
Male	71 (83.5)	14 (16.5)		85 (51.8)
Co-morbid conditions, n (%)				
Hypertension	104 (77.6)	18 (60.0)	0.063$	122 (74.4)
Diabetes mellitus	48 (36.4)	6 (20.0)	0.132$	67 (40.6)
Coronary artery disease	58 (43.3)	9(30.0)	0.220$	54 (33.3)
Congestive heart failure	23(17.2)	8 (35.4)	0.300$	31 (18.9)
Chronic obstructive pulmonary disease	10 (7.5)	3 (10.0)	0.708$	13 (7.9)
Multiple conditions	70 (52.2)	16 (53.3)	1.000$	86 (52.4)
NIHSS, median (min-max)	4 (1–16)	14 (4–18)	<0.001¶	6 (1–18)
Length of hospital stay (day), median (min-max)	4 (2–22)	4 (2–101)	0.877¶	5 (1–116)
Arrival time of ED (h), median (min-max)	0 (0–65)	0 (0–16)	0.954¶	0 (0–57)
WBC, 10^3/UL, mean±SD	10.0±3.1	12.1±3.8	0.009†	10.4±3.3
Neutrophil, 10^3/UL, mean±SD	6.9±3.01	9.7±3.9	<0.001†	7.4±3.4
Lymphocytes, 10^3/UL, mean±SD	2.3±1.5	1.5±0.9	0.005†	2.3±1.4
Monocytes, 10^3/UL, mean±SD	0.7±0.3	0.8±0.4	0.101†	1.9 ±0.7
NLR	2.7±1.5	12.1±4.5	0.011†	5.8±9.2
TOAST, n (%)				
Large-artery disease	15 (11.2)	-	<0.001$	15 (9.1)
Cardioembolism	13 (9.7)	2 (6.7)		15 (9.1)
Small-artery disease (lacune)	25 (18.7)			25 (15.2)
Undetermined origin	81 (60.4)	28 (93.3)		109 (66.5)
mRS score				
No significant disability	21 (12.8)	-		21 (12.8)
Slight disability	67 (40.9)	-		67 (40.9)
Moderate disability	26(15.9)	-		26(15.9)
Moderate-severe disability	14 (8.5)	-		14 (8.5)
Severe disability	6 (3.7)	-		6 (3.7)
Dead	-	30 (18.3)		30 (18.3)

†Student's t test, ¶Mann–Whitney U test, $Fisher's Exact Test. SD: standard deviation; min: minimum; max: maximum; n: number of cases; ED: emergency department; NIHSS: National Institutes of Health Stroke Scale; NLR: neutrophil-to-lymphocyte ratio; TOAST: The Trial of Org 10172 in Acute Stroke Treatment; WBC: white blood cell

6–24 h in human patients (9). In the present study, WBC counts were significantly elevated among non-surviving patients.

Lymphopenia, including decreased T cells, is an early indicator of AIS and emerges within a few days following stroke initiation (3, 7, 15). Serum lymphocyte levels may be inversely associated with poor outcomes (8). The decreased serum levels of lymphocytes in AIS may be directly related to the increase in NLR ratios (5, 7, 8). Lymphocytes increase 3–6 days after AIS onset and peak around 7 days after stroke (4, 13). We observed that non-surviving patients had significantly reduced lymphocyte counts. This NLR increase may be the result of an invasion of the edematous penumbra by immune cells and an associated decrease in serum lymphocytes associated with the infarct volume.

An earlier study reported that the degree of inflammatory activation is higher in subjects with the CE subtype than in subjects with other TOAST subtypes of stroke (16). Another study demonstrated significantly higher NLR levels in patients with LAD AIS (10). However, our study found no significant differences in NLR between stroke subtypes.

Table 2. Acute ischemic stroke subtypes and peripheral immunocell distribution

	Large-artery disease	Cardioembolism	Small-artery disease (lacune)	Undetermined origin	p
WBC, 10^3/UL mean±SD	8.3±1.6	11.7±3.8	9.04±1.9	10.1±3.6	0.009
Neutrophil 10^3/UL mean±SD	5.3±1.5	8.9±4.01	6.1±2.0	7.1±3.6	0.008
Lymphocytes 10^3/UL mean±SD	1.7±0.5	1.6±0.8	1.5±0.8	1.7±1.6	0.089
Monocytes 10^3/UL mean±SD	0.3±0.2	0.3±0.1	0.2±0.3	0.7±0.9	0.233

WBC: white blood cell; SD: standard deviation

Immune-inflammatory activation during AIS is associated with stroke volume and severity and is graded using the NIHSS score. A strong correlation between NLR and the NIHSS score has been shown in previous clinic trials (9, 16). Similarly, our results supported these reports that both a median NIHSS score [14 (4–18)] and NLR ratio were higher in non-surviving subjects than in surviving patients.

This study has several limitations because of its retrospective design nature. Data extraction from hospital records has a limited ability to accurately identify health conditions and includes a substantial amount of missing data. Another limitation is the lack of a direct comparison between neutrophil and lymphocyte counts and the levels of other inflammatory markers. Also, many co-morbidities and environmental factors that might have affected the inflammatory marker levels were not taken into account. We were unable to evaluate the correlation between the infarct volume and NLR because no infarct volume measurement was made. Finally, the absence of systemic infection was determined by patient history and body temperature measurement alone; therefore, we do not know if infection may have contributed to changes in the inflammatory parameters measured in this study cohort.

Conclusion

The NLR is a simple, widely accessible, and inexpensive marker that may be used as an independent predictor of short-term mortality in AIS patients during ED presentation, but it is not a good predictor for AIS subtypes. However, additional large-scale studies are necessary to support these results.

Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

Informed Consent: Patient conset for this retrospective study has not been received.

Peer-review: Externally peer-reviewed.

Conflict of Interest: No conflict of interest was declared by the authors.

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References

1. Ortega SB, Noorbhai I, Poinsatte K, Kong X, Anderson A, Monson NL, et al. Stroke induces a rapid adaptive autoimmune response to novel neuronal antigens. Discov Med 2015; 19: 381-92.
2. Saliba W, Barnett-Griness O, Elias M, Rennert GK. Neutrophil to lymphocyte ratio and risk of a first episode of stroke in patients with atrial fibrillation: a cohort study. J Thromb Haemost 2015; 13: 1971-9. [CrossRef]
3. Oh SH, Kim OJ, Shin DA, Song J, Yoo H, Kim YK, et al. Alteration of immunologic responses on peripheral blood in the acute phase of ischemic stroke: blood genomic profiling study. J Neuroimmunol 2012; 249: 60-5. [CrossRef]
4. Tokgoz S, Keskin S, Kayrak M, Seyithanoglu A, Ogmegul A. Is neutrophil/lymphocyte ratio predict to short-term mortality in acute cerebral infarct independently from infarct volume? J Stroke Cerebrovasc Dis 2014; 23: 2163-8. [CrossRef]
5. Köklü E, Yüksel İÖ, Arslan S, Bayar N, Çağırcı G, Gencer ES, et al. Is elevated neutrophil-to-lymphocyte ratio a predictor of stroke in patients with intermediate carotid artery stenosis? J Stroke Cerebrovasc Dis 2016; 25: 578-84. [CrossRef]
6. Seyhanli ES, Lok U, Gulacti U, Buyukaslan H, Atescelik M, Yildiz M, et al. Assessment of serum and urine ghrelin levels in patients with acute stroke. Int J Clin Exp Med 2015; 8: 722-9.
7. Urra X, Cervera A, Villamor N, Planas AM, Chamorro A. Harms and benefits of lymphocyte subpopulations in patients with acute stroke. Neuroscience 2009; 158: 1174-83. [CrossRef]
8. Kumar AD, Boehme AK, Siegler JE, Gillette M, Albright KC, Martin-Schild S. Leukocytosis in patients with neurologic deterioration after acute ischemic stroke is associated with poor outcomes. J Stroke Cerebrovasc Dis 2013; 22: e111-7. [CrossRef]
9. Tokgoz S, Kayrak M, Akpinar Z, Seyithanoğlu A, Güney F, Yürüten B. Neutrophil lymphocyte ratio as a predictor of stroke. J Stroke Cerebrovasc Dis 2013; 22: 1169-74. [CrossRef]
10. Gökhan S, Ozhasenekler A, Mansur Durgun H, Akil E, Ustündag M, Orak M. Neutrophil lymphocyte ratios in stroke subtypes and transient ischemic attack. Eur Rev Med Pharmacol Sci 2013; 17: 653-7.
11. Wang F, Hu S, Ding Y, Ju X, Wang L, Lu Q, et al. Neutrophil-to-lymphocyte ratio and 30-day mortality in patients with acute intracerebral hemorrhage. J Stroke Cerebrovasc Dis 2016; 25: 182-7. [CrossRef]
12. Li Z, Cui L, Ma J, Ma X, Li G. Association between neutrophil to lymphocyte ratio and atrial fibrillation. Int J Cardiol 2015; 187: 361-2. [CrossRef]
13. Hyun S, Kwon S, Cho S, Park S, Jung W, Moon S, et al. Can the neutrophil-to-lymphocyte ratio appropriately predict carotid artery stenosis in patients with ischemic stroke? A retrospective study. J Stroke Cerebrovasc Dis 2015; 24: 2646-51. [CrossRef]
14. Zhao L, Dai Q, Chen X, Li S, Shi R, Yu S, et al. Neutrophil-to-lymphocyte ratio predicts length of stay and acute hospital cost in patients with acute ischemic stroke. J Stroke Cerebrovasc Dis 2016; 25: 739-44. [CrossRef]
15. Kraft P, Drechsler C, Schuhmann MK, Gunreben I, Kleinschnitz C. Characterization of peripheral immune cell subsets in patients with acute and chronic cerebrovascular disease: a case-control study. Int J Mol Sci 2015; 16: 25433-49. [CrossRef]
16. Tuttolomondo A, Pecoraro R, Casuccio A, Di Raimondo D, Buttà C, Clemente G, et al. Peripheral frequency of CD4+ CD28- cells in acute ischemic stroke: relationship with stroke subtype and severity markers. Medicine (Baltimore) 2015; 94: e813. [CrossRef]

EURASIAN JOURNAL OF EMERGENCY MEDICINE

Prevalence and Post-exposure Prophylaxis use for Needlestick Injuries among Health Care Providers in a Tertiary Care Hospital in Kochi, India

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Abstract

Aim: The post-exposure prophylaxis (PEP) protocol in needlestick injuries (NSIs) associated with human immunodeficiency virus (HIV) needs to be evaluated in a developing country like India. The aim of this study was to assess the prevalence of NSI and PEP use for HIV exposure in NSIs among health care providers (HPs) in India.

Materials and Methods: A cross-sectional, institution-based study was conducted among HPs in Amrita Institute of Medical Sciences, Kochi, India. Secondary data for 8 years were recorded. The study population included HPs who had NSIs and who reported to the Emergency Department of the hospital. Descriptive statistics and logistic regression analysis were used.

Results: A total of 949 self-reported cases of NSIs from January 2006 to December 2014 were reported, of which 42.9% were from staff nurses. HPs employed in general/specialty wards (32.5%) had the highest NSI incidence rate. In total, 67.7% of the NSIs were moderately deep, while 22.6% of them were superficial. The commonest device involved was the hypodermic needle (36.7%). Most NSIs occurred during "post-procedure work-up" (64%). Further, 32 HPs had received NSIs from known HIV seropositive patients. Totally, 62.5% of the HPs involved were staff nurses, with a mean age of 26 years. Of the 32 HPs, 28 were given prophylactic triple-drug anti-retroviral treatment. All 28 HPs were followed up for 6 months, and no seropositivity was reported.

Conclusion: The present study shows the high prevalence of NSIs among HPs, particularly among staff nurses. HPs have always known to be at risk of contracting acquired infectious diseases. In light of new emerging communicable diseases with new or unknown pathogens as causative agents, the prevention of NSIs among HPs has acquired significant value. Periodic health education campaigns should be promoted, and strict adherence to standard precautionary protocols should be made mandatory to prevent and minimize the incidence of NSIs among HPs. Periodic updates about PEP should also be made to raise awareness among HPs. *(Eurasian J Emerg Med 2016; 15: 73-7)*

Keywords: Needlestick injuries, health care providers, post-exposure prophylaxis, emergency department

Introduction

Health care providers (HPs) are at a higher risk of occupational exposure to blood-borne infections through percutaneous exposure. The World Health Organization has stated that worldwide, nearly three million HPs experience such an incident (1). Around 60 pathogens can be transmitted through needlestick injuries (NSIs), of which human immunodeficiency virus (HIV) tops the list (2). NSIs have a 0.3% risk of transmitting HIV, which is the second highest (3). Around 57% of HPs had multiple unreported NSIs in the preceding 12 months, which highlights a negligence seen among HPs (4). However, previous studies have suggested that anti-retroviral treatment (ART) reduces the risk of HIV transmission by 81% following occupational exposure (5). Limited epidemiological studies regarding the risk and circumstances of NSIs among HPs have been identified in developing countries; the use of post-exposure prophylaxis (PEP) has also been identified. The availability of similar epidemiological data will help in formulating an effective prophylactic strat-

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egy against NSIs in India. Hence, we conducted this study with the following objectives:

(a) To assess the prevalence of NSIs among HPs

(b) To assess PEP use among HPs following HIV exposure in NSIs

Materials and Methods

A cross-sectional study was conducted among HPs in Amrita Institute of Medical Sciences, Kochi, India to assess the prevalence of NSIs and PEP use among HPs following HIV exposure. This study was conducted at the Emergency Department (ED) and Infection Control Department in AIMS. This is a tertiary care institution with an average number of in-patients of 25,000 per year and employs approximately 2500 HPs. Institutional ethical committee approval was obtained prior to the commencement of the study. The study population selected was HPs comprising doctors, staff nurses, nursing assistants, health care volunteers, lab workers, students, and paramedical staff who had a documented occupational/percutaneous exposure by a needlestick. All NSIs were self-reported to the ED from January 2006 to December 2014, which were systematically recorded by the Infection Control Department. Data were classified as per the Epinet (University of Virginia) format on the basis of job category, department, device type, procedure involved, injury depth, time since initiating PEP following NSI, prescribed regimen, and follow-up status. ELISA, which confirms HIV infection, was performed immediately and at the sixth month post-exposure. On reporting to the ED, possible sources were identified and confirmed by a serology test for communicable diseases for both health care workers and the patient source.

NSIs are defined as injuries caused by an object such as hypodermic needles, IV cannulas, blood collection needles, suture needles, winged IV sets, and needles used to connect parts of IV delivery systems (6). The severity of injury was defined as a superficial (surface scratch and absence of bleeding), moderate (penetration of skin and bleeding), or deep (deep puncture or wound with or without bleeding (5)). PEP consisted of first aid, counseling, risk assessment, and short-term courses of anti-retroviral given for 30 days, along with follow-up and evaluation.

Statistical analysis

The Statistical Package for Social Science version 20 (IBM SPSS Statistics, New York; USA) was used for data analysis. Descriptive statistics were used to determine the frequency and percentage of occupational exposure. Logistic regression was used to find the association of the variables with HIV exposure. Tables and graphs are used to present the results.

Results

A total of 949 cases were reported from 2006 to 2014, and the highest incidence was noted in 2014 (15.2%) (Figure 1). Overall, there was a significant preponderance of the occurrence of NSIs among staff nurses (42.9%), followed by nursing assistants, and housekeepers with 16.9% and 9.2%, respectively. The incidence rate among doctors in our study was comparatively low (5%) (Figure 2).

The highest incidence rate of NSIs was reported in the patient room/ward (32.5%), followed by the dental clinic (18.1%) and ICU (18%). In total, 67.7% of the sustained NSIs were moderately deep, while 22.6% of injuries were superficial. The types of needles causing the NSIs were

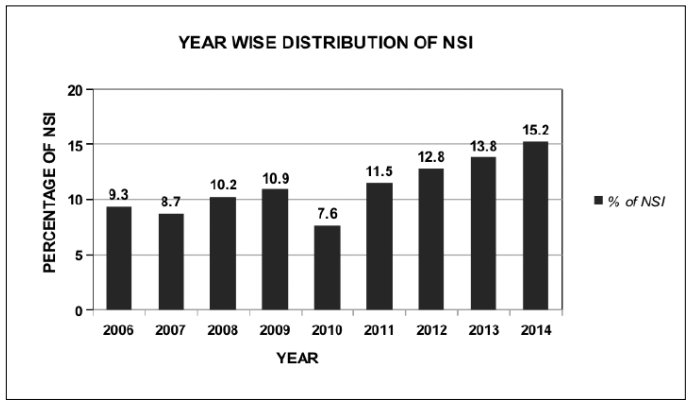

Figure 1. Distribution of the incidence of needlestick injuries by year

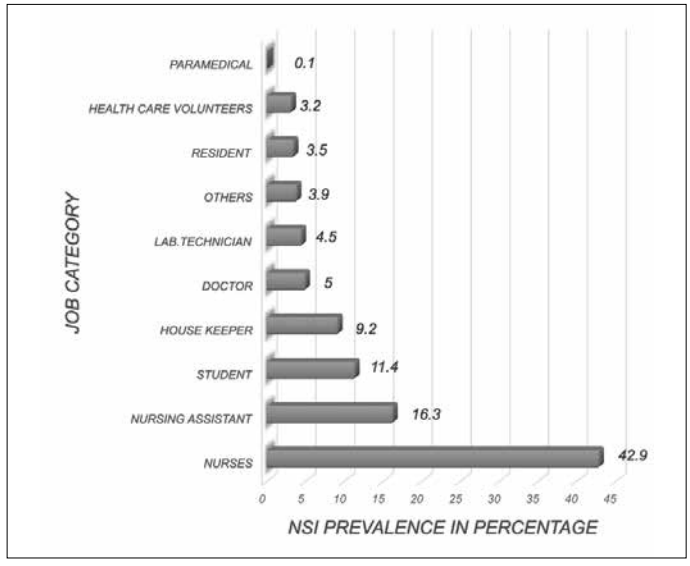

Figure 2. Prevalence of needlestick injuries among health care providers

hypodermic needles (36.7%), disposable syringes (14.9%), and intravenous catheters (10%), followed by other needles (Table 1).

Most NSIs reported were during "post-procedure work-up" (64%), of which 22.4% of NSIs occurred "during manipulation after procedure" and 9.7% during recapping, while 36% occurred "during the procedure," of which 19.8% were during the use of needles (Table 2).

A total of 32 HPs of the 949 cases had received NSIs from known HIV seropositive patients, of which 62.5% of the HPs were staff nurses. In total, 84.4% of the HIV exposure cases following NSIs comprised female HPs. The mean age of HPs who received NSIs from known HIV seropositive patients were 26.6 years (Table 3). The commonest device involved was the hypodermic needle (65.6%) (Table 4). The greatest number of HIV exposure cases due to NSIs, occurred in the ICU (40.6%).

All the 28 cases were initiated on triple-drug ART, containing tenofovir 300 mg, emtricitabine 200 mg, and efavirenz 600 mg, taken orally, once daily, 2 h after food at night time for 30 days. Four of the HPs deferred due to the fear of side effects. All the HPs at risk were asked to do HIV ELISA on the day of sustaining the NSIs, followed by HIV-RNA PCR two weeks after the NSIs, and HIV ELISA during follow-up at 1 month and 6 months, respectively, and no seropositivity was reported in any of the cases.

Table 1. Properties of needlestick injuries

Section-wise Distribution of Needlestick Injuries	Frequency	%
• Patient Room/Ward	308	32.5
• Dental Clinic	172	18.1
• Intensive Care Unit	171	18.0
• Procedure Room	73	7.7
• Out Patient Clinic	60	6.3
• Emergency Department	49	5.2
• Other Describe	42	4.4
• Service/Utility	29	3.1
• Clinical Laboratories	25	2.6
• Outside Patient Room	15	1.6
• Dialysis Unit	5	0.5
Depth of Injury		
• Superficial	226	23.8
• Moderate	629	66.3
• Severe	94	9.9
Devices Associated with Needlestick Injuries		
• Hypodermic Needle	348	36.7
• Syringe Disposable	141	14.9
• Intravenous Catheter	95	10
• Needle Holder/Vacuum Tube	82	8.6
• Suture Needle	82	8.6
• Vacuette Needle	54	5.7
• Intravenous Stylet	39	4.1
• Needle On Intravenous Tubing	31	3.3
• Syringe, Prefilled Cartridge	28	3
• Needle, Other Vascular Catheter	17	1.8
• Butterfly Needle	14	1.5
• Needle Described	8	0.8
• Needle Unknown Type	5	0.5
• Syringe, Other Type	3	0.3
• Trocar	2	0.2
Total	949	100

On a logistic regression of variables with HIV exposure, the only variable significantly associated with HIV exposure was the job category of the HP. Staff nurses were proven to have 1.56 times more risk compared to the other HPs (OR=1.56, 95% CI 0.58–4.19, p=0.026).

Discussion

From a literature search, only a few hospital-based studies on the incidence of NSIs among HPs in South India could be obtained.

Table 2. Procedures associated with needlestick injuries

Procedure	Frequency	%
During the Procedure		
During the use of needles	188	19.8
Blood collection	44	4.6
Between steps of a multi-step procedure	25	2.6
Intravenous line insertion	26	2.7
During surgery	20	2.1
Checking random blood sugar	18	1.9
Giving injection	10	1.1
Cleaning	6	0.6
Suturing	4	0.4
Withdrawing a needle from rubber or other resistance	2	0.2
After the Procedure		
Manipulation after use before disposal	213	22.4
Recapping	92	9.7
Device left on the floor, table, bed or other place	67	7.1
After disposal protruding from disposal	26	2.7
Item pierced the side of disposal container	23	2.4
While putting items into the disposal container	45	4.7
Waste collection	16	1.7
Disassembling device	10	1.1
In preparation for reuse of reusable	3	0.3
From items left on the floor near a disposal container	2	0.2
Others	109	11.5
Total	949	100.0

Table 3. Distribution of HIV exposure among health care providers

Job Category	Number	%
Staff Nurse	20	62.5
Doctors	5	15.6
Nursing Students	3	9.4
Nursing Assistants	4	12.5
Total	32	100

A total of 949 self-reported cases of NSIs from January 2006 to December 2014 were recorded, with the incidence of NSIs increasing over the years. The increased incidence of NSIs among HPs can be explained by the circumstances/procedures during which the exposure had occurred, ineffective in-service education and training on

Table 4. Devices and HIV exposure

Type of Device	Number	%
Hypodermic needle	21	65.6
IV stylet	7	21.9
Vacuette needle	2	6.3
K wire	1	3.1
Prefilled cartridge	1	3.1
Total	32	100.0

the use of person protection equipment, relative inexperience, and negligence from the HP. All HPs, after recruitment, are given initial training in infection control and waste management.

In the present study, the incidence of NSIs in a calendar year was only 105.4 HP, which could be explained by some underreporting. The main reasons for underreporting might be due to the fact that a significant proportion of HPs did not know about the existence of a PEP service and were unaware about whom to contact in the event of an occupational exposure. Other reasons include an underestimation of HIV transmission and an unwillingness to take anti-retroviral drugs, as has been noted in previous studies (7-12).

In the present study, majority of NSIs were reported by staff nurses, (42.9%), which is a similar result compared with previous studies (4, 6, 13-16). This incidence rate is high though compared with a study done by Jayanth et al. (17), where 28% of nurses had experienced NSIs. In the present study, it was revealed that students (11.4%) were found to have a higher incidence rate than doctors, probably due to their lack of awareness of occupational exposure to blood pathogens and lack of training on the use of personal protection equipment. Nursing assistants (16.3%) were also found to have a significant proportion of NSIs, probably because they were not involved in awareness programs (18-21).

In the present study, majority of NSIs occurred in patient rooms (32.5%), which was consistent with the observations made by Guo et al. (22) (38%) but differs from results of other studies, where the highest percentage of NSIs were observed in the minor operation theater and emergency operation theater (18, 23). The present study reveals that the maximum number of NSIs occurred during the "post-procedure" work-up from used needles (64%) compared to the "during procedure" work-up (36%). In the post-procedural work-up, "manipulation after use before disposal" (22.4%) had the highest incidence rate, probably because of a lack of technical preparation, distraction, and working in a hurry. In our study, NSIs during recapping had an incidence rate of 9.7%, which is in concordance with a study conducted by Yoshikawa et al. (24). Despite the existence of "universal precautions" since 1987 to prevent NSIs due to the recapping of needles, the incidence rate of NSIs due to recapping remains high (66.3%) among HPs in India (25). In total, 2.4% of the NSIs occurred due to the needle piercing the disposal container, which underlines the need for puncture-proof disposal containers. The commonest device involved was the hypodermic needle (36.7%); this fining was similar to the observations made by Radha et al. (4) (44%) (18). Studies regarding the depth of injury are rarely reported in India. In the current study, majority of pricks were moderately deep (66.3%). Superficial injuries (23.8%) were found in only 23.2%.

Of the total of 949 cases, 32 (3.47%) were found to have NSIs from HIV seropositive patients. These findings were less when compared to observations made by Kumakech et al. (26) in the UK, in which 8.93% were exposed to HIV through NSIs. This difference in the incidence rate was probably due to the higher prevalence of HIV in western countries. In the present study, 84.4% of HIV exposures to NSIs comprised female HPs, with a mean age of 26.6±6.0 years, which is a similar result to that of the study conducted by McEvoy et al. (27), where 50% of the HPs were below 25 years of age. This may be due to the relative work inexperience of the staff. Staff nurses (62.5%) acquired the maximum exposure to HIV due to NSIs, which can be explained by the circumstances/procedures during which exposure would have occurred. Similar observations were made by Kumakech et al. (26) and McEvoy et al. (27), where 61% of staff nurses were exposed. In the present study, the incidence rate of NSIs among doctors was 15.6%, which is less compared to the study conducted by McEvoy et al. (27) (21%). The commonest device involved was the hypodermic needle (65.6%), for which no comparative study data could be obtained. The greatest number of HIV exposure due to NSIs occurred in the ICU (40.6%), similar to the observations made by Kumakech et al. (26), in which 46.8% occurred in medical and surgical wards. van der Maaten et al. (7) reported the highest incidence of NSIs in the obstetrics ward. Observations made in the UK and China, where physicians were not available around the clock and non- of anti-retroviral medications, had reported significant underreporting and improper PEP delivery (7, 17).

The mean duration between initiating PEP and occupational injury was 2.8 h in the current study, but it was found to be 7.6 h in a previous study (28). This may be due to the availability of an ER physician 24 h a day and 7 days a week who could counsel HPs and prescribe anti-retroviral medications.

Among the 32 HPs who received NSIs from HIV seropositive patients, 28 were initiated on triple-drug therapy, which consisted of tenofovir 300 mg, emtricitabine 200 mg, and efavirenz 600 mg taken orally, once daily, 2 h after food at night for 30 days. Four HPs deferred due to the fear of side effects. All HPs at risk were asked undergo HIV ELISA on the day of receiving the NSI, followed by HIV-RNA PCR 2 weeks after receiving the NSI, and HIV ELISA during follow-up at 1 month and 6 months, respectively, and no seropositivity was reported.

Conclusion

The present study shows the high prevalence of NSIs among HPs, particularly among staff nurses. HPs have always been known to be at risk of contracting acquired infectious diseases. In light of new emerging communicable diseases with new or unknown pathogens as causative agents, the prevention of NSIs among HPs has acquired significant value. Periodic health education campaigns should be promoted, and strict adherence to standard precautionary protocols should be made mandatory to prevent and minimize the incidence of NSIs among HPs. Periodic updates about PEP should also be made to raise awareness among HPs.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Amrita Vishwa Vidyapeetham University.

Peer-review: Externally peer-reviewed.

Conflict of Interest: No conflict of interest was declared by the authors.

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References

1. Prüss-Ustün A, Rapiti E, Hutin Y. Estimation of the global burden of disease attributable to contaminated sharps injuries among health-care workers. Am J Ind Med 2005; 48: 48-90. [CrossRef]
2. Tarantola A, Abiteboul D, Rachline A. Infection risks following accidental exposure to blood or body fluids in health care workers: a review of pathogens transmitted in published cases. Am J Infect Control 2006; 34: 367-75. [CrossRef]
3. Bryant J, Baxter L, Hird S. Non-occupational postexposure prophylaxis for HIV: a systematic review. Health Technol Assess 2009; 13: 1-60. [CrossRef]
4. Radha R, Khan A. Epidemiology of needle stick injuries among the healthcare workers of rural tertiary care hospital – A cross sectional study. Nat J Community Med 2012; 3: 589-94.
5. Cardo DM, Culver DH, Ciesielski CA, Srivastava PU, Marcus R, Abiteboul D, et al. A case-control study of HIV seroconversion in health care workers after percutaneous exposure. N Engl J Med 1997; 337: 1485-90. [CrossRef]
6. Hashmi A. Prevalence of Needle-stick and Sharps Injuries among Healthcare Workers, Najran, Saudi Arabia. Epidemiology: Open Access. 2012: 117. DOI:10.4172/2161-1165.1000117. [CrossRef]
7. van der Maaten GC, Nyirenda M, Beadsworth MJ, Chitani A, Allain T, van Oosterhout JJ. Post exposure prophylaxis of HIV transmission after occupational injuries in Queen Elizabeth Central Hospital, Blantyre, Malawi, 2003-2008. Malawi Med J 2010; 22: 15-9. [CrossRef]
8. Lin C, Li L, Wu Z, Wu S, Jia M. Occupational exposure to HIV among health care providers: A Qualitative study in Yunnan, China. J Int Assoc Physicians AIDS Care (Chic) 2008; 7: 35-41.
9. Gumodoka B, Favot I, Berege ZA, Dolmans WM. Occupational exposure to the risk of HIV infection among health care workers in Mwanza Region, United Republic of Tanzania. Bull. Bull World Health Organization. 1997;75:133–140.
10. Abdel-Malek ZA, Kadekaro AL, Kavanagh RJ, Todorovic A, Koikov LN, McNulty JC, et al. Melanoma prevention strategy based on using tetrapeptide alpha-MSH analogs that protect human melanocytes from UV-induced DNA damage and cytotoxicity. FASEB J 2006; 20: 1561-3. [CrossRef]
11. Haiduven DJ, Simpkins SM, Phillips ES, Stevens DA. A survey of percutaneous/ mucocutaneous injury reporting in a public teaching hospital. Journal of Hosp Infect 1999; 41: 151-4. [CrossRef]
12. Sohn S, Eagan J, Sepkowitz KA. Safety engineered device implementation: does it introduce bias in percutaneous injury reporting? Infect Control Hosp Epidemiol 2004; 25: 532-5.
13. Falagas ME, Karydis I, Kostogiannou I. Percutaneous exposure incidents of the health care personnel in a newly founded tertiary hospital: a prospective study. PLoS One 2007; 2: e194.
14. Foley M. Update on needlestick and sharps injuries: the Needle Stick Safety and Prevention Act of 2000. Am J Nurs 2004; 104: 96. [CrossRef]
15. Tan L, Hawk JC, Sterling ML. Report of the Council on Scientific Affairs: preventing needlestick injuries in health care settings. Arch Intern Med 2001; 161: 929-36. [CrossRef]
16. Katkuri S, Begum S. Occupational Exposure to Blood and Body Fluids Among Health Care Workers in Teaching Hospital, Hyderabad, India. J Pharm Biomed Sci 2015; 5: 95-9.
17. Jayanth ST, Kirupakaran H, Brahmadathan KN, Gnanaraj L, Kang G. Needle stick injuries in a tertiary care hospital. Indian J Med Microbiol 2009; 27: 44-7.
18. Gilks CF, Wilkinson D. Reducing the risk of nosocomial HIV infection in British health worklers working overseas: role of postexposure prophylaxis. BMJ 1998; 316: 1158-60. [CrossRef]
19. Reis JMB, Lamounier Filho A, Rampinelli CA, Soares ECS, Prado RS, Pedroso ERP. Training-related accidents during teacher-student-assistance activities of medical students. Rev Soc Bras Med Trop 2004; 37: 405-8. [CrossRef]
20. Salzer HJ, Hoenigl M, Kessler HH, Stigler FL, Raggam RB, Rippel KE, et al. Lack of risk-awareness and reporting behavior towards HIV infection through needlestick injury among European medical students. Int J Hyg Environ Health 2011; 214: 407-10. [CrossRef]
21. Sharma GK, Gilson MM, Nathan H, Makary MA. Needlestick injuries among medical students: incidence and implications. Acad Med 2009; 84: 1815-21. [CrossRef]
22. Guo YL, Shiao J, Chuang YC, Huang KY. Needlestick and sharps injuries among health-care workers in Taiwan. Epidemiol Infect 1999; 122: 259-65. [CrossRef]
23. Souza-Borges FRF de, Ribeiro LA, Oliveira LCM. Occupational exposures to body fluids and behaviors regarding their prevention and post-exposure among medical and nursing students at a Brazilian public university. Rev Inst Med Trop 2014; 56: 157-63. [CrossRef]
24. Yoshikawa T, Wada K, Lee JJ, Mitsuda T, Kidouchi K, Kurosu H, et al. Incidence rate of needlestick and sharps injuries in 67 Japanese hospitals: a national surveillance study. PLoS One 2013; 8: e77524.
25. Muralidhar S, Singh PK, Jain RK, Malhotra M, Bala M. Needle stick injuries among health care workers in a tertiary care hospital of India. Indian J Med Res 2010; 131: 405-10.
26. Kumakech E, Achora S, Mbchb FB. Occupational exposure to HIV: a conflict situation for health workers. Int Nurs Rev 2011; 58: 454-62. [CrossRef]
27. McEvoy M, Porter K, Mortimer P, Simmons N, Shanson D. Prospective study of clinical, laboratory, and ancillary staff with accidental exposures to blood or body fluids from patients infected with HIV. Br Med J (Clin Res Ed) 1987; 294: 1595-7. [CrossRef]
28. Chen M, Fox E, Rogers C. Post-exposure prophylaxis for human immunodeficiency virus: knowledge and experience of junior doctors. Sex Transm Infect 2001; 77: 444-5. [CrossRef]

Effects of a Standard Dose of Fresh Frozen Plasma on Various Elevations in the International Normalized Ratio

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Abstract

Aim: This study aimed to determine the effects of using a standard dose of fresh frozen plasma (FFP) on the international normalized ratio (INR) of patients with various elevations in INR from using warfarin.

Materials and Methods: This prospective study was conducted in the emergency department (ED) of a training and research hospital from February 2015 to January 2016 with patients who presented with elevated INRs from using warfarin. Their demographic data, clinical features, and laboratory findings, including pre- and post-transfusion INRs, were recorded. The standard dose of FFP used was 3 units of FFP (900 mL). Delta INR (ΔINR) was defined as the pre-transfusion INR minus the post-transfusion INR. Two hours after the end of the FFP transfusion, each patient's INR was measured again.

Results: Thirty-two patients who received FFP and whose pre- and post-transfusion INRs were measured were included. Of these 32 patients, 23 (71%) were women, and the patients' mean age was 72.8±11.1. The mean pre- and post-transfusion levels and ΔINR were 10.6±5.3, 4.3±2.3, and 6.2±4.3, respectively. There was a strong positive correlation between high pre-transfusion INR and ΔINR ($p<0.001$, $r=0.85$). Regression analysis performed to estimate ΔINR after the transfusion of a standard dose of FFP found that ΔINR=0.69×(pre-transfusion INR) -1.111 ($p<0.001$).

Conclusion: The present study found that using a standard dose of FFP caused varying reductions in ΔINRs that correlated with the pre-transfusion INR. *(Eurasian J Emerg Med 2016; 15: 78-81)*

Keywords: Warfarin, fresh frozen plasma, international normalized ratio, emergency department

Introduction

Warfarin, a widely used oral anticoagulant, acts by inhibiting vitamin K-dependent coagulation factors and is used to treat several thromboembolic diseases, including atrial fibrillation, deep-venous thrombosis, pulmonary thromboembolism, heart valve replacement, and dilated cardiomyopathy (1, 2). The clinical efficacy of warfarin is evaluated by measuring the international normalized ratio (INR) within the determined therapeutic range, which depends on the disease (3). As long as the target INR is achieved and maintained, warfarin therapy has been proven to decrease the risk of thromboembolic events (4). However, one of the foremost challenges in using warfarin is to maintain the target INR within the therapeutic range for the disease under treatment (5). Supra-therapeutic INRs (>3.5) can cause minor or major bleeding. According to the results of previous studies, the most frequent complication of warfarin therapy is hemorrhage necessitating emergency department (ED) treatment (6, 7).

In patients with elevated INRs, the treatment options are to stop warfarin therapy, administer oral or intravenous vitamin K, or administer intravenous fresh frozen plasma (FFP). Although FFP is not the first option for treating supra-therapeutic INRs, particularly in patients with major bleeding, it is widely used in EDs to rapidly normalize INRs. Although there is no clear evidence-based data on the dose of FFP required to successfully treat elevated INRs, previous guidelines have recommended 10–15 mL of plasma per kilogram of body weight (8, 9). However, it is the standard dose of FFP to reduce various elevations in INR is not clear. Therefore, this study aimed to determine the effects of using a standard dose of FFP on INRs of patients with various elevations in INR from using warfarin.

Materials and Methods

This prospective study was conducted in the ED of a training and research hospital from February 2015 to January 2016. The local

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ethics committee approved the study, and the researchers obtained written informed consent from the patients or their legally authorized relatives.

The study included patients age 18 or older who were admitted to the ED with elevated INRs, either with or without bleeding and who had one or more indications for FFP treatment, which were defined as major bleeding and an elevated INR, minor bleeding that had been unstoppable despite appropriate intervention and an elevated INR, and highly elevated INR (>20) with or without any other complaints. The study excluded patients younger than the age of 18, those who did not receive FFP treatment, and those whose pre- and post-transfusion INRs were not measured.

After the patients were initially evaluated, their demographic data, clinical features, and laboratory findings, including pre- and post-transfusion INRs, were recorded. The standard dose of FFP used was 3 units of FFP (900 mL). The median weight of our patients was 74 (min: 62, max: 85) and the mean of mL/kg of FFP body weight was 12.8. Delta INR (ΔINR) was defined as the pre-transfusion INR minus the post-transfusion INR. Two hours after the end of the FFP transfusion, each patient's INR was measured again. After transfusion with a standard dose of FFP, each patient was evaluated for both clinical outcome (stoppable/unstoppable bleeding and/or re-bleeding) and laboratory outcome [decrease to a therapeutic (1.5–3.5) or normal (<1.5) INR]. Patients who continued to bleed after a standard dose of FFP or whose INRs could not be decreased received a second FFP transfusion (3 units of FFP).

Statistical analysis

Statistical analyses were performed using Statistical Package for the Social Sciences version 15.0 (IBM SPSS Statistics; New York; USA). The Shapiro–Wilk test was used to assess the normal distribution of all parameters related to the patients. The patients' parametric data were expressed as mean and standard deviation (SD). The mean ΔINR were analyzed by one-way analysis of variance (ANOVA) in nondependent groups. Pearson's test was used to calculate the correlation between high pre-transfusion INRs and ΔINR. Finally, to estimate the ΔINR after an FFP transfusion, linear regression analysis was performed using the formula y=a+bx, where x=[pre-transfusion INR]. A p value of <0.05 was considered statistically significant.

Results

During the study period, 106 patients with elevated INRs were admitted to the ED. Of these, 74 did not receive FFP because they had no major bleeding or other indications; thus, they were excluded. This left 32 patients who both received FFP and whose pre- and post-transfusion INRs were measured. Of these 32 patients, 23 (71%) were women. The patients' mean age was 72.8±11.1 years. Table 1 shows the patients' demographic and clinical characteristics. The mean pre-transfusion INR, post-transfusion INR, and ΔINR were 10.6±5.3, 4.3±2.3, and 6.2±4.3, respectively.

Then, patients were categorized according to their pre-transfusion INRs; eight patients were categorized as having slightly elevated INR (INR=3–6), 12 were categorized as having moderately elevated INR (INR=6–9), and 12 were categorized as having severely elevated INR (INR>12). In addition, ΔINRs associated with these INRs were 2.15±0.9, 5.5±1.9, and 9.6±4.7, respectively. As Table 2 shows, the differences among all groups were statistically significant (ANOVA, Tamhane, p<0.001). As Figure 1 shows, there was a strong positive correlation between high pre-transfusion INRs and ΔINR (p<0.001, r=0.85). Regression analysis performed to estimate ΔINR after transfusion of a standard dose of FFP found that ΔINR=0.69×(pre-transfusion INR)−1.111 (p<0.001).

Finally, when the data were analyzed according to laboratory outcomes (post-transfusion INR) and clinical outcomes (re-bleeding or unstoppable bleeding), 12 patients' post-transfusion INRs could not be decreased to either therapeutic or normal levels. However, no patients required a second 2-unit FFP transfusion, and no patients experienced re-bleeding or unstoppable bleeding.

Discussion

This study aimed to detect whether transfusion with a standard dose of FFP decreased INRs in patients whose INRs were elevated due to warfarin use. The study identified two important results. First, it appears that using a standard dose of FFP causes varying reductions in ΔINRs in patients whose pre-transfusion

Table 1. Demographic and clinical features of the patients

Age (mean±SD)	72.8±11.1
Sex	23 females (71%)
Comorbid diseases, n (%)	
• Hypertension	24 (75)
• Coronary artery disease	16 (50)
• Diabetes mellitus	14 (43.8)
• Congestive heart disease	12 (37.5)
• Chronic kidney disease	2 (6.3)
• Other	9 (28)
Vital signs (mean±SD)	
• Systolic blood pressure, mmHg	125±26
• Diastolic blood pressure, mmHg	68±13
• Heart rate, beats/min	91±11
Indication for using warfarin, n (%)	
• Atrial fibrillation	15 (47)
• Venous thromboembolism	7 (22)
• Heart valve replacement	6 (19)
• Other	4 (12)
Indication for FFP transfusion, n (%)	
• Major bleeding	17 (53.2)
◦ Gastrointestinal hemorrhage	14
◦ Intracranial hemorrhage	2
◦ Intra-abdominal hemorrhage	1
• Very high INR (20)	4 (12.5)
• Unstoppable minor bleeding	11 (34.3)
Pre-transfusion INRs, mean±SD	10.6 (5.3)
Post-transfusion INRs, mean±SD	4.3 (2.3)
ΔINR, mean±SD	6.2 (4.3)

Table 2. ΔINRs according to different pre-transfusion INR groups

Pre-transfusion INR group	Number of patients n (%)	ΔINR	p
• 3–6	8 (25)	2.15±0.9	
• 6–9	12 (37.5)	5.5±1.9	<0.001
• >12	12 (37.5)	9.6±4.7	

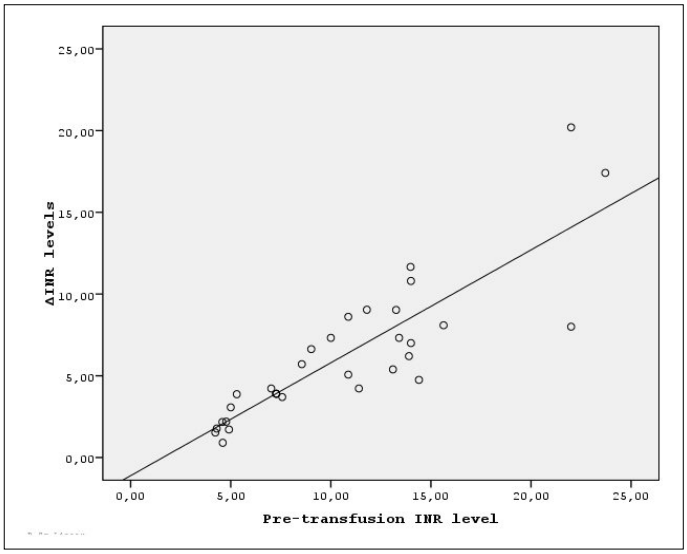

Figure 1. Scatterplot graph showing the correlation between high pre-transfusion INRs and ΔINR (p<0.001, r=0.85)

INRs are elevated to various degrees. Second, despite this first result, using a standard dose of FFP may fail to reduce INRs to therapeutic levels. In 12 patients, post-transfusion INRs could not be decreased to therapeutic levels. However, none of these 12 patients had indications requiring a second FFP transfusion because none of the patients experienced re-bleeding or unstoppable bleeding. Therefore, the findings of the study appear to indicate that a standard dose of FFP is sufficient to safely reduce INRs in patients with both elevated INRs and indications for FFP transfusion. Of course, it must be taken into consideration that this study had a small population; thus, the results may not be enough to extrapolate from.

Two studies, Abdel-Wahab et al. (10) and Holland et al. (11), evaluated ΔINRs after 1-unit FFP transfusions in patients with minimally increased INR (in these studies, the pre-transfusion INRs were 1.1–1.85 and 1.1–1.6, respectively). The results showed ΔINRs of 0.07 and 0.03, respectively. Shinagare et al. (12) reported that in patients with moderately increased INR (2.01–5.0), the average ΔINR after a 1-unit FFP transfusion was 0.77. Sezik et al. (13) reported that in patients who received FFP transfusions due to high INRs, a strong correlation was found between pre-transfusion INRs and $\Delta INR_{1\text{-unit FFP}}$ (p<0.0001, r=0.957). Holland et al. (14) evaluated the effects of FFP transfusion on laboratory coagulation parameters in 103 patients receiving FFP transfusions due to elevated INRs and found that while FFP transfusion minimally decreased INRs in patients who had minimally increased INRs, it caused more significant decreases in INRs of patients who had higher pre-transfusion INRs. In addition, regression analysis was performed in the study to predict the INR change, and the results showed that INR change=0.37×(pre-transfusion INR)−0.47 (14). As in these previous studies, the present study found a strong positive correlation between elevated pre-transfusion INRs and ΔINR. In addition, the present study performed a regression analysis to estimate ΔINR after transfusion of a standard dose of FFP (3 units) and found that ΔINR=0.69×(pre-transfusion INR)−1.111.

Currently, modern guidelines recommend prothrombin complex concentrate (PCC) (50 units/kg) as the first option in reversing the effects of warfarin. FFP is only recommended if there is major bleeding and PCC is unavailable. However, PCC is unavailable in our hospital; thus, we have to use FFP to reverse the effects of warfarin.

Study limitations

The most significant limitation of this study was the small population size. In addition, our study was an observational prospective study and not a randomized controlled study. Our study group mainly comprised geriatric patients who use multi-drugs and have co-morbidities. Therefore, the results may not be sufficient to extrapolate from.

Conclusion

The present study found that using a standard dose of FFP caused varying reductions in ΔINRs with correlated pre-transfusion INRs in patients whose INRs were elevated to varying degrees before transfusion. However, FFP may fail to reduce INRs to therapeutic levels. Considering that none of the patients in the present study experienced re-bleeding or unstoppable bleeding, the findings indicate that a standard dose of FFP is sufficient to safely reduce INRs in patients who have both elevated INRs and indications for FFP transfusion.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Keçiören Training and Research Hospital.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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References

1. Limdi NA, Veenstra DL. Warfarin pharmacogenetics. Pharmacotherapy 2008; 28: 1084-97. [CrossRef]
2. Levine M, Pizon AF, Padilla-Jones A, Ruha AM. Warfarin overdose: a 25-year experience. J Med Toxicol 2014; 10: 156-64. [CrossRef]
3. Lane DA, Lip GY. Maintaining therapeutic anticoagulation: the importanceof keeping "within range". Chest 2007; 131: 1277-9. [CrossRef]
4. Lip GYH, Edwards SJ. Stroke prevention with aspirin, warfarin, and ximelagatran in patients with non-valvular atrial fibrillation: a systematic review and meta-analysis. Thromb Res 2006; 118: 321-33. [CrossRef]
5. van Walraven C, Jennings A, Oake N, Fergusson D, Forster AJ. Effect of study setting on anticoagulation control: a systematic review and meta-regression. Chest 2006; 129: 1155-66. [CrossRef]

6. Sayhan MB, Oğuz S, Yüksel V, Hüseyin S, Sayhan ES, Yağcı G. The Analysis of Patients Admitted to the Emergency Department Dueto Complications Related to Warfarin Treatment. JAEM 2014; 13: 194-8. [CrossRef]
7. Levine MN, Raskob G, Beyth RJ, Kearon C, Schulman S. Hemorrhagic complications of anticoagulant treatment. Chest 2004; 126: 287-310. [CrossRef]
8. O'Shaughnessy DF, Atterbury C, Bolton Maggs P, Murphy M, Thomas D, Yates S, et al. Guidelines for the use of fresh-frozen plasma, cryoprecipitate and cryosupernatant. Br J Haematol 2004; 126: 11-28. [CrossRef]
9. Slattery DE, Pollack CV, Thrombotics and Antithrombotics, in: Tintinalli JE, Stapczynski JS, Ma OJ, Yealy DM, Meckler GD, Cline DM (Eds.), Emergengy Medicine: A Comprehensive Study Guide. 8th ed. New York: McGraw-Hill, 2016. pp. 1524-34.
10. Abdel-Wahab OI, Healy B, Dzik WH. Effect of fresh-frozen plasma transfusion on prothrombin time and bleeding in patients with mild coagulation abnormalities. Transfusion 2006; 46: 1279-85. [CrossRef]
11. Holland LL, Foster TM, Marlar RA, Brooks JP. Fresh frozen plasmais ineffective for correcting minimally elevated international normalized ratios. Transfusion 2005; 45: 1234-5. [CrossRef]
12. Shinagare SA, Angarkar NN, Desai SR, Naniwadekar MR. An audit of fresh frozen plasma usage and effect of fresh frozen plasma on thepre-transfusion international normalized ratio. Asian J Transfus Sci 2010; 4: 128-32.
13. Sezik S, Aksay E, Kılıç TY. The effect of fresh frozen plasma transfusion on international normalized ratio in emergency department patients. J Emerg Med 2014; 47: 596-600. [CrossRef]
14. Holland LL, Brooks JP. Toward rational fresh frozen plasma transfusion: The effect of plasma transfusion on coagulation test results. Am J Clin Pathol 2006; 126: 133-9.[CrossRef]

Intrapleural and Intraperitoneal Free Fluid in Calcium Channel Blocker Overdose

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Abstract

Aim: Toxicity findings affecting many systems, particularly the cardiovascular system, are observed in calcium channel blocker (CCB) overdose. Here, we aimed to present the incidence of CCB overdose patients with intraperitoneal and intrapleural free fluids detected by abdominal ultrasonography (USG).

Materials and Methods: CCB overdose patients admitted to the emergency room in a 2-year period were prospectively included. All patients with CCB overdose were evaluated by bedside abdominal USG in terms of the presence of pleural and peritoneal fluid.

Results: A total of 14 patients with CCB poisoning were included in our study. Six (42.8%) patients had taken verapamil, 7 (50%) patients amlodipine, and 1 (7.2%) patient nifedipine. The mean age of the patients was 27.2±15.9 years (range: 18–65 years). The median time from drug intake to arrival at the hospital was 3.0 h (IQR: 1.75–5). Nine (64.28%) of these patients were detected to have intraperitoneal and intrapleural free fluid by bedside USG. The mean arterial pressure of patients with intraabdominal and intrapleural fluid was lower than that of patients without the detected fluid, i.e., 56.8 (IQR: 54.8–61.8) vs. 65.6 (IQR: 64.2–66.8), respectively ($p<0.001$).

Conclusion: Besides the cardiovascular findings, intraperitoneal and intrapleural free fluid is also a common feature in CCB overdose. Bedside USG may help to identify these patients. *(Eurasian J Emerg Med 2016; 15: 82-5)*

Keywords: Hypotension, calcium channel blocker, overdose, peritoneal free fluid, pleural free fluid

Introduction

Calcium channel blockers (CCBs) are used in the treatment of hypertension, angina pectoris, Reynaud's phenomenon, arrhythmia, and for the prophylaxis of migraine. All CCBs show their physiological effects by blocking voltage-sensitive calcium channels (L-type). The cardiac effects of excessive intake are myocardial depression, cardiovascular collapse, heart block, bradycardia, vasodilatation (relative volume deficit), and hypotension. These effects emerge in the first few hours after ingesting standard pills, while it can take up to 18–24 h with slow-release medications. Nausea and vomiting are common and occur because of ileus or even ischemia in the intestine (1, 2). In addition, hyperglycemia, lactic acidosis, seizures, coma, and non-cardiogenic pulmonary edema have been reported in CCB overdose (1, 3).

Intestinal tract complications such as mesenteric ischemia, paralytic ileus, colonic ischemia, pseudo-obstruction, gangrene, and perforation in the terminal ileum and cecum have been reported as case reports with CCB overdose in previous studies (2, 4-7).

In this study, we aimed to present the incidence of CCB overdose patients with intraperitoneal and intrapleural free fluids detected via abdominal ultrasonography (USG).

Materials and Methods

Calcium channel blockers overdose cases admitted to the emergency room in a 2-year period were studied prospectively. The local ethics committee approved the study. Patients under 18 years of age and who were poisoned with multiple drugs were

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excluded. The diagnosis of CCB drug poisoning was confirmed with information obtained from the patients or their relatives, presentation of the drug boxes, and the presenting clinical findings of the patient. Determining an exact toxic dose for a given individual was difficult because of the variability in patient-specific factors, such as age, weight, genetics, health status, and other recently ingested substances. The minimum toxic doses were determined to be 0.03 g for amlodipine, 0.16 g for verapamil, and 0.2 g for nifedipine by considering the lowest reported toxic doses for adults (8). The demographic characteristics of the patients (age, gender), time of arrival at the hospital, type of suspected drug intake, stated amount of drug taken (g), vital signs (pulse rate per minute, blood pressure), physical examination findings, laboratory values, given treatment, results of bedside USG, and situation regarding patient survival were recorded in the standard data form. USG examinations of patients were conducted by a radiologist. Patients whose mean arterial pressure (MAP) was under <65 mmHg were considered to be hypotensive. Patients with pleural and peritoneal fluids detected with USG were called back for control 10 days after hospital discharge and USG was performed again.

Statistical analysis

The Statistical Package for the Social Sciences version 21 (IBM SPSS Statistics, New York, USA) statistical software was used for the analysis of data. Numerical variables were given as the mean, median, and interquartile ratio (IQR), whereas categorical variables were given as frequencies (n) and percentages. Because the data were not normally distributed, two group comparisons of the numeric variables were performed by Mann–Whitney U test. All the hypotheses were constructed as two tailed, and an alpha critical value of 0.05 was accepted as significant.

Results

During the study period, there were 33 patients with CCB overdose, 19 (58%) of whom were excluded because of other multiple drug ingestions. A total of 14 patients, 11 (78.5%) female and 3 (21.5%) male, with CCB poisoning were included in our study. The characteristics of the patients with CCB poisoning are shown in Table 1. The mean age of the patients was 27.2±15.9 years (range 18–65 years). The median time from drug intake to arrival at the hospital was 3.0 (IQR: 1.75–5) h. All of the patients were taking the drugs in an attempt to commit suicide. Six (42.8%) patients had taken verapamil, 7 (50%) patients amlodipine, and 1 (7.2%) patient nifedipine. A 65-year-old patient with known hypertension and coronary artery disease was found to have attempted suicide with his own CCB drugs, whereas the other patients had no previous history of cardiovascular diseases or chronic medication use. The aforementioned 65-year-old patient had AV complete block just after entering ED. The block failed to respond to atropine and external cardiac pacemaker treatment. He died 3 h after hospital admission. Among the surviving patients, none of them were on medication, except a woman who was using oral contraception.

The MAP of patients was 61.8 mmHg (IQR: 56.4–65.3). The MAP of patients with detected intraabdominal and intrapleural fluid and without detected fluid was 56.8 (IQR: 54.8–61.8) and 65.6 (IQR: 64.2–66.8), respectively ($p<0.001$). Patients with hypotension were treated with an intravenous infusion of calcium and inotropic treatment.

Nine (64.8%) of 14 patients were found to have free fluid in the peritoneum and pleura. None of the other patients had abdominal pain or constipation. Physical examination findings of the acute abdomen (defense, rebound) were not present. The mean laboratory values of the patients are shown in Table 2, except for the mortality case, whose laboratory values were unavailable. Table 3 shows the

Table 1. Characteristics of the study patients with CCB poisoning

Age (years)/ gender	Pulse rate (/minute)	MAP (mmHg)	Time of arrival at hospital after drug intake (h)	Type of suspected drug	Stated amount of drug taken (g)	Intrapleural fluid	Intraperitoneal fluid	Dead
18/F	45	53.8	1	V	2.8	+	+	-
29/F	58	63.3	3	N	0.3	+	+	-
18/F	51	61.7	5	V	4.8	+	+	-
19/F	47	53.2	2	A	0.2	+	+	-
65/M	59	55.9	5	A	0.2	+	+	+
20/F	56	56.8	5	A	0.3	+	+	-
23/F	47	56.6	2	V	4.8	+	+	-
18/F	62	59.4	1	A	0.3	+	+	-
19/M	60	62.0	3	A	0.15	+	+	-
38/M	59	63.1	5	V	1.44	-	-	-
32/F	60	65.3	4	A	0.08	-	-	-
19/F	68	66.4	1	A	0.1	-	-	-
18/F	57	65.6	5	V	2.4	-	-	-
48/F	71	67.2	3	V	1.2	-	-	-

CCB: calcium channel blocker; F: female; M: male; MAP: mean arterial pressure; V: verapamil; A: amlodipine; N: nifedipine

Table 2. Laboratory values of patients

Laboratory data	Mean values of patients	Normal value
White blood cell	15.7±4.9	4.5–11 µL
Hemoglobin	11.7±2.0	13.6–17.2 g/dL
Hematocrit	35.3±5.0	39.5%–50.3%
Platelet count	225.8±95.5	156–373 µL
Glucose	170.5±71.4	70–105 mg/dL
Aspartate aminotransferase	20.4±9.8	<30 U/L
Alanine aminotransferase	13.8±13.6	<30 U/L
Blood urea nitrogen	13.4±5.6	8–25 mg/dL
Creatinine	1.1±0.6	0.9–1.3 mg/dL
Sodium	139.3±3.2	135–145 mmol/L
Potassium	3.8±0.6	3.5–5.1 mmol/L
Ionized calcium	1.25±0.07	1.1–1.3 mmol/L
INR	1.27±0.21	1
pH	7.31±0.03	7.35–7.45
Bicarbonate	18.8±2.6	22–28 mmol/L

Table 3. ECG changes of the patients during observation

ECG findings	n (%)
Severe Sinus Bradycardia (<50/min)	5 (35.7)
Complete AV block	1 (7.1)
Prolonged PR	4 (28.6)
QRS widening	2 (14.2)
Ventricular early beat	3 (21.4)
ST-T wave changes	1 (7.1)
Premature atrial contractions	0

ECG: Electrocardiography; PR: PR interval; QRS: QRS duration; ST: ST segment; T: T wave

electrocardiography (ECG) changes of all 14 patients under observation. Except for the dead patient, none of them had complete AV block. There was prolonged PR detected in four patients (Table 3). The Glasgow Coma Scale score of the patients, excluding the mortality case, was 15. Only one patient had a seizure, but the patient was back to normal after the seizure and there were no pathological findings in his brain CT.

The median duration of hospital stay for the hypotensive and non-hypotensive patients was 9 (IQR: 3.5–15.2) days and 1.5 (IQR: 1–12) days, respectively. Control ultrasounds of the patients with free fluid 10 days after discharge revealed no evidence of intraperitoneal and intrapleural fluid.

Discussion

Although frequently used for treatment, CCB overdose may be fatal if prompt treatment is not administered with early diagnosis. In CCB overdose, cardiovascular collapse, heart block, bradyarrhythmia and hypotension, hyperglycemia, lactic acidosis, seizures, coma, and non-cardiogenic pulmonary edema and intestinal ischemia may occur (1, 3, 9). In our case series, there was just one complete AV block.

Hypotension may occur because of peripheral vasodilation, decreased cardiac contractility, bradycardia, or a combination thereof. Although hypotension occurs in the first few hours, it can also appear as late as 18–24 h with modified slow-release preparations (3, 10). Our patients had no slow-release preparations intake, and the mean time from the intake of drugs to arrival at the hospital was approximately 3 h.

The differential diagnosis of the signs and symptoms occurring in patients with undiagnosed CCB poisoning should be clear and patients should be treated. The most commonly occurring and life-threatening symptoms of CCB poisoning are AV block and hypotension. Here, the use of bedside USG in the emergency department as part of the examination to investigate the cause is suggested because of the ease of use, lack of radiation risks, and rapid diagnosis (11, 12). USG provides information, particularly about intraabdominal organs, intrapleural fluid, pericardial effusion, and cardiac functions. We believe ultrasonographic free fluid in patients with hypotension and the lack of clearly identified CCB poisoning from information received from patients and/or their relatives can guide the physicians in their diagnosis.

Establishing fluid support in the treatment of hypotension in CCB poisoning is the first step. However, in patients with severe hypotension, IV calcium, glucagon, inotropic therapy, high-dose insulin therapy, lipid emulsion, and aortic balloon pump application are other treatments (10, 13, 14). In our study, IV calcium, hydration with normal saline, and inotropic therapy were administered to the patients with hypotension and with USG-detected peritoneal and pleural free fluid. Despite the given treatment, complete AV block developed in one patient. The patient did not respond to atropine and external pacemaker treatment and died at the 3rd hour. The other patients were completely treated and discharged.

Different clinical findings can occur in patients because of extensive tissue hypoperfusion due to hypotension. The presence of variable amounts of collaterals makes the colon susceptible to ischemia (15). Depending on the CCB overdose, although complicated and surgery-requiring complications such as submucosal edema, ischemia, necrotic ulceration, bleeding, and even gangrene have been observed in case reports in the literature, clinical situations, such as pseudo-obstruction, that can be treated without surgical treatments have also been shown (2, 10). In a patient who developed non-occlusive colonic ischemia due to verapamil overdose, Perbet et al. (5) found a gangrenous segment in the left column with exploratory laparotomy, and a histopathological examination revealed submucosal edema, necrotic patchy ulceration areas, and intramural hemorrhage due to submucosal vessel dilatation. Gutierrez et al. (6) reported gangrene segments in the ileum and cecum with exploratory laparotomy in a verapamil-overdose patient who had a blood pressure of 73/30 mmHg, a pulse rate of 75 beats/min, and who had developed abdominal pain and abdominal distension during treatment. We believe that there was peritoneal and pleural fluid leakage because of tissue perfusion defects and vasodilation due to CCB overdose in our patients and that hypotension had aggravated this. Hypotension being the common characteristic of the published papers on intestinal ischemia supports our thoughts. In previous publications, patients had abdominal complaints, such as abdominal pain and distention, and intestinal symptoms had emerged as a consequence. However, in our patients, intrapleural and peritoneal

fluids were detected despite the lack of abdominal pain, constipation, or distension complaints.

Study limitations

There are limitations to this study. First, the sample size was small. Second, intestinal examinations using abdominal computed tomography or magnetic resonance imaging would better define the etiology of the fluid by showing the intestinal pathologies better. Third, we considered CCB overdose based on history and clinical findings. Finally, laboratory drug levels would be a more logical approach but were unavailable in our study setting.

Conclusion

Calcium channel blockers overdose patients with hypotension but without abdominal pain and constipation complaints, peritoneal and intrapleural free fluid is common and may be detected using bedside USG. Further extensive multicenter controlled trials are needed for determining the relationship between the presence of intrapleural and intraperitoneal free fluid and hypotension and the prognosis of patients with CCB overdose.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Çukurova University School of Medicine.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Conflict of Interest: No conflict of interest was declared by the authors.

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References

1. DeWitt CR, Waksman JC. Pharmacology, pathophysiology and management of calcium channel blocker and beta-blocker toxicity. Toxicol Rev 2004; 23: 223-38. [CrossRef]
2. Fauville JP, Hantson P, Honore P, Belpaire F, Rosseel MT, Mahieu P. Severe diltiazem poisoning with intestinal pseudo-obstruction:case report and toxicologial data. J Toxicol Clin Toxicol 1995; 33: 273-7. [CrossRef]
3. Derlet RW, Horowitz BZ. Cardiotoxic drugs. Emerg Med Clin North AM 1995; 13: 771-91.
4. Otero RM, Nguyen HB, Rivers EP, Approach To The Patient With Shock, Tintinalli JE, Tintinalli's Emergency Medicine A Comprehensive Study Guide. 7th Ed., New York: The McGrow- Hill Companies, Inc. 2011.p.168.
5. Perbet S, Constantin JM, Guérin R, Faure M, Brugère C, Da Inès D, et al. Non-occlusive colonic ischemia induced by verapamil ER overdose. Intensive Care Med 2009; 35: 956-7. [CrossRef]
6. Gutierrez H, Jorgersen M. Clonic ischemia after verapamil overdose. Ann Intern Med 1996; 124: 535. [CrossRef]
7. Doughty Jc, Donald AK, Keogh G, Cooke TG. Stercoral perforation with verapamil. Postgrad Med J 1994; 70: 525. [CrossRef]
8. Shepherd G. Treatment of poisoning caused by beta-adrenergic and calcium-channel blockers. Am J Health Syst Pharm 2006; 63: 1828-35. [CrossRef]
9. Sporer KA, Manning JJ. Massive ingestion of modified-release verapamil with a concretion and bowel infarction. Ann Emerg Med 1993; 22: 603-5. [CrossRef]
10. Newton CR, Delgado JH, Gomez HF. Calcium and beta receptor antagonist overdose: a review and update of pharmacological principles and management. Semin Respir Crit Care Med 2002; 23: 19-25. [CrossRef]
11. Rose JS, Bair AE, Mandavia D. The UHP ultrasound protocol: a novelultrasound approach to the empiric evaluation of the undifferentiated hypotensive patient. Am J Emerg Med 2001; 19: 299-302. [CrossRef]
12. Jones AE, Tayal VS, Sullivan DM, Kline JA. Randomized controlled trial of immediate versus delayed goal-directed ultrasound to identify the cause of nontraumatic hypotension in emergency department patients. Crit Care Med 2004; 32: 1703-8. [CrossRef]
13. Akinci E, Koylu R, Yortanli M, Cander B. Evaluation of the Treatment Approaches and Complications of Calcium Channel Blocker Intoxications. JAEM 2013; 12: 189-94. [CrossRef]
14. St-Onge M, Dubé PA, Gosselin S, Guimont C, Godwin J, Archambault PM, et al. Treatment for calcium channel blocker poisoning: a systematic review. Clin Toxicol (Phila) 2014; 52: 926-44. [CrossRef]
15. Acosta S, Ogren M, Sternby NH, Bergqvist D, Björck M. Fatal nonocclusive mesenteric ischaemia: population-based incidence and risk factors. J Intern Med 2006; 259: 305-13. [CrossRef]

Properties of Turkey-related Publications in International Emergency Medical Journals

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Abstract

Aim: To examine the publication characteristics of articles written by Turkish academics published in Science Citation Index Expanded (SCIE) emergency medical journals.

Materials and Methods: In this study, only publications from the field of emergency medicine (exluding emergency nursing and emergency pediatrics) broadcasting and that included in the Science Citation Index or SCI-E and published in 2003 and 2004 were investigated. The publications are summarized and classified according to the number of subjects and authors and the author's country.

Results: Among the 5,715 articles analyzed so far, only 195 of the publications (3.4%) originated from Turkey, whereas the rest of them (n=5,520) were from other countries. The United States ranked first with 2,582 (45.1%) publications, and Turkey was ranked in sixth place with 195 (3.4%) publications. For the topics analyzed, pre-hospital care took first place, accounting for 20.8% (n=1189) of the publications. In Turkey, the most frequent topic identified was cardiovascular (19.5%), followed by neurology (10.2%), bone and joint injury (8.2%), and trauma, resuscitation, and gastrointestinal emergencies (7.7%).

Conclusion: Turkey is ranked higher in the world ranking of countries that have contributed to the literature of emergency medicine. Although the trend in global publications is veering toward pre-hospital emergency topics, currently Turkish emergency academics do not give enough attention to this topic. *(Eurasian J Emerg Med 2016; 15: 86-9)*

Keywords: Emergency medicine, journals, article, case, Turkey

Introduction

Emergency medicine was first established as a distinct field at the Ohio Cincinnati University in 1970 in the United States, and in Turkey in 1994 at the Dokuz Eylul University (DEU) after an invitation to United States' emergency medicine specialist John Fowler. After he started working in Turkey, approval for a new department was announced by the official gazette newspaper in 1993 (1). In this manner, Turkish emergency medicine started to contribute to the international literature in this field.

Qualified information gathered in the indexes is very important. It has been reported that there are over 600 scientific databases in the world. However, only 80 are available for health sciences. All of these databases are available via the Internet. Specifically in the medical field, the most prominent are the Science Citation Index (SCI), Science Citation Index Expanded (SCIE), PubMed, Ovid, Thomson Reuters Web of Knowledge and Science, Scopus, the Cochrane Library, Embase, Sciencedirect, Scirus, Elsevier MD Consult, Index Copernicus, and Google Scholar (2, 3). In Turkey, the articles that are included in these indices are rewarded by the Turkish Academy of Sciences, the Scientific and Technological Research Council of Turkey (TUBITAK), and universities. Publications related to emergency medical journals in these indices are few in number. In Turkey, there are two emergency medical journals, but they have not yet been indexed and abstracted in SCIE. Thus, scholars engaged in the emergency medicine field in Turkey tend to send their articles to other international journals.

The aim of the present study was to examine the articles by Turkish academics published in international emergency medical journals that were indexed in SCIE.

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Materials and Methods

In the present study, only articles that were accepted by publications in the field of emergency medicine (excluding emergency nursing and emergency pediatrics) and that were indexed in the SCI or SCIE and published in the last 2 years were investigated. In June 2015, using the search engine PubMed, articles published between January 01, 2013, and December 31, 2014, were scanned. The journals' International Standard Serial Numbers were searched using PubMed. In the right-hand column of the PubMed search results in the "Results by Year" chart, the number of journal publications in 2013 and 2014 were found. The articles published in 2013 and 2014 were analyzed later by opening their abstracts and noting the name of the journal, the number of authors, the corresponding author's country, and the topic classification.

Publications were classified as research articles, case reports, case series, a brief report (short report/newsletter), short communication (short communication/presentation), correspondence (compilation and reviews), letters to the editor/visual diagnoses/reviews, meta-analyzes, and others (news, guides, biographies etc.); after which, the publications were analyzed and classified by their headings.

The publication topics were classified according to the index of contents located in the book *Tintinalli Emergency Medicine A Comprehensive Study Guide, 2012 Edition*. These topics were as follows: emergency wound management, disaster preparedness, analgesia-anesthesia and invasive sedation, environmental injuries, skin diseases, endocrine emergencies, infectious disease, gastrointestinal emergency, eye-ear-nose-throat and oral surgery, pre-hospital care, hematologic and oncologic emergencies, abuse and assault, cardiovascular disease, musculoskeletal disorders, bone and joint injuries, neurology, obstetrics and gynecology, special occasions, pediatrics, psychosocial disorders, pulmonary emergencies, renal and genitourinary diseases, resuscitation, resuscitative interventions, toxicology, and trauma.

Moreover, the institutions' of the first authors (universities, educational research, and other), the province, and citation counts were recorded. Google scholar (https://scholar.google.com.tr/) was used for determining the number of citations of academic publications in Turkish. After the full name of the publication had been written into the search bar, the results for "Cited Number" was recorded as the number of citations of the publications. The obtained data was recorded and analyzed using the SPSS for Windows 17.0 statistical package program.

Results

In terms of journal included in the specified indices, 12 journals that publish only in the field of emergency medicine met the study criteria. In these journals, 5715 published articles were screened and included. Only 195 of these publications (3.4%) originated from Turkey, while the remainder (n=5520) were from other countries (Table 1).

When the journal publications in 2013 and 2014 were investigated, it was found that out of 70 different countries, the United States of America (USA) ranked first with 2,582 (45.1%) publications, and Turkey ranked sixth with 195 (3.4%) publications (Table 2).

The number of authors listed in the whole publications were as follows: 9.7% (n=554) one author, 16.5% (n=939) two authors, 16% (n=913) three authors, 16% (n=913) four authors, 13.4% (n=767) five authors, 9.2% (n=531) 6 or more authors. The number of authors listed in Turkish publications (n=195) were found to be one author in 4.6% (n=9) of publications, two authors in 4.6% (n=9), three authors

Table 1. Distribution of articles and journals from Turkey and the rest of the world in 2013 and 2014

Name of journal	Number of publications from all countries n (%)	Number of publications from Turkey n (%)
Academic Emergency Medicine	423 (7.4)	7 (3.6)
American Journal of Emergency Medicine	1379 (24.1)	137 (70.3)
Annals of Emergency Medicine	642 (11.2)	0
Canadian Journal of Emergency Medicine	297 (5.4)	0
Emergency Medicine Australasia	288 (5.2)	4 (2.0)
Emergency Medicine Clinics of North America	116 (2.0)	0
Emergency Medicine Journal	701 (12.2)	13 (6.7)
European Journal of Emergency Medicine	260 (4.5)	3 (1.5)
Internal And Emergency Medicine	326 (5.7)	2 (1.0)
Journal of Emergency Medicine	954 (16.6)	29 (14.9)
Prehospital Emergency Care	171 (3.0)	0
Scandinavian Journal of Trauma Resuscitation & Emergency Medicine	158 (2.7)	0
Total	5715 (100)	195 (100)

Table 2. Distribution of publications by country

Order	Country	Number of publications (%)
1.	America	2582 (45.2)
2.	England	396 (6.9)
3.	Australia	356 (6.2)
4.	Canada	352 (5.7)
5.	Italy	317 (5.5)
6.	Turkey	195 (3.4)
7.	Taiwan	160 (2.8)
8.	China	148 (2.4)
9.	South Korea	138 (2.4)
10.	France	108 (1.9)
11.	Others	991(17.1)
	Total	5715 (100.0)

in 12.3% (n=24), four authors in 21% (n=41), five authors in 25.1% (n=49), and six or more authors in 10.3% (n=20).

The most common form of publications was an original article (47.8%; n=2732), followed by case reports/case series (24%; n=1374), brief report (short report/newsletter)/short communication (short communication/presentation)/correspondence (compilation and reviews) (15.9%; n=910), letters to the editor/visual diagnoses/reviews, (5.3%; n=304) other (news, guides, biographies, etc.) (6.1%; n=347), and meta-analysis (0.9%; n=48). The 195 publications from Turkey were of the following types: case reports (42.6%; n=83), research papers (31.3%; n=61), correspondence (compilation and reviews) (17.4%; n=34), letters to the editor (8.2%; n=16), and others (news, guides, biographies, etc.) (0.5%; n=1). The average number of authors in the articles originating from countries other than Turkey was 4.5±2.1, whereas it was 4.9±2.0 for Turkey.

When the publication area of the topics were analyzed, it was found that pre-hospital care took the first rank with 20.8% (n=1189), followed by cardiovascular, resuscitation, and trauma with 10.9% (n=623), 8.7% (n=497), and 8.2% (n=468), respectively. In Turkey, the most frequent topics identified were cardiovascular with 19.5%, followed by neurology with 10.2%, bone and joint injury with 8.2%, and trauma, resuscitation, and gastrointestinal emergencies with 7.7% (Table 3).

In Turkey, the institutions of the corresponding authors were divided into three categories: university hospitals, education and research hospitals, and others (government hospitals, private hospitals, etc.). Of the 195 publications, 59% (n=115) were from university hospitals, 29.2% (n=57) were from education and research hospitals, and 11.8% (n=23) from others (public hospitals, private hospitals, etc.). When publications were examined according to the city where the first author was localized, 34 different cities of Turkey were identified. Among them, Ankara took the first rank with 48 (24.6%) articles, followed by Izmir with 26 (13.3%), and Istanbul with 25 (12.8%).

The publications from Turkey were also analyzed according to the number of citations. It was found that 88 publications received no citations, while 107 publications were cited 1–28 times. When further examination was carried out on the basis of the first author's institution for the 107 cited publications, 65 (60.7%) of them were from university hospitals and 32 (29.9%) were from educational and research hospitals. Case reports were the most cited type of publication with 43% (n=46) citations, followed by research articles with 42% (n=45) citations. Cardiovascular was the most cited topic with 17.7% (n=20) of 107 citations, followed by resuscitation and neurology with 10.3%, and gastrointestinal tract with 9.3%.

Table 3. Distribution of publications according to topics

Topics	Turkey (%)	Other Countries (%)
Emergency Wound Management	0.5	0.4
Disasters and Preparedness	0	0.7
Anesthesia Analgesia and Invasive Sedation	2.1	1.7
Environmental Injuries	3.6	1.2
Skin Diseases	0	0.3
Endocrine Emergencies	0	0.8
Infection Diseases	3.6	5.3
Gastrointestinal Emergencies	7.7	4.3
Eye-Ear-Nose-Throat and Oral Surgery	1.0	2.3
Pre-Hospital Care	1.5	20.8
Hematologic and Oncologic Emergencies	2.1	2.2
Abuse and Assault	0	0.5
Musculoskeletal Disorders	19.5	10.9
Bone and Joint Disorders	2.1	1.2
Neurology	8.2	2.8
Obstetrics and Gynecology	10.2	5.4
Exceptions	0.5	0.9
Special Occasions	0	0.4
Pediatrics	4.6	5.6
Psychosocial Disorders	0.5	2.2
Pulmonary Emergencies	3.6	2.2
Renal Diseases and Genitourinary Diseases	2.1	1.8
Resuscitation	7.7	8.7
Resuscitative Interventions	5.6	5.1
Toxicology	5.6	4.1
Trauma	7.7	8.2
Total	100	100

Discussion

Although the establishment of emergency medicine only took place quite recently, it appeals to a wide audience and the area is open to a wide range of scientific topics, including the medical and surgical medical sciences. For determining Turkey's position in the area of emergency medicine worldwide, the number of publications in international journals and citation numbers are important indicators. Although it is open to debate, the number of scientific publications and the number of citations to these publications are recognized as scientific indicators of academics' performances.

We can say that Turkey is ranked at a high position in the world among the many countries that contribute to the emergency medicine literature. We believe that these data are promising compared to other developing countries. When the origins of the specified publication are analyzed, Turkey was ranked 6th out of 70 different countries. In our study, the top five countries were the United States of America (USA), the United Kingdom (UK), Australia, Canada, and Italy, respectively. It is disturbing to see that Turkish publications are not well distributed throughout the journals, but instead are clustered in one journal. In Turkey, most authors prefer the American Journal of Emergency Medicine. This is probably because of its easy acceptance and faster evaluation period than other journals. Their unbiased attitude toward research sent from countries like Turkey may also play a role.

Of the 12 journals reviewed, 45% of the publications originated from the USA. Wilson et al. showed that in the emergency medicine field, 14,605 articles have been published in the world between the years of 1996–2005, including the highest number of publications from the USA (58.5%, n=8550). In the same study, Turkey was ranked

9th with 227 (1.55%) publications (4). The USA, UK, and Canada took the highest rankings in the emergency medical field as well as in other fields of medicine as it has been shown that they have a high potential and output of scientific publications. According to the publication by TUBITAK in 2009 named 1981–2007 Turkey Scientific Publication Indicators, Turkey was ranked 26th out of 45 countries. In terms of the number of scientific publications in recent years, it was observed that Turkey has risen to a higher rank.

Taking the Turkish Higher Education Council official website data for the year 2009 as a base, it was seen that only the top five universities produce the most publications in Turkey, with a total number of 5,728. On the other side of the coin, the universities with the mentioned workload indicate that they have a total workforce of 8,768 regular faculty members. By seeing the big picture, it is clear that the publication rate is about 0.65 per academic. Thereby, in these most productive universities in Turkey, an average academic cannot even produce one publication. In England in 2008, the average was reported as 1.49 per academic. On the other hand, when Thomson ISI Web of Science was taken as a reference, it is seen that by June 30, 2010, 343 scientific publications were published per one million academics in Turkey.

As for academic advancement in Turkey, one needs original articles, but about half of the publications were research articles. The criteria in Turkey can be said to be forcing academics to do researches. However, as the number of publications in journals with high impact factors (IF) is very limited from Turkey, it could be suggested that authors are interested in the quantity rather than the quality of the papers produced.

In the research, we saw that the highest number of papers were in the cardiovascular field (19.5%). This was followed by neurology, resuscitation, and trauma, respectively. When all the topics of publications were examined in the countries other than Turkey, pre-hospital emergency had the highest rate in emergency medical journals (21%). However, in publications originating from Turkey, pre-hospital emergency medicine related publications were as low as (1.5%). In Turkey, it was observed that emergency medical academics pay little or no attention to the issues related to the pre-hospital field.

Jones et al. (5) found that out of the 163 publications included in their study, 28 (17%) were related to pain management, 24 (15%) to orthopedics, and 13 (8%) to pre-hospital and cardiovascular topics. Shuaib et al. (6) demonstrated that the first three subjects were cardiovascular with 20%, followed by toxicology (15%) and pain management (12%), respectively. Tsai et al. (7) reported that the first five topics were toxicology with 30.3%, followed by trauma (19.2%), resuscitation (17.2%), cardiovascular (10.1%), and pediatrics (7.7%). The differences presented here may be due to variations in the years of research or may be caused by the emergency medicine specialists periodically changing their attention in various topics.

Study limitations

In this research, we did not take into attention other articles that were published in the scientific journals other than those covering emergency medicine. Another limitation is that, we just included the articles indexed in SCIE. Recently, many papers have started to be published in open access journals not included in SCIE.

Conclusion

Turkey is ranked high in the world ranking of countries that contribute to the literature in emergency medicine. Although the trend in the world is toward pre-hospital emergency topics, Turkish emergency academics do not give enough care to this topic. There are still many emergency topics and emergency journals in which Turkey makes no contributions. Instead, there is a tendency of accumulation of the papers toward specific emergency journals instead of more even distributions.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Conflict of Interest: No conflict of interest was declared by the authors.

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References

1. Bresnahan KA, Fowler J. Emergency medical care in Turkey: current status and future directions. Ann Emerg Med 1995; 26: 357-60. [CrossRef]
2. Kalkan A, Kose O, Bilir O, Ersunan G, Ozel D, Guler F. Publication rate of abstracts presented at the emergency medicine congresses held by the European Society for Emergency Medicine (EUSEM) in 2011 and 2012. Emerg Med J 2015; 32: 728-32. [CrossRef]
3. Günaydın GP, Doğan NO. A Growing Threat for Academicians: Fake and Predatory Journals. Eurasian J Emerg Med 2015; 14: 94-6.
4. Wilson MP, Itagaki MW. Characteristics and trends of published emergency medicine research. Acad Emerg Med 2007; 14: 635-40. [CrossRef]
5. Jones CW, Hunold KM, Isaacs CG, Platts-Mills TF.Randomized trials in emergency medicine journals, 2008 to 2011. Am J Emerg Med 2013; 31: 231-5.[CrossRef]
6. Shuaib W, Acevedo JN, Khan MS, Santiago LJ, Gaeta TJ. The top 100 cited articles published in emergency medicine journals. Am J Emerg Med 2015; 33: 1066-71. [CrossRef]
7. Tsai YL, Lee CC, Chen SC, Yen ZS. Top-cited articles in emergency medicine. Am J Emerg Med 2006; 24: 647-54. [CrossRef]

Emergency and First Aid in Cases of the Use of Chemical, Biological, Radiation, and Nuclear Weapons

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Abstract

Chemical, biological, and radioactive substances purposely, accidentally, or after a natural disaster cause a lot of harmful effects on people and the environment. To prevent this harmful effect or at least minimize it, precautions must be immediately taken. These kinds of incidences have different importance for hospitals as victims apply first to hospitals, and they can decontaminate staff therein. Thus, different decontamination areas should be built in hospitals. Herein we discuss the decontamination that should be applied to victims. We provide information about the effects of nuclear weapons and the first aid rules for treating victims exposed to them. A clinical sign of radiation exposure is more obvious than that for biological and chemical weapons and because it can be detected more easily, fighting the clinical effects of nuclear weapons is easier than fighting the clinical effects of biological and chemical weapons. Biological weapons spread very easily and very rapidly from person-to-person, and the mortality rate can be high. Further, it causes a chaotic effect on society. Considering this feature of biological weapons, we will emphasize a number of precautions. Carrying and hiding toxic chemical weapons is easy. We will explain what should be done in case of exposure. *(Eurasian J Emerg Med 2016; 15: 90-3)*

Keywords: CBRN, decontamination, emergency and first aid

General Information and Decontamination Rules

A major event caused by an intentional or accidental spreading of chemical, biological, radioactive, or nuclear materials leading to harmful and hazardous situations for humans and the environment is termed a chemical, biological, radiation, and nuclear (CBRN) event. The pollution of a particular region, humans, buildings, soil, and water resources by exposure to CBRN materials is called contamination; the physical and chemical cleaning procedure performed with the purpose of eliminating this contamination is called decontamination (1, 2).

The Hospital Disaster Management Center Presidency should, as a priority, make a joint action plan with organizations, such as the Governor's Crisis Management Center, the Provincial Directorate of Health, the Disaster and Emergency Management Authority, the Turkish Atomic Energy Authority, and the Ministry of Environment, to determine the precautions needed to be taken against exposure to CBRN materials during a disaster and should act accordingly. A separate section should be reserved for CBRN materials in the preparation of hospital disaster plans (HDPs). The chiefs of logistics and finance should ensure the supply of the necessary equipment and materials with the knowledge of the HDP president. At least two decontamination areas, one stationary and one mobile, should be built in hospitals. Every hospital should exercise CBRN drills once every two years. Additionally, agreements should be made with organizations capable of cleaning these materials when contamination occurs. The telephone numbers and addresses of these organizations should be present in the emergency communication guide (2-4).

Materials required for decontamination:

- Protective clothes, gloves, caps, boots, and overshoes for personnel;
- Masks preventing contamination by inhalation for personnel and portable ventilators;
- Bathing compartments;
- Pressurized showers or similar bathing systems;
- Labels indicating contaminated and decontamination areas, together with materials, such as barriers, barricades, and strips, to prevent entrance to these sites;
- Wastewater collection tanks;
- Special bags, containers, and zones for contaminated equipment;

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- Laboratory equipment for sampling contaminating substances and predetermined sampling and sample storage protocols with the aforementioned organizations;
- Decontamination and cleaning materials;
- Radioactive substance detectors.

If decontamination is performed outside the hospital:

- Heating equipment and lighting system;
- Towels, clothes, and gas masks for patients;
- Wastewater collection tanks;
- Appropriately equipped compartments for patient privacy.

Immediately after the CBRN event, most of the injured tend to leave the event scene, and they present to the emergency services by their own means within the first few hours of the event. Most of the presenting individuals will be asymptomatic and unexposed to the agent. These individuals result in the unnecessary use of hospital resources. Because the first intervention is made by emergency service staff for injured patients, they constitute the group with the highest risk in terms of secondary contamination. To prevent secondary contamination, other entrances to the hospital should be brought under control, the security of the decontamination area should be ensured, and the patients should not be allowed to enter the hospital without decontamination (5). The personnel who are planned to work in the decontamination area should be trained beforehand, and they should not contact the patients without using personal protective equipment. In this area, the patients should be completely undressed. Their clothes should be put inside a medical waste bag, with its mouth sealed and then left in the controlled region. Because many chemical agents can lead to explosions or the release of toxic gases when they react severely with water, the patient is washed with unpressurized water for at least 15 min from the head to the toe including all body cleavages. If the chemical agent is a solid, it is first wiped gently and removed; then, it is washed. For removing oily or water-insoluble agents, a soap or shampoo can be used. The eyes should be washed with plenty of water. For the decontamination of agents ingested into the gastrointestinal system, the patient should not be forced to vomit; a glass of plain water can be drenched, and activated charcoal should be administered orally with a dose of 1 g/kg. After washing, drying is performed; to be sure that the patient is fully cleaned, measurements are taken, and the patient is then covered. In addition, in this area, basic medical care, such as opening the airway and respiratory and circulatory support, should be given simultaneously (2, 6, 7). After the completion of decontamination, the patient is sent to a safe zone for triage, treatment, and transport. All personnel who have made contact with the polluted patient are taken to the safe zone, following their personal decontamination. The wastewater in the decontamination area should be taken care of to ensure that it does not mix with the city sewer (8-10).

Emergency and First Aid in Cases of the Use of Nuclear Weapons

Nuclear weapons contain hundreds of kilos of conventional explosives, and explosions may occur as a single big explosion or as multiple small explosions. Although it has many effects, such as the strike, thermal radiation, high temperature, electromagnetic wave effects, and radioactive fall-out, the most hazardous effect is ionizing radiation. This ionized radiation is composed of alfa, beta, gamma, X-rays, and neutrons (Figure 1). These have short wavelengths, high energy, and high frequency. Thus, they show effects at the cellular level. While in the early period, exposure shows an effect on short living cells, with rapid regeneration like in the hematopoietic system, it also harms the central nervous system cells, which proliferate slowly in the late period (11).

First aid against the effects of nuclear weapons is similar to injuries and burns due to other causes. For decontamination processes, the working areas should be identified first, and the removal process of radioactive material should be initiated. Thus, triage and decontamination areas in the entrance of emergency services must be done. Decontamination should be initiated after patients become stable. Staff should interfere to victims after they take individual protective precautions. As a first step, the clothes of the patient should be removed and placed inside special radiation-retarding containers, and thereby decontamination is completed to an extent of 95%. Then, as the second step, the patient's face and hands are washed and decontamination is completed to an extent of 98%. As the third step, the hair and scalp are washed. The surfaces exposed to nuclear pollution are brushed or cleaned with hot soapy water solution, or they are immersed inside the solution. Mostly, contaminated victims should be decontaminated first and the integrity of the skin should be protected. Surgical debridement can be done in contaminations that cause disruption in the integrity of the skin. The wastewater is drained from a secure area (7, 9).

Emergency and First Aid in Cases of the Use of Biological Weapons

Biological weapons are pathogen and contagious bacteria, parasites, fungi, protozoa, rickettsia, viruses, and toxins. Besides their mass-destructive characteristics, the other properties of biological weapons are that they can be easy and inexpensive to obtain, the effects can be permanent and progressively increasing, their ease of use, and delayed awareness of their use (12). Centers for disease control and prevention centers in the USA classify biological weapons according to their virulence, mortality, and chaotic condition in society (Table 1) (13).

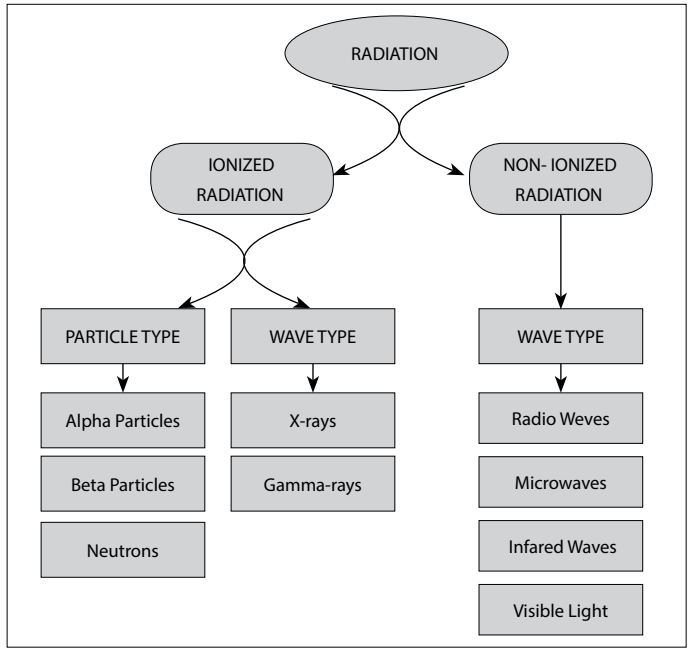

Figure 1. Types of radiation

Table 1. Classification of biological agents (13)

Agents Group A	Agents Group B	Agents Group C
Plague (*Yersinia pestis*)	Brucellosis (Brucella species)	Yellow fever
Botulism (*Clostridium botulinum*)	Ricin toxin (*Ricinus communis*)	Nipah virus
Anthrax (*Bacillus anthracis*)	Shigella	Tick encephalitis viruses
Smallpox (*Variola major*)	Q fever (*Coxiella burnetii*)	Hemorrhagic tick fever
Tularemia (*Francisella tularensis*)	Cholera (*Vibrio cholerae*)	Multi-resistant tuberculosis
Viral Hemorrhagic Fevers (*Lassa, Machupo, Ebola*)	Glanders (*Burkholderia mallei*)	Hanta virus
	Escherichia coli O157:H7	
	Salmonella	

Table 2. Classification of chemical weapons (15)

Nerve Gases	Blister Gases	Pulmonary Irritants	Blood Poisons	Incapacitators	Vomitive Agents
Sarin (GB)	Sulfur Mustard (HD)	Phosgene (CG)	Cyanogen Chloride	Psychomimetics (3-quinuclidinyl benzilate, LSD)	Adamsite (DM)
Tabun (GA)	Nitrogen Mustard (HN-mustard gases)	Diphosgene (DP)	Hydrogen Cyanide	Opioids and Benzodiazepines	Diphenylcyanoarsine (DC)
Soman (GD)	Lewisite (L)	Chlorine (CL)		Tear Gases Chloroacetophenone (CN), ortho-chlorobenzylidene-malononitrile (CS), Dibenzo [B,F] [1,4] Oxazepine) (CR)	Diphenylchloroarsine (DA)
Methylphosphono-thioic acid (VX)	Phosgene oxime (CX)	Chloropicrin (PS)			

The first thing to do following biological attack is the cleaning of personnel, equipment, water, buildings, and land from the microbes. The immunity should be maintained, known health measures should be applied, and for protection, active vaccination should be performed. Following preventive measures, the patient is evaluated; after providing basic life support, such as airway patency, ventilatory, and circulatory assistance, the decontamination procedure is initiated. The contaminated clothes of the patient are taken off and removed from the field by personnel wearing protective clothing. For decontamination, by using soapy water, laundry bleach, air filters, liquid, gaseous, or aerosol disinfectants, heat and radiation, the biological agent is destroyed or rendered harmless. Following decontamination, patients are isolated and their medical care is provided meticulously (6, 10). Specific and supportive treatment should be initiated based on the detected or suspected biological agent.

Emergency and First Aid in Cases of the Use of Chemical Weapons

Due to their physiological effects, chemical weapons are highly toxic chemical poisons with the capacity of mass killing or injuring living creatures in a very short period; they are also resistant to environmental factors and are easily transported and stored. These substances, which are present as solids, liquids, and gases, enter the body through the mouth, nose and throat, eye, skin, lungs, and digestive system. Classifications of chemical weapons are given in Table 2.

After taking the necessary precautions, the personnel complete the interventions directed to the vital functions (airway patency, ventilatory and circulatory support, and bleeding control), and then, the decontamination process is initiated, and chemical cleaning is done prior to the treatment. Following decontamination, the patient is further evaluated and treated (6).

Nerve gases are the most toxic chemical warfare agents. They directly affect the nervous system by inhibiting acetylcholinesterase and paralyze the vital functions. The specific antidote is atropine, and the first thing to do is use atropine autoinjectors. The gas residue, possibly present on the face, eyes, and open parts of the body, should be cleaned off by washing with plenty of water or by the use of a decontamination towel. If no water is available, cleaning should be done with a non-contaminated paper or cloth. Vesicant gases are strong alkylating agents, and they have cytostatic, mutagenic, and cytotoxic effects. They are lipophilic and are absorbed through healthy skin. There is no antidote for mustard gases, and victims should be decontaminated with water and soap immediately after exposure, and supportive treatment should be given. Lewisite is a vesicant with arsenic content and is more toxic than mustard gases. After the victim is decontaminated, BAL (Dimercaprol) 4–5 mg/kg IM should be used.

Suffocating gases (pulmonary irritants) enter the body via respiration and lead to anoxia by increasing capillary permeability. The patient should be allowed to rest and kept warm, and inhalers and systemic steroids should be administered, regardless of whether symptoms are present. Artificial ventilation is contraindicated. Blood poisoning gases prevent functions of the systems by inhibiting the oxygen consumption of somatic cells and affecting the circulatory and respiratory systems. The patient should not be moved, and he/she should breathe through a mask, in which an ampule of amyl nitrite has been sprinkled. Calmative

agents are chemical warfare agents that disable personnel by causing temporary physiological effects (paralysis, blindness, deafness, etc.) and mental effects or creating both effects. Spontaneous recovery usually occurs within 12 h. To sedate the patient, diazepam or sodium amytal is used. Tear gas is used more commonly for suppressing riots. No treatment is required. When exposed to clean air, the symptoms disappear within a few hours. A protective mask is used as a preventive measure. If the eyes are contaminated with a chemical substance, they should be washed with plenty of water, and the eyes should be closed following the administration of a tetracycline eye ointment (6, 10, 14, 15).

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References

1. T.C. Başbakanlık Afet ve Acil Durum Yönetimi Başkanlığı. Açıklamalı Afet Yönetimi Terimleri Sözlüğü. Erişim tarihi: Kasım 2014.
2. Türkiye Sağlık Bakanlığı Acil Sağlık Hizmetleri Genel Müdürlüğü. Sağlık Bakanlığı Kimyasal, Biyolojik, Radyolojik ve Nükleer Tehliklere Dair Görev Yönergesi. 2014.
3. T.C. Başbakanlık Afet ve Acil Durum Yönetimi Başkanlığı. Türkiye Afet Müdahale Planı (TAMP). Erişim tarihi: Nisan 2013.
4. Türkiye Sağlık Bakanlığı Acil Sağlık Hizmetleri Genel Müdürlüğü. İl Sağlık Afet ve Acil Durum Planı (İL-SAP) Hazırlama Kılavuzu.
5. Noji EK, Kelen GD. Disaster Medical Services. In: Tintinalli JE, Kelen GD, Stapczynski JS, editors. Emergency Medicine: A Comprehensive Study Guide. 6th ed. McGraw-Hill 2004.p.27-35.
6. KBRN Ortamında Koruyucu Sağlık Hizmetleri. Afet ve Afet Eğitimi Kongresi 2014. Erişim tarihi: 19-23 Kasım 2014.
7. Kumar V, Goel R, Chawla R, Silambarasan M, Sharma RK. Chemical, biological, radiological, and nuclear decontamination: Recent trends and future perspective. J Pharm Bioallied Sci 2010; 2: 220-38. [CrossRef]
8. Kimyasal ve Biyolojik ve Radyolojik ve Nükleer Afetler. Afet ve Afet Eğitimi Kongresi 2014. Antalya; Erişim tarihi: 19-23 Kasım 2014.
9. Bebiş H, Özdemir S. Savaş, Terör ve Hemşirelik. FN Hem Derg 2013; 21: 57-68.
10. Coşkun A, Akkoca M, Şimşek M, Kılıç S, Çayan HH, Kenar L, ve ark. TC Sağlık Bakanlığı Kimyasal ve Biyolojik Tehditlere Yaklaşım Algoritması 2014.
11. Ersel M. Radyasyon Maruziyeti. Satar S, editor 2009. p. 711-6.
12. Macintyre AG, Barbera JA. Bioterrorism Response: Implications for the Emergency Clinician. In: Tintinalli JE, Kelen GD, Stapczynski JS, editors. Emergency Medicine: A Comprehensive Study Guide. 6th ed. McGraw-Hill. 2004.p.35-42.
13. Ersel M. Biyolojik Silah Ajanları. Satar S, editor 2009.
14. Özüçelik DN, Karcıoğlu Ö, Topaçoğlu H, Koyuncu N, Coşkun F. Kimyasal Savaş Alanları. JAEM 2005; 3: 28-32.
15. Özdemir Ç, Bozbıyık A, Hancı İH. Kimyasal Silahlar: Etkileri, Korunma Yolları. Sürekli Tıp Eğitimi Dergisi (STED) 2001; 10: 298-300.

Mechanical Chest Compression Devices: Historical Evolution, Classification and Current Practices, A Short Review

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Abstract

The standard treatment of cardiac arrest is cardiopulmonary resuscitation (CPR), performed with effective manual chest compressions. Although current CPR was developed 50 years ago, cardiac arrest still has a high mortality rate and manual chest compressions have some potential limitations. Because of these limitations, mechanical chest compression devices were developed to improve the efficiency of CPR. This CPR technology includes devices such as the mechanical piston load-distributing band, active compression–decompression CPR, simultaneous sterno-thoracic CPR, impedance threshold valve, phased thoracic-abdominal active compression–decompression CPR and active compression-decompression CPR with enhanced external counterpulsation, and the impedance threshold valve. The purpose of this manuscript was to draw attention to developments in this medical area and to examine studies on the effectiveness of these devices. *(Eurasian J Emerg Med 2016; 15: 94-104)*

Keywords: Cardiac arrest, cardiopulmonary resuscitation, mechanical chest compression devices

Introduction

Standard cardiopulmonary resuscitation (S-CPR) refers to the entire body of techniques of external chest compression and securing positive pressure ventilation for the purpose of achieving adequate blood and oxygen flow into vital organs such as the heart and brain following cardiac arrest (1). The current application of S-CPR is based on the technique of "external chest compression" that was defined by Kouwenhoven in 1960 and comprises the phases of active compression and passive decompression. Despite the evolution of resuscitation medicine, the limited improvement in survival rates following cardiac arrest has led researchers to explore the possibility of different CPR techniques and also to develop devices that support ventilation and circulation (2-6). This manuscript was prepared to review the experimental and clinical studies conducted on the historical progress and effectiveness of mechanical chest compression devices (MCCD).

Limitations of S-CPR

The fundamental goal of effective CPR applications is to achieve return of spontaneous circulation (ROSC) and a good neurological outcome and the return of the patient to the patient's previous quality of life and functional level of health. Guidelines emphasize the importance of effective chest compression for successful CPR. The effectiveness of chest compressions depends on a couple of parameters (such as application of compressions to the right place, at an adequate depth and rate, on a regular and uninterrupted basis; letting the chest to fully recoil after each compression; avoiding overventilation; and maintaining a balance between compression and ventilation) (1, 5, 7, 8).

One of the basic problems related to S-CPR techniques is that even in the most effective chest compressions, a physiologically adequate amount of cardiac output may not be reached and because the quality of compression may change over time, this may cause cerebral and coronary blood flow to reduce even further as a result of the interruptions (9-11). If the chest compressions could reach the needed depth, as it does in infants and children, a higher intrathoracic pressure and cardiac output would be possible (12, 13). Another problem is that the quality of CPR is limited to the degree of knowledge, experience, and endurance of the rescuer (9, 14-17). Transferring the patient into an ambulance, discontinuing CPR prior to defibrillation, the difficulty of effectively applying the technique in a moving ambulance, failure to maintain the relationship between compression and ventilation, and reduced elastic recoil of the chest

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wall in prolonged CPR applications could all have an adverse effect on the success of CPR (5, 7, 13-17).

When the importance of chest compression is considered and in the light of the issues experienced in currently employed techniques and the low survival rates following cardiac arrest, the necessity of further developing S-CPR techniques and increasing the effectiveness of chest compression becomes clear.

Mechanical Chest Compression Devices: Definition, History, and Classification

Definition

MCCDs are noninvasive circulation support devices that function manually, pneumatically, or electrically and in accordance with CPR guidelines, provide uninterrupted and effective external chest compression to achieve an adequate blood flow to the heart and other vital organs during non-traumatic adult cardiac arrest. MCCDs can be used as an alternative to S-CPR in cases that may hinder effective compressions such as prolonged CPR during the transport of the patients or in the shortage of personnel (2, 6, 10, 18, 19).

These devices are included in the guidelines of the American Heart Association (AHA) under the heading "circulatory support devices" (6). They are described by the U.S. Food and Drug Administration (FDA) as "External cardiac compressors" (19). In the literature, the nomenclature varies, and "external cardiac compression devices," "automatic chest-compression devices," and "mechanical CPR devices" are some of the terms of reference (2, 10, 13, 18).

History

The advent of MCCDs is not new. These devices began to be developed in the beginning of the 1960s, when resuscitation medicine was merely in its infancy. Chronologically speaking, the "electro-pneumatic machine" developed by Harkins and Bramson (20) in 1961; the "portable pneumatic pump" developed by Nachlas and Siedband (21) in 1962; the "Beck-Rand external cardiac compression machine" developed by Safar et al. (22) in 1963; the "cardiac massage machine" developed by Bailey and Browse in 1964 (23); and the "hospital mechanical pump" developed by Nachlas and Siedband (21) in 1965 were the first MCCDs to be invented. In later years, experiments were conducted with many manually operated devices such as the "cardio-massager," "cardio-pulser," pneumatical "iron heart," and "Travenol LR50-90" (13, 24).

Many of the first developed and tested of these devices were very complex, too heavy, or ineffective for use in CPR; therefore, they were found to be nonfunctional and unacceptable for the clinical setting. On the other hand, since the 2000s, many devices have begun to be developed and have found a clinical area of use, and the literature of the effects of these devices on CPR outcomes are steadily increasing.

Classification

These devices are different from one another in terms of their working principles, the energy they consume, and their electronic features. MCCDs used currently can be classified as follows:

1. Piston-driven CPR devices (PD-CPR),
2. Load-distributing band CPR devices (LDB-CPR).

In addition to these two fundamental groups, third-generation devices, which combine different working mechanisms and different CPR techniques, have been used in recent years, aiming to increase the hemodynamic effects of S-CPR. These are as follows:

3. Active compression–decompression CPR devices (ACD-CPR),
4. Simultaneous sterno-thoracic cardiopulmonary resuscitation devices (SST-CPR/S-CPR/X –CPR),
5. Inspiratory impedance threshold valve/devices and ResQCPR (ACD + ITD CPR),
6. Phased thoracic-abdominal active compression–decompression CPR devices (PTACD-CPR), and
7. Active compression–decompression CPR with enhanced external counterpulsation and the inspiratory impedance threshold valve (AEI-CPR) (2, 6, 13, 25-29).

The devices in these groups and their working principles have been discussed below.

1. Piston-driven devices (PD-CPR)

These are based on the "cardiac pump theory" and are first-generation mechanical devices that use a piston to exert "single-point compression" on the sternum. One of the first examples in this group was the Pneumatically Run Thumper. A more developed model of this device is the Thumper Mechanical CPR Device Model 1007 and its updated model the Life-Stat. The Life-Stat consists of a backboard attached to a column and operates pneumatically with a piston. It has a ventilator that is meant to be used in conjunction with chest compression (Figure 1a) (Michigan Instruments, USA). Mechanical piston-driven devices that are operated manually work with a lever system and are marketed under brand names such as the "Animax Mono" (Figure 1b) (AAT Alber Antriebstechnik GmbH, Albstadt, Germany) and the "CPR RsQAssist," which employs an audio-visual metronome (10, 13, 24, 26, 29).

2. Load-distributing band devices (LDB-CPR)

"Load-distributing band devices" are based on the "thoracic pump theory" and represent second-generation mechanical chest compression technology. These devices exert thoracic compression on the anterior-anterolateral thorax using a wide pneumatic band that wraps around the chest, inflating and deflating at cyclically. The basic equipment in these devices consists of a backboard, a chest compression band (load-distributing Life Band), and a power system. The first example of this type of device was the "Vest-CPR." Currently, devices that work with this mechanism are marketed under commercial names such as the pneumatic Automated CPR Vest (Reax resuscitation device) and the pneumatic or electrical AutoPulse (Figure 2). Studies show that the chest compression achieved all around the chest with the AutoPulse creates higher coronary perfusion pressure than sternal pressure (13, 24, 25, 29-33).

3. Active compression–decompression CPR devices (ACD-CPR)

ACD-CPR devices are third-generation devices that work on the piston principle. These devices were developed based on a news article published in 1990 about a successful resuscitation attempt of a lay person performed with a toilet plunger to his father (34, 35). As is known, in S-CPR, the return of blood to the heart is dependent only on the passive recoil of the chest wall. The principle behind this technique may be summarized as the pumping of blood outside of the thorax through positive pressure in the active compression phase and then exerting an external negative vacu-

Figure 1. a, b. Piston-driven CPR devices (a) Pneumatic: Thumper (LifeStat) (https://www.michiganinstruments.com). (b) Manual: Animax Mono (http://www.aat-online.de/)

Figure 2. Load-distributing band CPR devices
Auto Pulse (69)

Figure 3. a, b. Active compression–decompression CPR devices. (a) Pneumatic/electrically driven ACD-CPR devices: LUCAS 2 (36). (b) Manual driven ACD-CPR devices: ResQPump (18).

um, creating an intrathoracic negative pressure during the active decompression phase to increase the venous return of blood to the heart. Thus, in the next compression phase, an increase is achieved in cardiac output, coronary and cerebral blood flow, and in arterial blood pressure. The most widely known and commonly used of the ACD-CPR devices is the LUCAS (Lund University Cardiac Assist System). The original LUCAS 1 was a pneumatic device that was developed in Sweden by Steen in 2002. The new model of the device, introduced in 2010 under its new name LUCAS 2 (LUCAS™ 2 Chest Compression System), runs on electricity and consists of a piston for compression, a silicone suction cup for decompression, a rechargeable battery, a backboard, and connecting legs (Figure 3a). The device allows defibrillation without interrupting compression, and its X-ray translucent capability makes cardiac catheterization possible. The ACDC Thumper is another pneumatic device. The manual devices that operate with the ACD-CPR technique are marketed under trade names such as CardioPump, ResQPump, and Ambu® Cardio Pump (Figure 3b) (6, 13, 24, 29, 36-40).

4. Simultaneous sterno-thoracic CPR devices (SST-CPR / X-CPR)

These devices were designed to benefit from both the cardiac pump and thoracic pump theories. These devices have two components: a piston (which depresses the sternum in the compression phase) and a circumferential band (which constricts the thorax simultaneously compressions).The "Life Belt" is a device that is operated manually using the SST-CPR principle. Another such device is the pneumatic "Weil Mini Chest Compressor" (Figure 4) (Resuscitation International, USA) (13, 41-44).

5. Inspiratory Impedance Threshold Device (ITD) and ResQCPR (ACD+ITD CPR)

The inspiratory ITD is a pressure-sensitive one-way valve system that can be connected to a face mask or to any developed airways equipment such as endotracheal tubing. The valve closes in the decompression phase of CPR, temporarily blocking the more than necessary passage of passive air through the open airway into the patient's lungs, thus decreasing intrathoracic pressure and creating a small vacuum. This increases the flow of venous blood to the heart, and the increased venous return increases cardiac output in the next compression. ITD are marketed under the trademark "ResQPOD® ITD 16." ITD can be used alone during S-CPR as well as it may be used in combination with manual ACD-CPR devices such as the CardioPump and the ResQPump. This system is known as ResQ-CPR. ResQCPR=ACD-CPR (ResQPUMP)+ITD (ResQPOD) (Figure 5a) (6, 27, 45-47).

Figure 4. Simultaneous sterno-thoracic cardiopulmonary resuscitation devices
Weil Mini Chest Compressor (http://www.resusintl.com/)

Figure 5. a, b. Other CPR devices. (a) Impedance threshold device (ITD) and ResQCPR: ResQPod+ResQPump (46). (b) Phased thoracic-abdominal compression–decompression CPR: Lifestick (48)

6. Phased thoracic-abdominal active compression–decompression CPR devices (PTACD-CPR)

Interposed abdominal compression CPR (IAC-CPR) activates the abdominal venous reservoir by increasing abdominal pressure; this CPR technique is based on forcing venous return, thereby increasing venous return to the heart. Abdominal compression is applied to the area midpoint between the xiphoid and umbilicus in the relaxation phase of chest compression. Phased thoracic-abdominal active compression–decompression CPR constitutes the working principle behind ACD-CPR and IAC-CPR and is a new method that combines the two techniques. PTACD-CPR is applied by simultaneous chest compression (positive intrathoracic pressure) and active abdominal decompression and then following this phase, simultaneous active chest decompression (negative intrathoracic pressure) and abdominal compression. The Lifestick™ was developed for use in this technique; it is a manually controlled device. The device consists of a rigid central bar and two arms with adhesive pads that are connected to this rigid bar. The larger adhesive pad is placed over the abdomen and the smaller over the anterior chest wall. An implementer compresses the two sides of the device just like a seesaw, applying pressure both on the chest and the abdomen alternately (Figure 5b) (11, 27, 48-50).

7. Active compression–decompression CPR with Enhanced External Counterpulsation and the Inspiratory Impedance Threshold Valve (AEI-CPR)

Enhanced external counterpulsation (EECP) is a circulatory support system that achieves increased cardiac output using a method whereby cuffs applied to the lower extremities are inflated during diastole to increase coronary blood circulation and deflated at the early systole to reduce afterload and increase venous return. AEI-CPR is another experimental technique, which is a combination of active compression–decompression CPR, EECP, and Inspiratory impedance threshold valve, aiming to improve CPR hemodynamics and increase survival rates. This technique, which is still in its theoretical and experimental stage, is simply expressed as AEI-CPR=ACD-CPR+EECP+ITV (51, 52).

Studies Conducted on the Effectiveness of MCCDs

Theoretically, MCCDs appear to provide many practical advantages, such as the mechanical devices deliver compressions at the same frequency and depth which are recommended in the guidelines, as opposed to the inter-rescuer variations and fatigue factors that affect the quality of chest compression; these devices allow the rescuers to perform other tasks (cannulation, airway, etc.) and defibrillation without the need of interruption in CPR; and they provide consistent rate and depth of chest compressions during transport of the patient.

However, the main issue is to what degree these devices have an impact on survival in cardiac arrest, on hemodynamic parameters, and on the survival neurologically intact and whether they produce a significant difference in in-hospital and out-of-hospital cardiac arrests (IHCA and OHCA, respectively) compared to S-CPR. Experimental studies conducted with some mechanical chest compression devices developed in recent years present strong evidence that these devices increase the effectiveness and quality of CPR. Moreover, although they were first developed to achieve uninterrupted CPR, particularly in cases of OHCA, the studies on the use of these devices in IHCAs help to expand their clinical usage area. This section will review some of the results of some MCCD-related experimental or clinical studies on in-hospital and out-of-hospital cases.

Experimental studies with LUCAS-CPR have shown that the device enables significantly higher cerebral blood circulation than S-CPR as well as higher rates of cardiac output, carotid artery blood

Table 1. Studies with LUCAS-CPR

Title	Study design	Results	Conclusion
1. Rubertsson S (2005). Increased cortical cerebral blood flow with LUCAS; a new device for mechanical chest compressions compared to standard external compressions during experimental cardiopulmonary resuscitation (9)	Experimental: pigs: VF was induced (n=14), L-KPR (n=7), S-KPR (n=7)	Mean cortical cerebral blood flow and $ETCO_2$ was significantly higher in L- CPR than in S-CPR (in order of; p=0.041 and p=0.009).	L-CPR generated higher cerebral blood flow and cardiac output than S-CPR. The results strongly support prospective randomized studies in patients to evaluate the effects of this device in clinical practice.
2.Steen S (2002). Evaluation of LUCAS, a new device for automatic mechanical compression and active decompression resuscitation (36)	Experimental: In an artificial thorax model and pigs: VF was induced	İn thorax model: Superior pressure and flow were obtained with L-CPR compared with S-CPR In pigs: higher CO, carotid artery blood flow, $ETCO_2$, and CPP were obtained with L-CPR (83% ROSC) than with S-CPR (0% ROSC).	LUCAS gave significantly better circulation during ventricular fibrillation than manual chest compressions.
3. Liao Q (2010). Manuel versus mechanical cardiopulmonary resuscitation. An experimental study in pigs (53)	Experimental: pigs: VF was induced (n=16), L-KPR (n=8), S-KPR (n=8)	ROSC: L–CPR (n=8), S-CPR (n=3), The mean CPP: L-CPR 20, S-CPR 5 mmHg, p<0.01, $ETCO_2$; higher in the L–CPR group (p<0.05).	L-CPR generated higher CPP than S-CPR.
4. Larsen A (2007). Cardiac arrest with continuous mechanical chest compression during percutaneous coronary intervention. A report on the use of the LUCAS device (54)	Clinical study: IHCA: LUCAS has been used During PCI (n=13)	The device allowed visualization of the coronary arteries in all patients, PCI was successfully performed in eight patients.	Coronary angiography and coronary intervention may be successfully performed in patients with cardiac arrest using the LUCAS device
5. Bonnemeier H (2009). Automated continuous chest compression for in-hospital cardiopulmonary resuscitation of patients with pulseless electrical activity: A report of five cases (55)	Clinical study: IHCA, LUCAS has been used During PCI (n=5)	The device allows for uninterrupted chest compressions during angiography and angioplasty. CT evidences show that L-CPR may also provide additional therapeutic effects in those patients with PEA due to PE, mechanical thrombus fragmentation, and increase pulmonary artery flow after LUCAS-compression.	LUCAS may significantly improve the chain of survival and clinical outcome in patients with IHCA.
6. Bonnemeier H (2011). Continuous Mechanical chest compression during in hospital cardiopulmonary resuscitation of patients with pulseless electrical activity (56)	Clinical study: IHCA, L-CPR, patients with PEA (n=28) L-CPR, During coronary angiography and pulmonary angiography (n=21),	ROSC: n=27, Dying within the first hour (n=10), 24 h (n=3) after CPR, Discharged from hospital CPC 1 and 2: n=13, PE (n=14), did not undergo thrombolytic therapy (n=6/14), CT angiography in these patients showed fragmentation of the thrombus.	Continuous chest compression with LUCAS seems to be feasible, safe, and might improve outcomes after IHCA of PEA cardiac arrest. Patients with PE may benefit probably because of thrombus fragmentation and increased pulmonary artery blood flow.
7. Wagner H (2010). Cardiac arrest in the catheterization laboratory: a 5-year experience of using mechanical chest compressions to facilitate PCI during prolonged resuscitation efforts (57)	Clinical study: Retrospective 2004-2008, IHCA: During PCI using LUCAS (n=43)	The PCI procedures were successfully performed during mechanical chest compressions (n=36) and pericardiocentesis (n=1).	Discharge CPC 1: >25% (n=11) Mechanical chest compressions devices enable continued chest compressions during PCI with maintained circulation, which may reduce mortality in patients with cardiac arrest, requiring lengthy CPR, in the catheterization laboratory,
8. Fidler R (2014). Three modes of cardiac compressions in a single patient: A comparison of usual manual compressions, automated compressions, and open cardiac massage (58)	Case report: Post-CABG patient receiving three modes of cardiac compressions S-CPR, L-CPR, and open cardiac massage	S-CPR (8 min): Average arterial pressures=65/10 mmHg L-CPR (10 min): Average arterial pressures=100/60 mmHg. Open cardiac massage: Average arterial pressures=70/15 mmHg	LUCAS-2 could provide superior arterial blood pressure compared to S-CPR and open cardiac massage.

Table 1. Studies with LUCAS-CPR (Continued)

Title	Study design	Results	Conclusion
9. Axelssona C (2006). Clinical consequences of the introduction of mechanical chest compression in the EMS system for treatment of out-of-hospital cardiac arrest- A pilot study (60)	OHCA, Non-randomized, Sweden, 2003-2005, L-CPR (n=159), S-CPR (n=169)	No significant difference in ROSC (51% in both groups), Survival to hospital admission: L-CPR (38%) and S-CPR (37%), Hospital discharge: L-CPR 8% and S-CPR 10% Discharge CPC 1: L-CPR 83%, S-CPR 76%. *(device was used in only 105 cases (66%)*	No sufficient evidence to support that mechanical CPR would improve outcomes. It is important to perform further randomized trials to investigate how to use mechanical chest compressions in accordance with pre-hospital standards
10. Smekal D (2011). A pilot study of mechanical chest compressions with the LUCAS device in cardiopulmonary resuscitation (61)	OHCA, prospective pilot study, Sweden, 2005-2007 L-CPR (n=75), S- CPR (n=73)	ROSC with a palpable pulse: L-CPR 41%, S-CPR 32 (p=0.30), ROSC with BP >80/50 mmHg > 5 min: L-CPR 31%, S-CPR 26%, p=0.59 Hospitalized alive >4 h: L-CPR 24%, S-CPR 21%, p=0.69	Discharged: L-CPR 8%, S- CPR 10% (p=0.78). In this pilot study, there was no difference in early survival between L-CPR and S-CPR.
11. Axelssona C (2009). Mechanical active compression–decompression cardiopulmonary resuscitation (ACD-CPR) versus manual CPR according to pressure of end tidal carbon dioxide ($PETCO_2$) during CPR in out-of-hospital cardiacj arrest (62)	OHCA, a prospective pilot study, Sweden, 2003-2005 L-CPR (n=64), S- CPR (n=62)	$ETCO_2$ was significantly higher in L- CPR than in S- CPR according to initial (p=0.01), average (p=0.04), and minimum (p=0.01). No differences in survival outcomes.	L-CPR performed better than S-CPR regarding cardiac output.
12. Rubertsson S (2014). Mechanical Chest Compressions and Simultaneous Defibrillation vs Conventional Cardiopulmonary Resuscitation in Out-of-Hospital Cardiac Arrest: The LINC Randomized Trial (63)	OHCA, randomized, multicenter (Sweden, Netherlands, England), 2008–2012 L-CPR (n=1300) S-CPR (n=1289)	ROSC:L-CPR 35.4%, S-CPR 34.6%, p: 0.68, Four-hour survival: L-CPR 23.6%, S-CPR 23.7%, p>0.99, Discharge with a CPC score of 1-2: L-CPR 8.3%, S-CPR 7.8%, p:0.61 Surviving at 6 months with a CPC score of 1-2: L-CPR 8.5%, S-CPR 8.1%, p:0.67	There was no significant difference between the two groups. In clinical practice, mechanical CPR using the presented algorithm did not result in improved effectiveness compared with manual CPR.
13. Perkins G (2015). Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic cluster randomized controlled trial (64)	OHCA, randomized, England, 2010-2013, L-CPR (n=1652) S-CPR (n=2819)	ROSC (survived event): L-CPR 23%, S-CPR 23%, 30 day survival: L-CPR 6%, S-CPR 7%, p: 0.86, Survival with CPC 1–2: L-CPR 5%, S-CPR 6%, p: 0.72 *[device was used in only 985 cases (60%)]*	There was no significant difference between two groups. This trial was unable to show any superiority of mechanical CPR.
14. Blomberg H (2011). Poor chest compression quality with mechanical compressions in simulated cardiopulmonary resuscitation: A randomized, cross-over manikin study (65)	Experimental, evaluated the CPR performance of ambulance crews (L-CPR and S-CPR) in a manikin setup (n=21)	Adequate compressions: L-CPR 58%, S-CPR 88%, The median compression depth: L-CPR 3.8 cm, S-CPR 4.7 cm Only 12 out of the 21 ambulance crews (57%) applied the mandatory stabilization strap on the LUCAS device.	The performance of trained ambulance crews (which uses LUCAS) was found to be remarkably poor. Poor chest compressions due to failure in recognizing and correcting a malposition of the device reduced a potential benefit of mechanical chest compressions.

VF: ventricular fibrillation; CO: cardiac output; CPP: coronary perfusion pressures; PCI: percutaneous coronary intervention; IHCA: in-hospital cardiac arrest; OHCA: out -hospital cardiac arrest; ROSC: return of spontaneous circulation; PE: pulmonary emboli; PEA: pulseless electrical activity; CPC: cerebral performance category; CABG: coronary artery bypass grafting; $ETCO_2$: end-tidal CO2; L-CPR: LUCAS KPR; BP: blood pressure

flow, end tidal CO_2 ($ETCO_2$), aortic and coronary perfusion pressure, and ROSC (9, 36, 53). The LUCAS device has been used in IHCA situations, in cardiac catheterization laboratories, and intensive care units. Studies show that the LUCAS device is functional during percutaneous coronary interventions (54-58). The findings reported in the mentioned studies have been summarized in Table 1. The use and effectiveness of mechanical chest compression devices such as LUCAS in organ transplants from non-heart-beating donors, in situations where a decision to terminate life and execute an organ transplant has been made, and where CPR is continued until the start of extracorporeal oxygenation (ECMO) are the subjects of ongoing studies (59).

Details of LUCAS-CPR studies with nontraumatic adult OHCA patients are shown in Table 1. Axelsson et al. (60) and Smekal et al. (61) have reported no significant differences in their studies when compared with S-CPR, whereas the same team in another study (62) revealed that $ETCO_2$ values, which are a prognostic value for cardiac output and survival, were significantly higher in the LUCAS group

than in the S-CPR group. In two large randomized studies ("LINC-LUCAS in Cardiac Arrest" and "PARAMEDIC-The Prehospital Randomised Assessment of a Mechanical Compression Device In Cardiac Arrest"), no significant difference was found between LUCAS-CPR and S-CPR in terms of ROSC and survival with good neurological outcomes (63, 64). In another study in which the skills of healthcare personnel in using LUCAS were evaluated, it was determined that the rate and depth of compressions applied to a manikin using LUCAS were inadequate compared with S-CPR (65).

Table 2 displays the findings of studies conducted on the effectiveness of AutoPulse in CPR (A-CPR). A study conducted with IHCA patients where AutoPulse was used reported that A-CPR produced higher coronary perfusion pressure than S-CPR (66). In two non-randomized studies using AutoPulse in OHCA patients, it was shown that A-CPR produced better results than S-CPR (32, 67). In a multi-center randomized study, the results of the ASPIRE Trial (Assisted Prehospital International Resuscitation Research) indicated that survival to hospital discharge and good neurological outcomes were lower in A-CPR than in S-CPR (68). The results of two nonrandomized, small sample size studies support the effectiveness of A-CPR (69, 70). Another large, randomized study (30) reports that survival rates with ROSC and satisfactory neurological outcomes were better with A-CPR than with S-CPR. A review of the results of the "Circulation-Improving Resuscitation Care (CIRC) Trial," another multicenter randomized study conducted with AutoPulse, revealed that A-CPR is equal to S-CPR in terms of ROSC and survival rates (71).

Table 3 presents the results of some studies that have reported on other MCCDs and techniques. Some trials on ResQCPR (ACD+ITD CPR) have reported short- and long-term survival rates to be higher than those for S-CPR (47, 72, 73). The results of trials with simultaneous sterno-thoracic CPR devices (SST-CPR/X-CPR) reveal hope for the future of these devices. In a study that consisted of a small series of cases, X-CPR produced higher coronary perfusion pressure than S-CPR (42). In a study with the Lifestick, a phased thoracic-abdominal active compression–decompression CPR device, no difference was detected compared with S-CPR in terms of ROSC, but it was reported that this technique could be advantageous for patients with asystole or pulseless electrical activity (48). Another study conducted with a small sample (49) did not report any statistically significant difference between using the Lifestick and applying S-CPR.

In the literature, there are also simulation studies where CPR devices and techniques were compared. Zhang et al. (11) used a circulation computer model in an experimental study to compare five ITD-supported techniques (S-CPR, ACD-CPR, IAC-CPR, Lifestick-CPR, and EECP-CPR) in terms of their hemodynamic effects, and they found Lifestick-CPR to be the most effective. A similar simulation study of five CPR techniques [S-CPR, ACD-CPR, IAC-CPR, ACD-CPR+External counterpulsation (ECP), and S-CPR+ECP] had made a comparison and found that cardiac output, cerebral blood flow, coronary blood flow, and mean coronary perfusion pressure to be the lowest in S-CPR and highest in IAC-CPR, with ACD-CPR+ECP exhibiting values close to this (51).

MCCDs in the Guidelines

An evaluation was made of the recommendations for use and the levels of evidence cited in the AHA 2010 and 2015 guidelines based on large randomized trials. In the case of automatic ACD-CPR devices such as LUCAS and LDB-CPR devices such as Autopulse, the guidelines state that the evidence to support or reject the routine use of these devices in the treatment of cardiac arrest is not sufficient and that manual chest compressions remain as the standard treatment of cardiac arrest; however, these devices may be a reasonable alternative for use by properly trained personnel (AHA 2015: Class IIb, LOE B-R). Furthermore, the guidelines state that the use of mechanical piston devices may be considered in specific settings where the delivery of high-quality manual compressions may be challenging or dangerous for the provider [e.g., limited rescuers available and prolonged CPR during hypothermic cardiac arrest, in a moving ambulance, in the angiography suite, and during preparation for extracorporeal CPR (ECPR)], provided that rescuers strictly limit interruptions in CPR during deployment and removal of the devices (AHA 2015: Class IIb, LOE C-EO) (6, 74).

The AHA 2010 guideline states with regard to manual ACD-CPR devices that there is no adequate evidence to either recommend or reject the routine use of these devices and that the use of the devices may be considered in the event of properly trained personnel. The AHA 2015 guideline has not made any revision with regard to these devices, maintaining the same recommendations and evidence level specified in the 2010 guideline (Class IIb, LOE B) (6, 74).

With respect to the sole use of the ITD-CPR device, the AHA 2010 guideline's recommendation and evidence level places the device in Class IIb, LOE B, whereas the AHA 2015 guideline has changed the recommendation and evidence level, placing it in the category of "Not recommended for routine use S-CPR" (Class III: No benefit, LOE A) (6, 74).

There appears to be no evaluation in the AHA 2010 guideline for ITD+ACD-CPR (RESQCPR). In the 2015 guideline, however, it is stated that this combination is not recommended for routine use as an alternative for S-CPR but may be considered as an alternative only in the presence of available equipment and trained personnel (Class IIb, LOE C-LD) (6, 74).

It can be seen that the AHA 2010 and 2015 guidelines do not include information and data on CPR devices and combinations such as the SST-CPR, PTACD-CPR, and AEI-CPR because these are still in the experimental stage and are not supported by adequate clinical research (6, 74).

Conclusion

In a general assessment, it may be stated that although large randomized trials have as yet highlighted the superiority of these devices over S-CPR in OHCA, they have at the same time not produced any evidence to prove their failure or harm.

The possibilities to be created by the harmonious cooperation of the disciplines of mathematics, biology, medicine, engineering, and the physical sciences in "the process of developing biomedical equipment technologies" and the role technology will play in constructing the future cannot be ignored. Therefore, an increase in the number of experimental and clinical research on CPR technologies and the evaluations & revisions performed according to the results of these studies will pave the way for the development of changes with respect to the application methods and areas of these devices. Ensuring that these devices become more functional, effective, and reliable will improve the effectiveness of CPR and may reduce the incidence of morbidity and mortality accompanying cardiac arrest.

Table 2. Studies with Autopulse

Title	Study design	Results	Conclusion
1. Timerman S (2004). Improved hemodynamic performance with a novel chest compression device during treatment of in-hospital cardiac arrest (66)	IHCA (at ICU), Brazil, 2000-2001, A-CPR (n=8), S-CPR (n=8)	Peak aortic pressure: A-CPR153, S-CPR 115 mmHg, p<0.0001 Peak right atrial pressure: A-CPR=129, S-CPR=83 mmHg, p<0.0001 CPP: A-CPR=20 mmHg, S-CPR=15 mmHg, p<0.015	A-CPR demonstrated a clinically significant improvement in hemodynamics compared to manual chest compressions.
2. Hock Ong ME (2006). Use of an automated, load-distributing band chest compression device for out-of-hospital cardiac arrest resuscitation (32)	OHCA, observational, A-CPR (n=284), (2003-2005) S-CPR (n=499) (2001-2003) device was used in only 210 cases	ROSC: A-CPR 34.5%, S-CPR 20.2% Survival to hospital admission: A-CPR 20.9%, S-CPR 11.1% Survival to hospital discharge: A-CPR 9.7%, S-CPR 2.9% No difference in CPC (p=0.360) *(device was used in only 210 cases)*	A-CPR is better. AutoPulse was improved survival to hospital discharge when compared to S- CPR
3. Casner M (2005). The impact of a new CPR device on rate of spontaneous circulation in out-of hospital cardiac arrest (67)	OHCA, Retrospective, A-CPR (n=69), S-CPR (n=93)	Arrival to an emergency department with measurable spontaneous pulses: A-CPR 39%, manual 29%, p: 0.003, At shockable rhythms: A-CPR 44%, manual 50%, p: 0.340, At asystole: A-CPR 37%, manual 22%, p: 0.008, At PEA: A-CPR 38%, manual 23%, p: 0.079).	A-CPR may improve ROSC and may particularly benefit patients with no shockable rhythms.
4. Hallstrom A (2006). Manual chest compression vs. use of an automated chest compression device during resuscitation following out-of-hospital cardiac arrest: A randomized trial (ASPİRE) (68)	OHCA, randomized, multicenter (US, Canada) 2004-2005 A-CPR (n=554), S-CPR (n=517)	Survival to 4 h: A-CPR 29.5%, S-CPR 28.5%, p=0.74 Survival to hospital discharge: A-CPR 5.8%, S-CPR 9.9%, p=0.060 CPC 1–2 at hospital discharge: A-CPR 3.1%, S-CPR 7.5%, p=0.006	Use of an automated LDB-CPR device as implemented in this study was associated with worse neurological outcomes and a trend toward worse survival compared with manual CPR.
5. Krep H (2007). Out-of-hospital cardiopulmonary resuscitation with the AutoPulse™ system: A prospective observational study with a new load-distributing band	OHCA, prospective, Germany, 2004-2005 A-CPR (n=46), ACD-CPR (n=48)	ROSC: 54.3% (n=25/46), chest compression device (69) Admitted to ICU: 39.1% (n=18/46), Discharged from ICU: 21.8% (n=10/46) Discharged CPC 1=2; CPC 2=1; CPC 3= 7 patient (n=10) ROSC ACD-CPR with use cardio pump: 52% (n=48)	The AutoPulse is an effective and safe mechanical CPR device useful in OHCA
6. Duchateau F-X (2010). Effect of the AutoPulse™ automated band chest compression device on hemodynamics in out-of-hospital cardiac arrest resuscitation (70)	OHCA, prospective, France (2008) A-CPR (n=29) (first S-CPR and then A-CPR same groups)	Median diastolic BP: A-CPR 23 mmHg, S-CPR 17 mmHg, p<0.001 Median systolic BP: A-CPR 106 mmHg, S-CPR 72 mmHg, p<0.02, Mean BP: A-CPR 36 mmHg, S-CPR 29 mmHg, p<0.002, $ETCO_2$: did not increase with Autopulse (from 21 to 22 mmHg, p=0.80)	The use of the AuotoPulse is associated with increased diastolic BP compared to S-CPR.
7. Jennings PA (2012). An automated CPR device compared with standard chest compressions for out-of-hospital resuscitation (25)	OHCA, retrospective, Australia, 2006-2010 A-CPR (n=66), S-CPR (n=220)	Survival to hospital : A-CPR 26% (17/66), S-CPR 20% (43/220), p=0.23 Survived to hospital discharge: A-CPR 3% (n=2/66), S-CPR 7% (15/220), p=0.38	Further research is warranted, which involves randomization and larger number of cases to investigate the potential benefits of A-CPR, including survival to hospital discharge.
8. Hock Ong ME (2012). Improved neurologically intact survival with the use of an automated, load-distributing band chest compression device for cardiac arrest presenting to the emergency department (30)	OHCA, multicenter, randomized, Singapore S-CPR (n=459, 2004-2007) A-CPR (n=522, 2007-2009)	ROSC: A-CPR 35.3% (n=195), S-CPR 22.4% (n=103) Survival to hospital discharge: A-CPR 3.3%, S-KPR 1.3% CPC 1 -2 at hospital discharge: A-CPR 81.3% (n=13/16), S-CPR 33.3% (n=2/6).	The AutoPulse improved survival with intact neurological status on discharge in adults with non-traumatic cardiac arrest.
9. Wik L (2014). Manual vs. integrated automatic load-distributing band CPR with equal survival after out of hospital cardiac arrest. The randomized CIRC trial (71)	OHCA, multicenter (US, Europe), randomized, (2009-2011), A-CPR (n=2099), S-CPR (n=2132)	ROSC: A-CPR 28.6%, S-CPR 32.3%, no different 24-h survival: A-CPR 21.8%, S-CPR 25%, no different survival to hospital discharge: A-KPR 9.4%, S-KPR 11%, no different	CIRC Trial: Compared to high-quality A-CPR, S-CPR resulted in statistically equivalent survival to hospital discharge.

CO: cardiac output; CPP: coronary perfusion pressure; IHCA: in-hospital cardiac arrest; OHCA: out -hospital Cardiac arrest; ROSC: return of spontaneous circulation; PEA: pulseless electrical activity; CPC: cerebral performance category; $ETCO_2$: end-tidal CO2; A-KPR : AutoPulse CPR; ICU: intensive care unit; BP: blood pressure

Table 3. Studies wıth other devices

	Title	Study design	Results	Conclusion
Impedance threshold device (ITD+ACD-KPR)	Plaisance P (2004). Evaluation of an impedance threshold device in patients receiving active compression decompression cardiopulmonary resuscitation for out of hospital cardiac arrest (72)	OHCA, multicenter, randomized, prospective, France, 1999-2000 ACD-KPR+ active ITD (n=200) ACD-KPR + sham ITD (n=200)	24-h survival: ACD-KPR+ active ITD 32%, ACD-KPR+sham ITD 22%,p = 0.02 ROSC: ACD-KPR+active ITD:48%, ACD-KPR+ sham ITD:39%, p=0.05 Survival ICU admission: ACD-CPR+active ITD 40%, ACD-CPR+sham ITD 29% (p=0.02) Hospital discharge: ACD-CPR+active ITD: 5%, ACD-KPR+sham ITD:4% (p:0.02)	ACD-KPR+active ITD significantly improved 24-h survival rates.
	Wolcke BB (2003). Comparison of standard cardiopulmonary resuscitation versus the combination of active compression–decompression cardiopulmonary resuscitation and an inspiratory impedance threshold device for out-of-hospital cardiac arrest (73)	OHCA, prospective, Germany, 1999-2002 ACD-CPR+ITD (n=103) S-CPR (n=107)	ROSC: ACD-CPR+ITD 55%, S-CPR 37%, p:0.016 1-hour survival: ACD-CPR+ITD 51%, S-CPR 32%, p:0.006 24-h survival: ACD-CPR+ITD 37%, S-CPR 22%, p:0,033 Hospital discharge: ACD-CPR+ITD 18%, S-CPR 13%, p:0.41	Compared with S-CPR, ACD- CPR+ITD significantly improved short-term survival rates
	Frasconea RJ (2013).Treatment of non-traumatic out-of-hospital cardiac arrest with active compression decompression cardiopulmonary resuscitation plus an impedance threshold device (47)	ResQTrial; OHCA, randomized, prospective, multicenter (US, 2005-2009) ResQCPR (n=1403) S-CPR (n=1335)	Survival with good neurologic outcomes: ResQCPR 7.9%, S-CPR 5.7%, p:0.027, 1-year survival: ResQCPR 7.9, S-CPR 5.7%, p: 0.026	ResQCPR showed significant increase in survival to hospital discharge with favorable neurological function compared with S-CPR
Simultaneous Sterno thoracic	Cha KC (2014). Hemodynamic Effects of an Automatic Simultaneous Sterno thoracic CPR Device in Patients with Cardiac Arrest (42)	OHCA, X –CPR (n=11) S-CPR (n=14)	Right atrial pressures during compression and relaxation and $ETCO_2$ were not different between two groups. Femoral arterial pressures during relaxation and CPP were higher in X-CPR (p=0.017).	X-KPR demonstrated higher coronary perfusion pressure than standard CPR
	Yang Z (2014). Similar Hemodynamic Efficacy Between 30-mm and 50-mm Compression Depth During Mechanical Chest Compression with Weil Mini Chest Compressor (43)	Experimental, pigs: VF was induced, MCC compression depth: 30 mm (n=5) and 50 mm (n=5)	There were no differences in CPP, $ETCO_2$, and carotid blood flow between the two groups A significantly less rib fracture was observed in the 30-mm group, p<0.05.	Similar hemodynamic efficacy was observed between 30- and 50-mm compression depth with the Weil Mini Chest Compressor.
	Chen W (2012). The effects of a newly developed miniaturized mechanical chest compressor on outcomes of cardiopulmonary resuscitation in a porcine model (44)	Experimental, pigs: VF was induced (n=30) MCC and (LUCAS or Thumper)	MCC generated significantly greater CPP, $ETCO_2$, carotid blood flow, and intrathoracic negative pressure, with significantly lower compression depth and fewer rib fractures than both the LUCAS and Thumper devices	MCC may provide a new option for cardiopulmonary resuscitation.
Phased Chest and Abdominal	Arntz HR (2001). Phased Chest and Abdominal Compression–Decompression Versus Conventional Cardiopulmonary Resuscitation in Out-of-Hospital Cardiac Arrest (48)	OHCA, Germany, Lifestick (n=24), S-CPR (n=28),	ROSC: S-CPR 50% (13/26), Lifestick-CPR 38% (9/24), p:0.55, ROSC at VF: S-CPR 68% (13/19), Lifestick 44% (4/9), p:0.43, ROSC at NEA/ asystole: S-CPR 0%, Lifestick-CPR 33% (5/15), p:0.23 Survival 1h: S-CPR 46% (12/26), Lifestick 25% (6/24) Hospital discharge: S-CPR 7/26, Lifestick 0 Autopsy: Sternal or rib fractures were found more frequently with S-CPR, p<0.05)	Lifestick resuscitation is feasible and safe and may be advantageous in patients with asystole or pulseless electric activity.
	Havel C (2008). Safety, feasibility, and hemodynamic and blood flow effects of active compression–decompression of thorax and abdomen in patients with cardiac arrest (49)	OHCA, Prospective, single-center, phase II study, Lifestick (n=20) Thumper (n=11) Although Lifestick seemed to improve hemodynamic effects compared with the	Thumper device, they were not significantly different between Lifestick and Thumper in resuscitations.	Lifestick is safe and beneficial, The small number of patients included in the study limits the conclusions about the hemodynamic effects of the Lifestick.

CO: cardiac output; CPP: coronary perfusion pressure; IHCA: in-hospital cardiac arrest; OHCA: out -hospital Cardiac arrest; ROSC: return of spontaneous circulation; PEA: pulseless electrical activity; CPC: cerebral performance category; ETCO2: end-tidal CO2; A-KPR : AutoPulse CPR; ICU: intensive care unit; BP: blood pressure

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References

1. Travers AH, Rea TD, Bobrow BJ, Edelson DP, Berg RA, Sayre MR, et al. 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care: Part 4: CPR Overview. Circulation 2010; 122: 676-84. [CrossRef]
2. Cooper JA, Cooper JD, Cooper JM. Contemporary reviews in cardiovascular medicine: cardiopulmonary resuscitation; history, current practice, and future direction. Circulation 2006; 114: 2839-49. [CrossRef]
3. Sasson C, Rogers MA, Dahl J, Kellermann AL. Predictors of survival from out-of-hospital cardiac arrest: a systematic review and meta-analysis. Circ Cardiovasc Qual Outcomes 2010; 3: 63-81. [CrossRef]
4. Kozacı N, Ay MO, İçme F, Aktürk A, Satar S. Are we successful in cardiopulmonary resuscitation? Cukurova Med J 2013; 38: 601-9.
5. Kleinman ME, Brennan EE, Goldberger ZD, Swor RA, Terry M, Bobrow BJ, et al. 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care: Part 5: Adult Basic Life Support and Cardiopulmonary Resuscitation Quality. Circulation 2015; 132: 414-35. [CrossRef]
6. Cave DM, Gazmuri RJ, Otto CW, Nadkarni VM, Cheng A, Brooks SC, et al. 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care: Part 7: CPR Techniques and Devices. Circulation 2010; 122: 720-8. [CrossRef]
7. Berg RA, Hemphill R, Abella BS, Aufderheide DC, Hazinski MF, Lerner B, et al. Part 5: adult basic life support: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation 2010; 122(18 Suppl 3): S685-705. [CrossRef]
8. Nolan JP, Soar J, Zideman DA, Biarent D, Bossaert LL, Deakin C, et al. European Resuscitation Council Guidelines for Resuscitation 2010 Section 1. Executive summary. Resuscitation 2010; 81: 1219-76. [CrossRef]
9. Rubertsson S, Karlsten R. Increased cortical cerebral blood flow with LUCAS; a new device for mechanical chest compressions compared to standard external compressions during experimental cardiopulmonary resuscitation. Resuscitation 2005; 65: 357-63. [CrossRef]
10. Keseg DP. The Merits of Mechanical CPR: Do mechanical devices improve compression consistency and resuscitation outcomes. JEMS 2012; 37: 24-9.
11. Zhang Y, Wu X, Yuan H, Xu L, Karemaker J. Computer models in bedside physiology. Chapter 2: Optimal cardiopulmonary resuscitation as identified by computer modeling. 2013: 12-32. Downloaded from UvA-DARE. Available at http://dare.uva.nl.
12. Topjian AA, Nadkarni AA, Berg VM. Cardiopulmonary resuscitation in children. Curr Opin Crit Care 2009; 15: 203-8. [CrossRef]
13. Gaxiola A, Varon J. Evolution and new perspective of chest compression mechanical devices. Am J Emerg Med 2008; 26: 923-31. [CrossRef]
14. Hightower D, Thomas SH, Stone CK, Dunn K, March JA. Decay in quality of closed-chest compressions over time. Ann Emerg Med 1995; 26: 300-3. [CrossRef]
15. Ochoa FJ, Ramalle-Gomara E, Lisa V, Saralegui I. The effect of rescuer fatigue on the quality of chest compressions. Resuscitation 1998; 37: 149-52. [CrossRef]
16. Wik L, Kramer-Johansen J, Myklebust H, Sorebo H, Svensson L, Fellows B, et al. Quality of cardiopulmonary resuscitation during out-of-hospital cardiac arrest. JAMA 2005; 293: 299-304. [CrossRef]
17. Perkins GD, Boyle W, Bridgestock H, Davies S, Oliver Z, Bradburn S, et al. Quality of CPR during advanced resuscitation training. Resuscitation 2008; 77: 69-74. [CrossRef]
18. Wigginton JG, Miller AH, Benitez FL, Pepe PE. Mechanical devices for cardiopulmonary resuscitation. Curr Opin Crit Care 2005; 11: 219-23. [CrossRef]
19. Classification of the External Cardiac Compressor (including CPR aid devices). FDA Executive Summary. Available at: http://www.fda.gov/downloads/AdvisoryCommittees/CommitteesMeetingMaterials/Medical Devices. September 11, 2013.
20. Harkins GA, Bramson ML. Mechanized external cardiac massage for cardiac arrest and for support of the failing heart. A preliminary communication. J Surg Res 1961; 1: 197-200. [CrossRef]
21. Nachlas MM, Siedband MP. A simple portable pneumatic pump for external cardiac massage. Am J Cardiol 1962; 10: 107-9. [CrossRef]
22. Safar P, Harris LC. The Beck-Rand external cardiac compression machine. Anesthesiology 1963; 24: 586-8. [CrossRef]
23. Bailey, Browsw NL, Keating VJ. Automatic external cardıac massage: a portable pneumatic external cardıac compression machine. Brit Heart J 1964; 26: 481-9. [CrossRef]
24. Harrison-Poul R. A history of mechanical devices for providing external chest compressions. Resuscitation 2007; 73: 330-6. [CrossRef]
25. Jennings PA, Harris L, Bernard S, Bray J, Walker T, Spelman T, et al. An automated CPR device compared with standard chest compressions for out-of-hospital resuscitation. BMC Emerg Med 2012; 12: 2-5. [CrossRef]
26. Xu L, Wu X, Zhang Y, Yuan H. The Optimization Study on Time Sequence of Enhanced External Counter-Pulsation in AEI-CPR. Journal of Computers 2009; 4: 1243-8. [CrossRef]
27. Lurie KG. Mechanical devices for cardiopulmonary resuscitation: an update. Emerg Med Clin N Am 2002; 20: 771-84. [CrossRef]
28. Perkins GD, Brace S, Gates S. Mechanical chest-compression devices: current and future roles. Curr Opin Crit Care 2010; 16: 203-10. [CrossRef]
29. Halperin H, Carver DJ. Mechanical CPR devices. SIGNA VITAE 2010; 5: 69-73.
30. Ong ME, Fook-Chong S, Annathurai A, Hu Ang S, Tiah L, Yong KL, et al. Improved neurologically intact survival with the use of an automated, load-distributing band chest compression device for cardiac arrest presenting to the emergency department. Crit Care 2012; 16: 14-21.
31. Eroğlu SE. Türkiye'de satışa sunulan göğüs kompresyon cihazları: Autopulse. Available at: http://www.acilci.net/eroglu-turkiyede-satisa-sunulan-gogus-kompresyon-cihazlari- Autopulse. Erişim tarihi: 10 Ağustos 2013.
32. Ong ME, Ornato JP, Edwards DP, Dhindsa HS, Best AM, Ines CS, et al. Use of an automated, load-distributing band chest compression device for out-of-hospital cardiac arrest resuscitation. JAMA 2006; 295: 2629-37. [CrossRef]
33. Haydin S, Ündar A. Yaşam destek sistemlerinin Dünya'daki gelişmeleri ve Türkiye'deki son durum. Anadolu Kardiyol Derg 2013; 13: 580-8.
34. Lurie KG, Lindo C, Chin J. CPR: the P stands for plumber's helper. JAMA 1990; 264: 1661. [CrossRef]
35. Altman LK. Toilet Plunger Is the Model For Device to Restart Hearts. The New York Times. Published: June 3, 1992.
36. Steen S, Liao Q, Pierre L, Paskevicius A, Sjoberg T. Evaluation of LUCAS, a new device for automatic mechanical compression and active decompression resuscitation. Resuscitation 2002; 55: 285-99. [CrossRef]
37. Eroğlu SE. Türkiye'de satışa sunulan göğüs kompresyon cihazları: LUCAS-2. Available at: http://www.acilci.net/eroglu-turkiyede-satisa-sunulan-gogus-kompresyon-cihazlari-LUCAS-2. Erişim tarihi: 16 Ağustos 2013.
38. Ju H. Technology Brief Update: Mechanical chest compression devices for patients experiencing cardiac arrest. HealthPACT. Available at: https://www.health.qld.gov.au/healthpact/docs/updates/WP153_update.pdf. May 2013.
39. Smekal D. Safety with mechanical chest Compressions in CPR; clinical studies with the LUCAS™ device. Available at: http://www.diva-portal.org/smash/get/diva2:639365/FULLTEXT01.pdf. 2013
40. Cohen TJ, Goldner BG, Maccaro PC, Ardito AP, Trazzera S, Cohen MB, et al. A comparison of active compression-decompression cardiopulmonary resuscitation with standard cardiopulmonary resuscitation for cardiac arrests occurring in the hospital. N Engl J Med 1993; 329: 1918-21. [CrossRef]

41. Hwang SO, Lee KH, Lee JW, Lee SY, Yoo BS, Yoon J, et al. Simultaneous sterno-thoracic cardiopulmonary resuscitation improves short-term survival rate in canine cardiac arrests. Resuscitation 2002; 53: 209-16. [CrossRef]
42. Cha KC, Kim H, Lee DG, Cha YS, Kim OH, Kim TH, et al. Hemodynamic effects of an automatic simultaneous sternothoracic CPR device in patients with cardiac arrest. Circulation 2014; 130: A108.
43. Yang Z, Gong P, Wu X, Qian J, Zhao S, Duggal N, et al. Similar hemodynamic efficacy between 30 mm and 50 mm compression depth during mechanical chest compression with weil mini chest compressor. Circulation 2014; 130: A306.
44. Chen W, Yinlun W, Xiaobo W, Shijie S, Joe B. The effects of a newly developed miniaturized mechanical chest compressor on outcomes of cardiopulmonary resuscitation in a porcine model. Crit Care Med 2012; 40: 3007-12. [CrossRef]
45. Lurie KG, Voelckel WG, Zielinski T, Mc Knite S, Lindstrom P, Colleen P, et al. Improving standard cardiopulmonary resuscitation with an inspiratory impedance threshold valve in a porcine model of cardiac arrest. Anesth Analg 2001; 93: 649-55. [CrossRef]
46. Thayne RC, Thomasa DC, Neville JD, Van Dellen A. Use of an impedance threshold device improves short-term outcomes following out-of-hospital cardiac arrest. Resuscitation 2005; 67: 103-8. [CrossRef]
47. Frascone RJ, Wayneb MA, Sworc RA, Mahoneyd BD, Domeiere RM, Olinger ML, et al. Treatment of non-traumatic out-of-hospital cardiac arrest with active compression decompression cardiopulmonary resuscitation plus an impedance threshold device. Resuscitation 2013; 84: 1214-22. [CrossRef]
48. Arntz HR, Agrawal R, Richter H, Schmidt S, Rescheleit T, Menges M, et al. Phased chest and abdominal compression-decompression versus conventional cardiopulmonary resuscitation in out-of-hospital cardiac arrest. Circulation 2001; 104: 768-72. [CrossRef]
49. Havel C, Berzlanovich A, Sterz F, Domanovits H, Herkner H, Zeiner A, et al. Safety, feasibility, and hemodynamic and blood flow effects of active compression-decompression of thorax and abdomen in patients with cardiac arrest. Crit Care Med 2008; 36: 1832-37. [CrossRef]
50. Kern KB, Hilwig RW, Berg RA, Schock RB, Ewy GA. Optimizing ventilation in conjunction with phased chest and abdominal compression–decompression (Lifestick™) resuscitation. Resuscitation 2002; 52: 91-100. [CrossRef]
51. Luo J, Zeng H. Modeling and Simulation of Hemodynamic effects during different cardiopulmonary resuscitation (CPR) technologies. PeerJ PrePrints. Available at: http://dx.doi.org/10.7287/peerj.preprints.334v1. 31 Mar 2014.
52. Yannopoulos D, Halperin HR, Hopkins J. Lower extremity counterpulsation during the decompression phase of CPR improves hemodynamics and provides continuous forward carotid blood flow. Circulation 2007; 116: II-485.
53. Liao Q, Sjöberg T, Paskevicius A, Wohlfart B, Steen S. Manual versus mechanical cardiopulmonary resuscitation. An experimental study in pigs. BMC Cardiovasc Disord 2010; 10: 2-8. [CrossRef]
54. Larsen AI, Hjornevik AS, Ellingsen CL, Dennis WT. Cardiac arrest with continuous mechanical chest compression during percutaneous coronary intervention. A report on the use of the LUCAS device. Resuscitation 2007; 75: 454-9. [CrossRef]
55. Bonnemeier H, Olivecron G, Simonis G, Götberg M, Weitz G, Iblher P, et al. Automated continuous chest compression for in-hospital cardiopulmonary resuscitation of patients with pulseless electrical activity: A report of five cases. Int J Cardiol 2009; 136: 39-50. [CrossRef]
56. Bonnemeier H, Simonis G, Olivecron G. Continuous mechanical chest compression during in hospital cardiopulmonary resuscitation of patients with pulseless electrical activity. Resuscitation 2011; 82: 155-9. [CrossRef]
57. Wagner H, Terkelsen CJ, Friberg H, Harnek J, Kern K. Cardiac arrest in the catheterisation laboratory: a 5-year experience of using mechanical chest compressions to facilitate PCI during prolonged resuscitation efforts. Resuscitation 2010; 81: 383-7. [CrossRef]
58. Fidler R, Hirsch J, Strechert M, Johnson M. Three modes of cardiac compressions in a single patient: A comparison of usual manual compressions, automated compressions, and open cardiac massage. Resuscitation 2014; 85: 75-6. [CrossRef]
59. Rodríguez AM, Ferrara LP, Pascuala JMN, Alonsoa CB, Maldonadoa ME, Belmonte AA, et al. Kidney transplant function using organs from non-heart-beating donors maintained by mechanical chest compressions. Resuscitation 2010; 81: 904-7. [CrossRef]
60. Axelsson C, Nestin J, Svensson L, Axelsson AB, Herlitz J. Clinical consequences of the introduction of mechanical chest compression in the EMS system for treatment of out-of-hospital cardiac arrest- A pilot study. Resuscitation 2006; 71: 47-55. [CrossRef]
61. Smekal D, Johansson J, Huzevka T, Rubertsson S. A. Pilot study of mechanical chest compressions with the LUCAS™ device in cardiopulmonary resuscitation. Resuscitation 2011; 82: 702-6. [CrossRef]
62. Axelsson C, Karlsson T, Axelsson AB, Herlitzb J. Mechanical active compression decompression cardiopulmonary resuscitation (ACD-CPR) versus manual CPR according to pressure of end tidal carbon dioxide (PETCO2) during CPR in out-of-hospital cardiac arrest (OHCA). Resuscitation 2009; 80: 1099-103. [CrossRef]
63. Rubertsson S, Lindgren E, Smekal D, Östlund O, Silfverstolpe J, Lichtveld RA, et al. Mechanical chest compressions and simultaneous defibrillation vs conventional cardiopulmonary resuscitation in out-of-hospital cardiac arrest: the LINC randomized trial. JAMA 2014; 311: 53-61. [CrossRef]
64. Perkins GD, Lall R, Quinn T, Deakin CD, Cooke MW, Horton J, et al. Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomized controlled trial. Lancet 2015; 385: 947-55. [CrossRef]
65. Blomberg H, Gedeborg R, Berglund L, Karlsten R, Johansson J. Poor chest compression quality with mechanical compressions in simulated cardiopulmonary resuscitation: A randomized, cross-over manikin study. Resuscitation 2011; 82: 1332-7. [CrossRef]
66. Timerman S, Cardoso LF, Ramires JA, Halperin H. Improved hemodynamic performance with a novel chest compression device during treatment of in-hospital cardiac arrest. Resuscitation 2004; 61: 273-80. [CrossRef]
67. Casner M, Andersen D, Isaacs SM. The impact of a new CPR device on rate of spontaneous circulation in out-of-hospital cardiac arrest. Prehosp Emerg Care 2005; 9: 61-7. [CrossRef]
68. Hallstrom A, Rea TD, Sayre MR, Christenson J, Anton AR. Manual chest compression vs use of an automated chest compression device during resuscitation following out-of-hospital cardiac arrest: a randomized trial. JAMA 2006; 295: 2620-8. [CrossRef]
69. Krep H, Mamier M, Breil M, Heister U, Fischer M, Hoeft A, et al. Out-of-hospital cardiopulmonary resuscitation with the AutoPulseTM system: A prospective observational study with a new load-distributing band chest compression device. Resuscitation 2007; 73: 86-95. [CrossRef]
70. Duchateau FX, Gueye P, Curac S, Tubach F, Broche C, Plaisance P, et al. Effect of the AutoPulse™ automated band chest compression device on hemodynamics in out-of-hospital cardiac arrest resuscitation. Intensive Care Med 2010; 36: 1256-60. [CrossRef]
71. Wik L, Olsen JA, Presse D, Sterz F, Lozano M, Brouwer MA, et al. Manual vs. integrated automatic load-distributing band CPR with equal survival after out of hospital cardiac arrest. The randomized CIRC trial. Resuscitation 2014; 85: 741-8. [CrossRef]
72. Plaisance P, Lurie KG, Vicaut E, Martin D, Gueugniaud PY, Petit JL, et al. Evaluation of an impedance threshold device in patients receiving active compression decompression cardiopulmonary resuscitation for out of hospital cardiac arrest. Resuscitation 2004; 61: 265. [CrossRef]
73. Wolcke BB, Mauer DK, Schoefmann MF, Teichmann H, Provo TA, Lindner KH, et al. Comparison of standard cardiopulmonary resuscitation versus the combination of active compression-decompression cardiopulmonary resuscitation and an inspiratory impedance threshold device for out-of-hospital cardiac arrest. Circulation 2003; 108: 2201-5. [CrossRef]
74. Brooks SC, Anderson ML, Bruder E, Daya MR, Gaffney A, Otto CW, et al. 2015 American Heart Association Guidelines Update for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care: Part 6: Alternative Techniques and Ancillary Devices for Cardiopulmonary Resuscitation. Circulation 2015; 132: 436-43.[CrossRef]

Evaluation of Gastrointestinal System Findings in Crimean-Congo Hemorrhagic Fever Patients

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Abstract

Aim: Crimean-Congo hemorrhagic fever (CCHF) is a disease caused by a virus. Early diagnosis of CCHF particularly in regions where the disease frequently occurs is important for taking necessary measures and for immediately starting the treatment process. This study aims to evaluate gastrointestinal system (GIS) findings in the patients.

Materials and Methods: Patient history, such as nausea, vomiting, abdominal pain, diarrhea, values of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) levels, and contact with tick, was recorded. Enzyme-linked immunosorbent assay and/or Polymerase Chain Reaction tests were used for diagnoses.

Results: The ratio of tick bite history was found to be 73.1%. According to the GIS findings of the patients at the time of admission, the ratio of nausea and vomiting, abdominal pain, diarrhea, and elevated AST and ALT levels were 61.2%, 37.6%, 27.9%, and 78.4% respectively. Five of the 93 patients died, and the mortality rate was 5.4%.

Conclusion: Considering that early diagnosis is vital for the clinical course of the patients and the prevention of hospital infections and that every patient may not have a history of tick bite, it should be kept in mind that the disease can occur particularly with GIS findings in high season living in endemic regions and thus CCHF should be suspected. *(Eurasian J Emerg Med 2016; 15: 105-7)*

Keywords: Crimean-Congo Hemorrhagic Fever, gastrointestinal findings, tick, viral hemorrhagic fever

Introduction

Crimean-Congo hemorrhagic fever (CCHF) is a disease caused by a virus of the Bunyaviridea family and has been reported in Asia, Africa, the Middle East, and Eastern European regions, as well as has been observed in Turkey since 2002. Early diagnosis of the disease, particularly in regions where it frequently occurs, is important for taking isolation measures and for immediately starting the treatment process (1).

The infection can be transmitted by contact with a CCHF-infected person, infected ticks, and farm animals. It clinically presents with a dramatic progress characterized by diffused hemorrhages, weakness, and fever. Liver enzymes, creatinine phosphokinase, and lactate dehydrogenase levels of these patients are elevated, and an endothelium infection plays a profound pathogenic role (2).

Crimean-Congo hemorrhagic fever, which is transmitted by ticks, is noteworthy because of its increasing prevalence and resulting mortality, particularly in recent years. Early diagnosis is important for a better clinical course of the patient and for the prevention of hospital infections. Management of patients is based on supportive care (3, 4).

Laboratory diagnosis of CCHF is made by identifying viral nucleic acids using a real-time reverse transcriptase polymerase chain reaction (PCR) or by identifying IgM positive or IgG seroconversion using enzyme-linked immunosorbent assay (ELISA) in blood or body fluid samples (5).

The symptoms occur because of the direct effect of the virus on target organs. Immunohistochemical analyses have shown the presence of intense antigens in the endothelium and liver. Symptoms in the early period of the disease are non-specific and can be confused with various manifestations. Nausea, vomiting, abdominal pain, and short-term diarrhea can occur in the early stage of the disease. Hypovolemia, hypoxia, and shock can develop in patients who have simultaneous hemorrhage from various regions, particularly in the gastrointestinal system (GIS) (6). In this study, we aimed to evaluate GIS findings in CCHF patients at the time of admission to the hospital.

Materials and Methods

We retrospectively evaluated 93 patients in our city who were diagnosed with CCHF in the period from January 2011 to April 2014, using

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computer records of the patients. Patients' history of nausea, vomiting, abdominal pain, diarrhea, aspartate aminotransferase (AST), alanine aminotransferase (ALT) elevation levels, and contact with ticks were recorded from the national case report form of CCHF. Because the patients' data were obtained from the National CCHF form, numerical data could not be obtained; GIS findings of the patients in this system are not reported in numerical values but instead are recorded as "yes/no."

ELISA and/or PCR tests were performed to diagnose the patients from blood samples analyzed by a reference laboratory. ELISA was used to determine CCHF virus Immunoglobulin IgM antibody positivity and Real-Time PCR was used to determine the presence of CCHF viral RNA. Data were analyzed using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) version 15. Results were reported as a numerical value, percentage, and mean.

Results

The study included a total of 93 patients with CCHF in the emergency department of our hospital, which serves 678.598 patients annually. The demographic characteristics of the patients were as follows: 50 were men and 43 were women; mean age was 44.8±10.8 years. The proportion of patients with tick bite history was 73.1%. According to the GIS findings of the patients at the time of admission, 61.2% had nausea and vomiting, 37.6% had abdominal pain, 27.9% had diarrhea, and 78.4% had elevated AST and ALT levels. Five of the 93 patients with CCHF died, and the mortality rate was 5.4% (Table 1).

Discussion

Crimean-Congo hemorrhagic fever disease is characterized by signs and symptoms like fever, nausea, vomiting, headache, myalgia, elevated liver enzymes, and mucocutaneous hemorrhage, as well as life-threatening intravenous coagulation and massive hemorrhages (7). GIS findings of CCHF patients from some previous studies are presented for comparison in Table 2 (8-19, 21, 22).

Crimean-Congo hemorrhagic fever is more common in people of the working age dealing with agriculture and animal husbandry who are more exposed to tick bites than other members of the population (4). In our study, 75% of the patients were found to have a history of tick bites. This proportion ranged between 50% and 82% in previous studies (8, 9, 11-16, 18, 19).

In our study, levels of nausea and vomiting rose to 80% and elevated AST and ALT to 100% in patients who died from CCHF. We detected a significantly higher proportion of nausea and vomiting in the deceased patients than in the survivors. Bakir et al. (13) reported significantly higher AST levels in deceased patients in their study. Ergonul et al. (14) observed that the proportions of melena, hematemesis, and nausea and vomiting were 100% in deceased patients. Hatipoglu et

Table 1. Evaluation of GIS findings of the patients with CCHF

	Survivors (n=88)	Death (n=5)	Total (n=93) n (%)
Age mean±SD	41.1±15.7	38.9±15.1	40.8±10.8
Male/Female	47/41	3 / 2	50/43
Tick bite history	63	5	68 (73.1)
Nausea and vomiting	53	4	57 (61.2)
Abdominal pain	33	2	35 (37.6)
Diarrhea	25	1	26 (27.9)
Elevated AST, ALT	68	5	73 (78.4)

GIS: Gastrointestinal System; CCHF: Crimean-Congo Hemorrhagic Fever; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase

Table 2. The percentages of GIS findings of CCHF patients from previous studies

Study	Nausea	Vomiting	Diarrhea	Abdominal Pain	Elevated AST/ALT	Hematemesis	Melena	HM	Number of Cases
Gonen (8)	40	40	20	40	60	6			15
Ozturk et al. (9)	70	45	35	25				5	20
Karti et al. (10)	84	84	37	84				21	19
Ertugrul et al. (11)	69	46	35	42	77				25
Cevik et al. (12)	51	51	20			13	17	19	69
Bakir et al. (13)	75	68	33			8	1	30	92
Ergonul et al. (14)	83	83	35			31	20	35	54
Ergonul et al. (16)	80	80	31			29	17	37	35
Belet et al. (17)	39	59	22	22	61/29				54
Tuygun et al. (18)	60	60							50
Yilmaz et al. (19)	65	43	25	33	86				1820
Schwarz et al. (21)	64		46						11
Kadanali et al. (22)	60	48	19					20	63
Present study	61.2	61.2	27.9	37.6	78.4				93

HM: Hepatosplenomegaly; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase

al. (20) reported that the proportion of diarrhea and ALT and AST values of the deceased patients were higher than of those who survived. Kadanali et al. (22) similarly found a vomiting proportion of 100% and found that AST and ALT levels were higher in the deceased patients than in those who survived.

A literature review from Turkey revealed a CCHF patient who was admitted to the hospital with a clinical presentation mimicking acute appendicitis, another patient who was admitted with abdominal pain and hematemesis, and another one who was admitted because of elevated transaminase (23, 24). Similarly, the literature contains a case presentation involving a patient who was admitted to hospital because of abdominal pain and died within 24 h (25). In a study carried out in India, it was reported that two patients were admitted to the hospital for abdominal pain and vomiting (26). The proportion of abdominal pain was 37.6% in the patients of the present study.

In a study performed in Turkey that included 42 dyspeptic patients hospitalized because of CCHF, the patients were divided into two groups according to fecal Helicobacter pylori positivity and the clinical and laboratory acuteness criteria of CCHF; the study reported no difference between the two groups in terms of clinical and laboratory criteria (27).

Conclusion

In our study, we observed the GIS findings of CCHF patients as 61.2% of the patients had nausea and vomiting, 37.6% had abdominal pain and 27.9% had diarrhea. Because not all patients had a history of tick bite, it should kept in mind that the disease can occur with GIS findings in the high season, particularly in people living in endemic regions; therefore, CCHF should be suspected.

Ethics Committee Approval: Ethics committee approval is not required because of our study was performed retrospectively.

Informed Consent: Written informed consent is not required because of our study was performed retrospectively.

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References

1. Yilmaz GR, Buzgan T, Cevik MA, Safran A, Uzun R, Cevik MA, et al. The Evaluation of Knowledge of the Health-Care Personnel Regarding Crimean-Congo Haemorrhagic Fever. Flora J 2009; 4: 27-35.
2. Ergonul O. Crimean-Congo haemorrhagic fever. Lancet Infect Dis 2006; 6: 203-14. [CrossRef]
3. Kaygusuz S. Preliminary Study Indicating the Epidemiological Situation of the Ticks in Kırıkkale-Kızılırmak Basın. Kırıkkale Uni J 2008; 10: 1-4.
4. Ergonul O. Crimean-Congo Haemorrhagic Fever. Ankem J 2009; 23: 234-40.
5. Uyar Y, Carhan A, Albayrak N, Altaş AB. Evalution of PCR and ELISA-IgM results in the laboratory diagnosis of Crimean-Congo haemorrhagic fever cases in 2008 in Turkey. Microbiology J 2010; 44: 57-64.
6. Ozkurt Z. Crimean-Congo haemorrhagic fever. Intensive Care J 2007; 7: 85-90.
7. Duru F, Fisgin T. Hematological aspects of Crimean-Congo hemorrhagic fever. Turk J Hematol 2009; 26: 161-6.
8. Gonen I. Clinical and laboratory findings of patients with Crimean-Congo hemorrhagic fever in the emergency department at hospital admission. JMID 2011; 1: 1-4. [CrossRef]
9. Ozturk DB, Kuscu F, Gurbuz Y, Gül S, Tütüncü EE, Şencan İ. Evaulation of 20 CCHF cases during 2006-2007 years. Klimik J 2008; 21: 93-6.
10. Karti SS, Odabasi Z, Korten V, Yilmaz M, Sonmez M, Caylan R, et al. Crimean-Congo hemorrhagic fever in Turkey. Emerg Infect Dis 2004; 10: 1379-84. [CrossRef]
11. Ertugrul B, Uyar Y, Yavas K, et al: An outbreak of Crimean-Congo hemorrhagic fever in western Anatolia, Turkey International Journal of Infectious Diseases 2009;13:431-436.
12. Ertugrul B, Uyar Y, Yavas K, Turan C, Oncu S, Saylak O, et al. Clinical and laboratory features of Crimean-Congo hemorrhagic fever: predictors of fatality. Int J Infect Dis 2008; 12: 374-9. [CrossRef]
13. Bakir M, Ugurlu M, Dokuzoguz B, Bodur H, Tasyaran MA, Vahaboglu H, et al. Crimean-Congo haemorrhagic fever outbreak in Middle Anatolia: a multicentre study of clinical features and outcome measures. J Med Microbiol 2005; 54: 385-9. [CrossRef]
14. Ergonul O, Celikbas A, Baykam N, Eren S, Dokuzoguz B. Analysis of risk-factors among patients with Crimean-Congo haemorrhagic fever virus infection: severity criteria revisited. Clin Microbiol Infect 2006; 12: 551-4. [CrossRef]
15. Midilli K, Gargili A, Ergonul O, Sengöz G, Ozturk R, Bakar M, et al. Imported Crimean-Congo hemorrhagic fever cases in Istanbul. BMC Infect Dis 2007; 7: 54. [CrossRef]
16. Ergönül O, Celikbaş A, Dokuzoguz B, Eren S, Baykam N, Esener H. Characteristics of patients with Crimean-Congo hemorrhagic fever in a recent outbreak in Turkey and impact of oral ribavirin therapy. Clin Infect Dis 2004; 39: 284-7. [CrossRef]
17. Belet N, Top A, Terzi O, Arslan HN, Baysal K, Sensoy G. Evaluation of children with Crimean-Congo hemorrhagic fever in the central Blacksea region. Pediatr Infect Dis J 2014; 33: e194-7.
18. Tuygun N, Tanir G, Caglayik DY, Uyar Y, Korukluoglu G, Cenesiz F. Pediatric cases of Crimean-Congo hemorrhagic fever in Turkey. Pediatr Int 2012; 54: 402-6. [CrossRef]
19. Yilmaz GR, Buzgan T, Irmak H, Safran A, Uzun R, Cevik MA, et al. The epidemiology of Crimean-Congo hemorrhagic fever in Turkey, 2002-2007. Int J Infect Dis 2009; 13: 380-6. [CrossRef]
20. Hatipoglu CA, Bulut C, Yetkin MA, Ertem GT, Erdinc FS, Kilic EK, et al. Evaluation of clinical and laboratory predictors of fatality in patients with Crimean-Congo haemorrhagic fever in a tertiary care hospital in Turkey. Scand J Infect Dis 2010; 42: 516-21. [CrossRef]
21. Schwarz TF, Nsanze H, Ameen AM. Clinical features of Crimean-Congo haemorrhagic fever in the United Arab Emirates. Infection 1997; 25: 364-7. [CrossRef]
22. Kadanali A, Ozden K, Erol S. Crimean-Congo Hemorrhagic Fever Virus Infection: Clinical and Laboratory Observations and Predictors of Fatality. Turkiye Klinikleri J Med Sci 2012; 32: 432-7. [CrossRef]
23. Celikbas A, Ergonul O, Dokuzoguz B, Eren S, Baykam N, Polat-Düzgün A. Crimean-Congo hemorrhagic infeciton simulating ace apendicitis. J Infect 2005; 50: 363-5. [CrossRef]
24. Gonen I, Ermis F. Crimean-Congo hemorrhagic fever presenting with gastrointestinal manifestations: two cases. Turk J Gastroenterol 2014; 25: 120-1. [CrossRef]
25. Saleem J, Usman M, Nadeem A, Sethi SA, Salman M. Crimean-Congo hemorrhagic fever: a first case from Abbottabad, Pakistan. Int J Infect Dis 2009; 13: e121-3.
26. Patel AK, Patel KK, Mehta M, Parikh TM, Toshniwal H, Patel K. First Crimean-Congo hemorrhagic fever outbreak in India. J Assoc Physicians India 2011; 59: 585-9.
27. Dokmetas I, Yonem O, Dokmetas S, Ozdemir L, Kilicli F, Engin A, et al. Effect of H. pyloripresence on the severity of Crimean Congo hemorrhagic fever. Endoscopy J 2014; 22: 11-3.

Postpartum Headache: An Unexpected Manifestation of Posterior Reversible Encephalopathy Syndrome

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Abstract

Postpartum headache is described as complaints of headache and neck or shoulder pain in the first 6 weeks after delivery. The causes of postpartum headache include tension headache/migraine, preeclampsia/eclampsia, spinal headache, and cerebral pathology such as hemorrhage, thrombosis, or vasculopathy. We highlighted a case of a postpartum lady with a history of gestational hypertension who frequently attended out-patient facilities because of recurrent headaches. She had an episode of generalized tonic seizure that warranted visiting an emergency department. The findings of brain radio images were consistent with those of posterior reversible encephalopathy syndrome (PRES). We recommend a high index of suspicion of such a disease when assessing parturient women with recurrent headaches during the initial primary care visit. The clinical features, complications, and radio-imaging characteristics of PRES are presented. *(Eurasian J Emerg Med 2016; 15: 108-10)*

Keywords: Postpartum, headache, PRES

Introduction

Postpartum headache is one of the commonest morbidities experienced by approximately 38–40% of parturient women during puerperium. Most headaches occur during the first week following delivery (1).

The causes of postpartum headache could vary from simple primary causes of headache such as tension headache to lactation headache to the more serious secondary causes with intracranial pathologies (2).

Posterior reversible encephalopathy syndrome (PRES) is an infrequent diagnosis in day-to-day obstetric care, but it is known to be part of a spectrum of conditions associated with eclampsia (3). Early recognition and early aggressive treatment may prevent seizures and irreversible cognitive impairment.

The main purpose of highlighting this case is to increase awareness among primary care physicians regarding PRES and its specific management when managing patients with postpartum headache.

Case Presentation

A 26-year-old female, para 1, post her cesarean section delivery frequently visited the clinic because of recurrent episodes of dull aching headaches that were associated with photophobia. Headache intensity was attenuated by movement and relieved by taking paracetamol and resting. She denied blurring of vision or weakness in the limbs, and there was no associated nausea, vomiting, and epigastric pain. Furthermore, there was no history of a fall to suggest trauma, no syncope or other cardiovascular symptoms, and no fever to suggest an infectious etiology. She was on metoprolol 50 mg twice daily for her gestational hypertension.

On day 6 postpartum, she had recurrent episodes of generalized tonic seizure with postictal drowsiness. There was no jerky movement of the limbs or urinary incontinence.

She was referred to the emergency department for stabilization and further management. On arrival, her GCS, BP, and HR were 15, 145/98 mmHg, and 104 beats per minute, respectively. A clinical examination revealed no abnormalities. She had moderate protein-

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uria and an elevated blood sugar level of 7.2 mmol/L. Non-contrast computed tomography of the brain revealed the presence of white matter edema at the occipital and posterior parietal areas (Figure 1), which was suggestive of PRES. Subsequently, she underwent magnetic resonance imaging with findings of an abnormal signal intensity of white matter involving both parieto-occipital regions that appear iso-intense to gray matter on T1, hyper-intense on T2, and not suppressed on FLAIR, which confirmed the diagnosis (Figure 2).

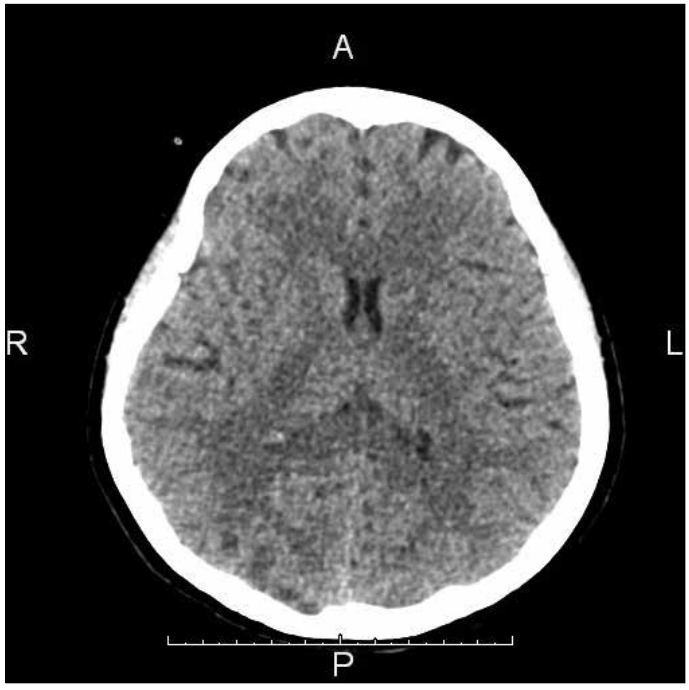

Figure 1. CT scan brain showing the parieto-occipital white matter edema

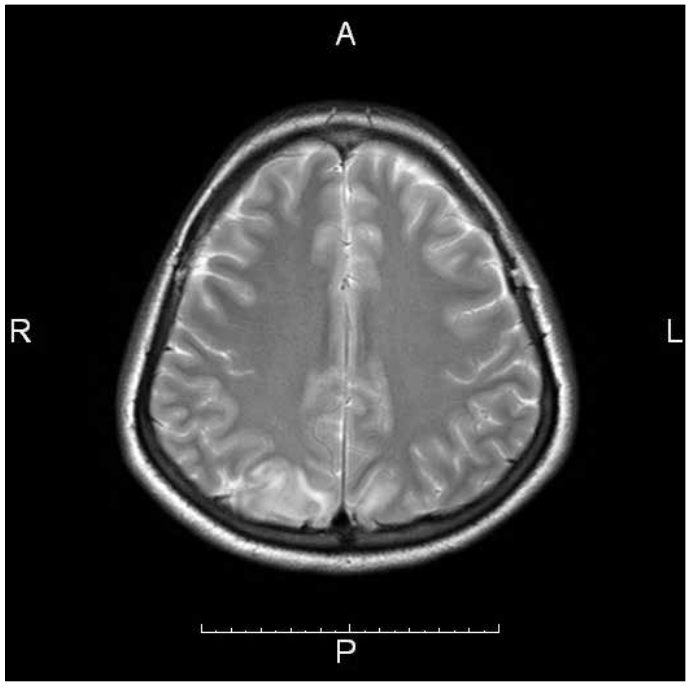

Figure 2. MRI of the brain showing an abnormal signal intensity of white matter involving both parietal-occipital regions that appear hyper-intense

She was started on an intravenous infusion of 4 g of magnesium sulfate. The dose of oral metoprolol was stepped up to 100 mg twice daily. She was seizure-free afterward, and her blood pressure was within the normal range. Her higher mental functions were normal, and there was no neurological deficit. She was discharged on the fifth day after admission. She was completely healthy during a recent gynecological follow-up.

Discussion

Postpartum headache is a very common complaint in the primary care setting, and its causes could be benign or life threatening. The practicing physician should be aware of the various diagnostic and management modalities of this complaint. The mean onset of headache was 3.4 days (ranging from 2 to 32 days) after delivery. Tension headache/migraine headache was the most common cause (47%) (4). However, other dangerous causes should be ruled out first.

PRES was quite recently recognized as a neuroradiological disorder. It is an infrequent diagnosis in day-to-day obstetric care, but it is known to be a part of a spectrum of conditions associated with eclampsia/preeclampsia (3). Apart from that, other risk factors for PRES include a history of malignant hypertension, fluid overload, sepsis, organ transplant recipients, renal failure, surgical patients, and malignancy with cytotoxic chemotherapy (5, 6). PRES is less common in people who live with chronic hypertension because they have adapted to the elevation in their blood pressure over time (6). PRES is characterized by headache, altered mental status, cortical blindness, and seizures. Persistent headaches lasting for more than 24 h after delivery warrant a re-evaluation of diagnosis. The cardinal systemic sign of PRES is an acute rise in the diastolic blood pressure, which can occur 24 h or more before other symptoms appear. In a limited primary care setting, any postpartum headache should be considered at risk; hence, further blood pressure monitoring and urine protein screening are considered to be mandatory. At this point, the assessment of airway, breathing, and circulation should have been performed with the availability of a good intravenous access. The next important step is the anticipation and management of potential catastrophic complications i.e., uncontrollable seizures and neurologic sequelae.

Although the name suggests that it is usually reversible, early diagnosis and treatment are essential because irreversible neurologic deficits or death may occur (3). Treatment involves lowering the mean arterial blood pressure to below 125 mmHg and anticonvulsant therapy. The primary treatment for PRES is the appropriate pharmacological intervention for blood pressure control (mean arterial blood pressure should be less than 125 mmHg). Nicardipine and labetalol are the hypertensive drugs of choice. Nitroglycerine should be avoided because its vasodilator effects may attenuate cerebral edema (7). Other medications include analgesics for headaches and anticonvulsants for seizure prevention and treatment. For non-pregnant patients experiencing seizure, benzodiazepines (such as lorazepam or diazepam) are considered as first-line drugs, and they provide rapid onset and therapeutic benefits (8). Magnesium sulfate is considered to be the drug of choice for seizures in pregnancy (9). Uncontrollable seizure activity may require a higher level of care, intensive care monitoring, and support (8).

While not readily available to the primary physician, it is interesting to note that radio imaging characteristic of PRES is patchy white matter edema (6). The typical lesions are located in the pari-

eto-occipital and posterior, frontal, cortical, and subcortical white matter, although the brain stem, basal ganglia, and cerebellum are less commonly involved (10). The mechanism of PRES is not yet clear. PRES may be associated with a failure in cerebral blood flow autoregulation combined with endothelial dysfunction (5). In this case, there is a possibility that the sudden rise in blood pressure disrupted the cerebral artery autoregulation; hence, there was a loss of cerebral blood flow control. Dilated arterioles may allow hyper perfusion, causing a breakdown in the blood–brain barrier (5).

Conclusion

Though headaches in the postpartum period are usually benign, a high index of suspicion for dangerous causes of headache is considered necessary, particularly when the headache is severe, persistent, or associated with high blood pressure. Postpartum headache is one of the manifestations of PRES. Failure to recognize and institute appropriate management may lead to unwanted complications such as an unnecessary increase in maternal morbidity and mortality rates.

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References

1. Pandya S. Postpartum headache: mandates correct clinical diagnosis and right intervention. JOACC 2011; 1: 55-6. [CrossRef]
2. Klein AM, Loder E. Postpartum headache. Int J Obstet Anesth 2010; 19: 422-30. [CrossRef]
3. Parisaei M, Derwig I, Yoon J, Erskine KJ, Jarman PR. Posterior reversible leukoencephalopathy in a case of postpartum eclampsia. Am J Obstet Gynecol 2005; 193: 885-6. [CrossRef]
4. Stella CL, Jodicke CD, How HY, Harkness UF, Sibai BM. Postpartum headache: is your work-up complete? Am J Obstet Gynecol 2007; 196: 318. e1-7.
5. Vaughn C, Zhang L, Schiff D. Reversible posterior leukoencephalopathy syndrome in cancer. Curr Oncol Rep 2008; 10: 86-91. [CrossRef]
6. O'Hara McCoy H. Posterior reversible encephalopathy syndrome: an emerging clinical entity in adult, pediatric, and obstetric critical care. J Am Acad Nurse Pract 2008; 20: 100-6. [CrossRef]
7. Hinchey J, Chaves C, Appignani B, Breen J, Pao L, Wang A, et al. A reversible posterior leukoencephalopathy syndrome. N Engl J Med 1996; 334: 494-500. [CrossRef]
8. Servillo G, Striano P, Striano S, Tortora F, Boccella P, De Robertis E, et al. Posterior reversible encephalopathy syndrome (PRES) in critically ill obstetric patients. Intensive Care Med 2003; 29: 2323-6. [CrossRef]
9. Duley L, Henderson-Smart DJ, Walker GJ, Chou D. Magnesium sulphate versus diazepam for eclampsia. Cochrane Database Syst Rev 2010; CD000127.
10. Casey SO, Sampaio RC, Michel E, Truwit CL. Posterior reversible encephalopathy syndrome: utility of fluid-attenuated inversion recovery MR imaging in the detection of cortical and subcortical lesions. AJNR Am J Neuroradiol 2000; 21: 1199-206.

EURASIAN JOURNAL OF EMERGENCY MEDICINE

Epinephrine: Medication Error

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Abstract

Epinephrine plays an integral role in the treatment of several life treating diseases. It can be administered at different doses and through different routes of administration. Nebulized L-epinephrine has been described as a safe treatment method. There is a significant difference in doses between nebulization and parenteral administration of epinephrine. Medication errors can result in death due to the use of high-dose epinephrine with parenteral administration. Here we report a child patient who was accidentally exposed to an approximately 30-fold higher dose of intravenous epinephrine. However, the patient did not develop permanent damage. Medication errors are common in pediatric inpatients, and efforts to reduce them are needed.
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Keywords: Child, epinephrine, medication error

Introduction

Epinephrine is the main sympathomimetic agent released by the adrenal gland. It plays an integral role in the treatment of several life treating diseases such as cardiac arrest, severe bradycardia, acute hypotension, bronchospasm, and anaphylaxis in the emergency department. It can be administered at different doses and through different routes of administration such as intravenous injection or infusion, umbilical artery or vein injections, endotracheal, intramuscular, local injection or nebulization (1).

A medication error can be defined as a failure in the treatment process that leads to or has the potential to lead to harm a patient. Here we report a child patient who was accidentally exposed to an excessive dose of intravenous epinephrine.

Case Presentation

An 8-month-old male patient was admitted to the Pediatric Emergency Department of our hospital with fever and respiratory distress because of a possible bronchiolitis. On initial physical examination, his respiratory rate was 60/min and oxygen saturation was 88% at room air. He had intercostal retractions and long expiration. Other systemic examinations revealed nothing unusual. His weight was 10 kg. Firstly, he was treated with oxygen, hydration and short acting beta-2 agonist inhalation. On follow up, because the patient did not show gradual recovery, nebulized epinephrine was administered. Nebulized epinephrine treatment was calculated with 5 mg 1:1000 (1 mg/mL) epinephrine. The nurse by mistakenly administered epinephrine through the peripheral intravenous route instead by nebulization as ordered. While receiving epinephrine treatment, patient developed paleness, sweating, tremor, and hypotonia. Epinephrine treatment was stopped immediately after 3 mg (0.3 mg/kg) intravenous epinephrine administration. Patient was followed up using a cardiac monitor. A normal sinus rhythm changed to sinus tachycardia at 180–200 beats per minute and urine output decreased (Figure 1). Vital signs were normal except for tachycardia. Symptoms lasted for approximately 2 h with supported treatment. During follow up, no additional problems were observed. No changes in laboratory test results were observed. The patient needed hospitalization only for acute bronchiolitis. He was followed up for 3 days and discharged without any complication.

Discussion

Medication errors are the most common type of medical errors to affect children. One of the particularly challenging factors involv-

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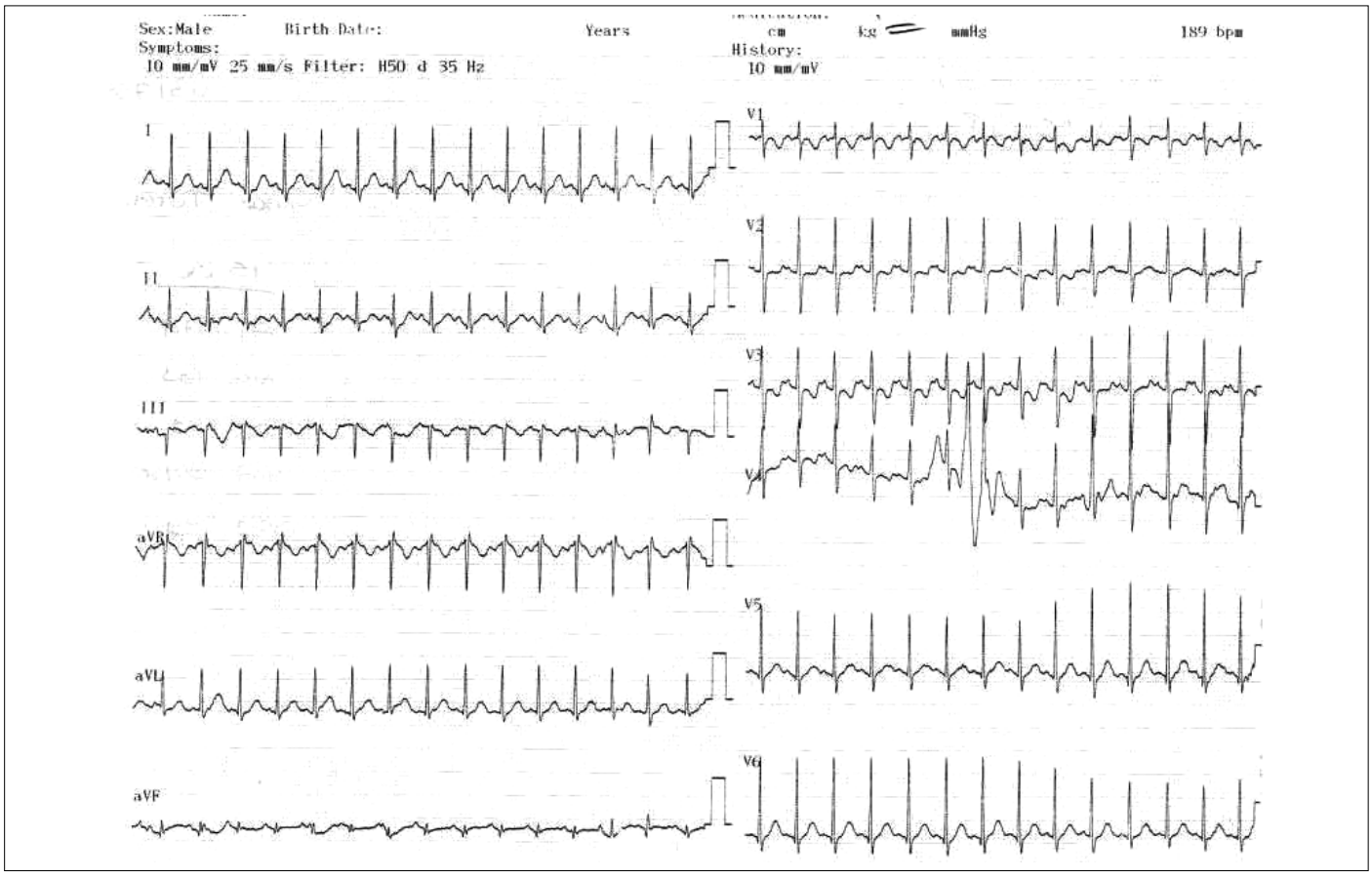

Figure 1. The patient's electrocardiography

ing children is the variation in their size. Errors may occur due to the chaotic and hurried pace in an emergency department (2). Epinephrine remains one of the most important drugs used in emergency care. Although it is used with relative frequency, it continues to be a potential source of harm in many emergency departments (3). Emergency department nurses are at the front line of preventing medication errors in pediatric patients. The academic pediatric community is a critical constituency involved in efforts to improve safe usage and minimize preventable harm from medicines (4).

Epinephrine, with its combined alpha and beta receptor agonist activity, is suggested to be an ideal bronchodilator (5). Nebulized L-epinephrine has been described as a safe treatment method. Patients treated with nebulized epinephrine show only mild side effects such as pallor, debility, tremor, muscle weakness, and early fatigue that regress with supported treatment (6). There is a significant difference in doses between nebulization and parenteral administration of epinephrine. An epinephrine dose of 0.5 mg/kg is used during nebulization and 0.01 mg/kg during parenteral administration. The nebulized dose is nearly 50-fold higher than the parenteral dose.

Medication errors can result in death due to the use of high epinephrine doses during parenteral administration. Cohen reported a 7-year-old patient who received a massive overdose of epinephrine (30 mg) intravenously and died the following day (7). A 3-year-old toddler developed multifocal atrial tachycardia following an iatrogenic overdose of epinephrine that was accidentally administered intravenously. His electrocardiogram showed a wandering atrial pacemaker that persisted for at least 1 year (8). In another patient, epinephrine developed severe cardiovascular reactions after 5 mg of intravenous administration. A 12 lead electrocardiogram and neurological examination in the recovery room did not disclose any residual defects (9). Fang et al. reported a 4-day-old newborn who was inadvertently administered a dose of epinephrine that was 100-fold higher than the usual dose; she developed hypokalemia and rhabdomyolysis. No obvious long-term sequelae were observed (10). In our patient, the application of an epinephrine dose was approximately 30-fold higher than the required dose. Epinephrine plasma half-life was very short (1–2 min). Fortunately, our patient did not develop any permanent damage.

Conclusion

Epinephrine errors cause by confusion over dose concentrations or routes of administration continue to be a concern in emergency departments. Immediate steps need to be taken to identify the risk and rectify the potential cause of error by providing clear directions to the staff regarding the doses and routes of epinephrine administration. In conclusion, medication errors are common in pediatric inpatients, and efforts to reduce them are required.

Informed Consent: Written informed consent was obtained from the patient's parents.

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References

1. Akça H, Tuygun N, Karacan CD. Nebulized Epinephrine Treatment in Pediatric Emergency Medicine. Pediat Therapeut 2014; 4: 210.
2. Cadwell SM. Pediatric medication safety in the emergency department. J Emerg Nurs 2008; 34: 375-7. [CrossRef]
3. Paparella SF. EPINEPHrine: a potpourri of potential medication safety risks. J Emerg Nurs 2013; 39: 151-3. [CrossRef]
4. Shone LP, Yin HS, Wolf MS. Medicine safety among children and adolescents. Acad Pediatr 2010; 10: 218-9. [CrossRef]
5. Simsek-Kiper PO, Kiper N, Hascelik G, Dolgun A, Yalçin E, Doğru Ersöz D, et al. Emergency room management of acute bronchiolitis: a randomized trial of nebulized epinephrine. Turk J Pediatr 2011; 53: 651-60.
6. Zhang L, Sanguebsche LS. The safety of nebulization with 3 to 5 ml of adrenaline (1:1000) in children: an evidence based review. J Pediatr (Rio J) 2005; 81: 193-7. [CrossRef]
7. Cohen M. Epinephrine. Tragic overdose. Nursing 1996; 26: 13.
8. Aburawi EH, Narchi H, Souid AK. Persistent wandering atrial pacemaker after epinephrine overdosing - a case report. BMC Pediatr 2013; 13: 1. [CrossRef]
9. Campbell RL. Cardiovascular effects of epinephrine overdose: case report. Anesth Prog 1977; 24: 190-3.
10. Fang W, Chen JY, Fang Y, Huang JL. Epinephrine overdose-associated hypokalemia and rhabdomyolysis in a newborn. Pharmacotherapy 2005; 25: 1266-70. [CrossRef]

Comments on Etomidate Usage in the Emergency Department

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Certainly for emergency medicine specialists, sedative hypnotic agents play an important role during difficult times in their professional life. These molecules are indispensable agents, especially in the emergency department, for the induction of "rapid sequence intubation" performed during unprepared conditions or "procedural sedation and analgesia" for children and adults. Though not a novel drug, etomidate challenges all algorithms prevalent in the field of anesthesia over the last 10 years. I wanted to remind you and share my humble opinions about this agent, which has been subjected to many positive and negative comments.

Etomidate is a preferred induction agent because of its substantially increased lipid solubility for critically ill patients whose blood pressure should be maintained at a stable level. At the beginning, consciousness of the patient is impaired because of a first-pass effect through the brain following its intravenous injection. A single bolus dose induces hypnosis within 10 s and terminates within 3–5 min. It does not have any analgesic effect. It depresses electroencephalography (EEG) activity and cerebral blood pressure similar to the effects of barbiturates. Because it does not affect the mean arterial pressure and decreases intracranial pressure without lowering cerebral perfusion pressure, it is especially useful in hemodynamically instable patients with increased intracranial pressure. Because etomidate is the only intravenous anesthetic agent that does not affect histamine release, it is also safe in patients with a reactive airway. For "rapid sequence intubation" and "procedural sedation and analgesia," its intravenous doses are 0.2–0.4 mg/kg in adults and 0.1–0.2 mg/kg in children. Its effects start at the most within 15 s and end at the most within 15 min.

Its adverse effects are as follows:

- Nausea and vomiting
- Injection side pain: For the treatment of pain along the intravenous route, opening of a large vascular access, saline infusion, and the use of a local analgesic are recommended.
- Myoclonus: This can be seen in one-third of cases and is caused by interruption of the inhibitory synapses on the thalamocortical pathway. The use of opioid analgesics and benzodiazepines as premedication can decrease this side effect. Unfavorable effects of this side effect on patient's clinical status have not been reported so far. However, when it is manifested in cases where it cannot be discriminated from seizure activity, it can lead to the conduction of unnecessary tests and a prolonged stay of the patient in the emergency department.
- Suppression of the adrenocortical hormone: This can emerge as a result of the inhibition of 11-β hydroxylase enzyme. It certainly suppresses adrenocortical hormone synthesis in a dose-dependent manner. A single dose inhibits adrenocortical hormone synthesis for 5 h. Some studies have demonstrated its suppressive effects even after 12 h following its use.

Owing to the abovementioned characteristics, as an induction agent, etomidate essentially resembles propofol and thiopental. Its extremely rapid onset together with short-acting effects decreases intracranial pressure. However, etomidate does not decrease blood pressure or cerebral perfusion pressure while depressing intracranial pressure, which may confer major advantages to etomidate.

Etomidate can also be compared with ketamine. Both of these drugs do not decrease blood pressure, and they can be used in patients with reactive airways. As an important advantage, ketamine also has an analgesic effect. Despite this, ketamine increases endogenous catecholamine sensitivity, which can create problems, especially in adult patients carrying a risk of coronary disease. Besides, as an important difference, ketamine increases intracranial pressure and secretions. Because recovery from ketamine anesthesia in adults is somewhat problematic, it has established its place in daily practice in the pediatric age group. In adults, ketamine has been replaced by an opiod-etomidate combination.

After briefly giving a reminder of the effects of etomidate, let us now discuss the main controversies. Although, etomidate is believed to be mostly beneficial for hemodynamically instable, critically ill patients, for this patient group, including patients with sepsis, the adrenal insufficiency-inducing effects of etomidate could be associ-

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ated with mortality, and this has also been a matter of concern. It has been demonstrated that etomidate administering, even as a single dose or as an infusion, absolutely decreases cortisol levels and suppresses the adrenal system. However, one thing we do not know yet is if this effect is really associated with an increased mortality for relevant patient groups. If the answer to this question is "yes," then the following question is "Is it possible to avoid these adverse effects if corticosteroid replacement is employed after etomidate usage?" To answer these questions, I tried to screen all the meta-analyses and review articles and important clinical trials about etomidate on search motors such as "tripdatabase," "Cochrane," and "pubmed," It was possible to find many papers addressing the first question; however, I could find only one randomized controlled study that dealt with the second question. Following a screening, I will try to summarize the publications that may be most useful for us.

The first systematic analysis on etomidate was first published in the journal of *Critical Care Medicine* in 2012 (1). This meta-analysis included studies using etomidate in patients who had undergone rapid successive intubation in the emergency department with the indication of sepsis. A total of five studies, whose etomidate arm included 865 patients with a primary end point of "mortality," were included in the analysis. Seven studies with a primary end-point of adrenal suppression performed on 1303 patients were analyzed separately. These studies were observational or randomized controlled trials (RCT). The all-cause mortality (n=865) was found to be RR (95% CI) 1.20 (1.02–1.42) in the pooled analysis. The mortality of RCTs (n=759) was only found to be RR (95% CI) 1.26 (1.06–1.50). As can be clearly seen, mortality was found to be statistically significantly higher in the group of patients using etomidate, as demonstrated in all the studies and RCTs. Besides, when evaluated regarding the development of adrenal insufficiency, the possibility of developing adrenal insufficiency was found to be 30% higher in the etomidate group. The pooled RR (95% CI) was found to be 1.33 (1.22–1.46) for all the studies (n=1303) and 1.35 (1.24–1.47) for RCTs only (n=944).

Publication of this study has generated considerably important consequences, and despite it being a meta-analysis with significant heterogeneity performed by a single center, significant limitations have been started to be imposed on the use of this drug. Because this drug has not been used very widely in our country and as it is not easily available, these arguments did not create an agenda in our country, whereas this issue was regarded as a great problem in the international emergency medicine arena, with a critical review published in *The Annals of Emergency Medicine* in 2013. (2). In this critical review, methodologies of the studies were criticized for their especially problematic randomization, blinded design, and follow-up. They argued that only two publications included in the meta-analysis were RCTs, whereas the other three studies had an observational design. More importantly, although in the etomidate group, higher mortality rates of 20% were demonstrated, confidence intervals very close to 1 [RR 1.20 (1.02–1.42)], with a considerably large range emphasized that this statistically significant result did not have a possible clinical significance. In conclusion, as a "take home message," the reviewers stated that the mortality-increasing effects of etomidate in patients with sepsis who required intubation could not be demonstrated. However, more robust randomized studies are needed to arrive at a definitive conclusion.

Another RCT relevant to this subject matter was published in 2014. The reliability of the studies and their outcomes have increased in parallel with the number of RCTs. In this study, adrenal insufficiency was markedly demonstrated in the etomidate group, while a lack of difference between etomidate and other induction agents, such as for the mortality rates, was also indicated. (3).

In 2015, a meta-analysis was published in Cochrane. This meta-analysis included only seven randomized controlled studies. They indicated a low degree of bias in only two of these seven RCTs. As a result of the meta-analysis, a difference between the odds ratios of the group who used etodimate and those of other groups could not be demonstrated (OR 1.17; 95% CI 0.86–1.60). However, adrenal insufficiency within the first 4–6 h was clearly demonstrated (OR 19.98; 95% CI 3.95–101.11). Besides this, adrenal insufficiency demonstrated a statistically significant difference even after 12 h. This meta-analysis indicated that this adrenal insufficiency did not lead to a clinically significant difference in mortality. Moreover, in the same meta-analysis, higher SOFA (Sequential Organ Failure Assessment) scores were reported in the etomidate group [mean difference (MD) 0.70; 95% CI 0.01–1.39]. These results were interpreted as statistically significant, but with clinically insignificant outcomes (4). As was seen, the true difference was very close to "0." Finally, in the same meta-analysis, a difference between the etomidate and other groups, such as for the length of the hospital stay, the day of mechanical ventilation, and the need for vasopressor use, was detected. In the "Comments of The Author" section, the author stated that etomidate did not exert apparently adverse effects on mortality. However, its somewhat lesser effects on the SOFA scores and adrenal insufficiency were reported in this meta-analysis. The authors also emphasized that the adverse effects on SOFA scores might be related to comatose patients, who constituted 42% of the patients included in the meta-analysis.

Most recently, a meta-analysis was published in the *Chest*, which analyzed two RCTs and 16 observational studies. The study mostly consisted of observational studies. However, when all the results of the RCTs (RR, 1.20; 95% CI, 0.84–1.72) and observational studies (RR, 1.05; 95% CI, 0.97–1.13) and both of them in combination (RR 1.05 (95% CI, 0.79-1.39) were analyzed, any increase in mortality rates could not be demonstrated in the etomidate group. However, as seen in other studies and in the meta-analyses, adrenal insufficiency was found to be significant both from a statistical and clinical aspect (5). The investigators who performed the meta-analysis, like the Cochrane investigators, expressed that single doses of etomidate could not be associated with mortality. However, they also reported that this meta-analysis mostly included observational studies, and selection bias is a possibility. They also added that for more definitive results, RCTs with a larger patient population should be conducted. .

In addition, it will be proper to remind that another argument is related to steroid replacement therapy after etomidate use. The most comprehensive randomized study on this issue was published in 2012. In this study, the patients who used etomidate were randomized into two groups, and one group received hydrocortisone infusion for 42 h at a daily dose of 200 mg at 6 h after intubation. The development of adrenal insufficiency, SOFA scores, length of hospital stay, duration of mechanical ventilation, length of hospital stay, and need for vasopressor use were compared between groups who had and who had not received replacement therapy. No intergroup difference was found for any parameter (6). Therefore, currently, steroid replacement therapy has not been recommended in patients using etomidate.

In this final paragraph, I will make comments based on my personal experience and knowledge. However, before I make my

final comment, these comments will be my personal sophisticated interpretation on the drug based on the integration of the review of the literature with an evaluation of the results obtained, and as aforementioned, my experiences. Finally, if a truly common language were to be formulated, it would be a more accurate approach to realize a "national identity of politics" with our research groups and even to share these politics with official organizations and finally to publish these politics for the benefit of the citizens of our country.

- *There is no such a thing as a "good" or a "bad" drug; it is related to our level of knowledge and experience. Only ignorance is the issue.*
- *Etomidate has important advantages at an extremely early onset of its short-acting effects.*
- *As is known, it does not affect hemodynamic data.*
- *If a contraindication for ketamine use is suspected or definitively demonstrated, etomidate can be used in hemodynamically instable* or *critically ill patients.*
- *If critically ill or sepsis patients are hemodynamically stable, then we have no reason to prefer etomidate. Indeed, definitive information about its adrenal insufficiency-inducing effects are available.*
- *Corticosteroid replacement used in patients who received etomidate did not demonstrate positive effects on adrenal insufficiency or hemodynamic data.*

References

1. Chan CM, Mitchell AL, Shorr AF. Etomidate is associated with mortality and adrenal insufficiency in sepsis: a meta-analysis. Crit Care Med 2012; 40: 2945-53. [CrossRef]
2. Hunter BR, Kirschner J. In patients with severe sepsis, does a single dose of etomidate to facilitate intubation increase mortality? Ann Emerg Med 2013; 61: 571-2.
3. Freund Y, Jabre P, Mourad J, Lapostolle F, Reuter PG, Woimant M, et al. Relative adrenal insufficiency in critically ill patient after rapid sequence intubation: KETASED ancillary study. J Crit Care 2014; 29: 386-9. [CrossRef]
4. Bruder EA, Ball IM, Ridi S, Pickett W, Hohl C. Single induction dose of etomidate versus other induction agents for endotracheal intubation in critically ill patients. Cochrane Database Syst Rev 2015; 1: CD010225.
5. Gu WJ, Wang F, Tang L, Liu JC. Single-dose etomidate does not increase mortality in patients with sepsis: a systematic review and meta-analysis of randomized controlled trials and observational studies. Chest 2015; 147: 335-46. [CrossRef]
6. Payen JF, Dupuis C, Trouve-Buisson T, Vinclair M, Broux C, Bouzat P, et al. Corticosteroid after etomidate in critically ill patients: a randomized controlled trial. Crit Care Med 2012; 40: 29-35. [CrossRef]

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In Children with Limb Injury Pain, Shall We Use Intranasal Fentanyl or Ketamine?

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Introduction

Pain relief is an essential component in the management of children presenting to the Emergency Department (ED). However, difficulties in obtaining venous access delay the provision of adequate analgesia (1). The intranasal route is both an effective and an easy way of administering drugs and has provided a well-tolerated alternative to the distress caused by intramuscular and intravenous access, especially in children (2, 3). Intranasal fentanyl has been widely reported to be an effective tool in pediatric pain relief along with other opiates (4). However, ketamine has only recently been described for the provision of analgesia in pediatric emergency settings (5-7).

This study by Graudins et al. was conducted to compare the analgesic effectiveness of intranasal ketamine versus fentanyl in pain reduction among children presenting with isolated limb injuries.

Methods and Design (Figure 1)

- **Population Studied:** The inclusion and exclusion criteria of the study are presented in Tables 1 and 2, respectively.
- **Study Design:** Randomized controlled double-blind intention-to-treat equivalence clinical trial.
- **Intervention:** Intranasal ketamine (1 mg/kg) or intranasal fentanyl (1.5 µg/kg) administered via a mucosal atomization device in a standardized volume of 0.03 mL/kg, with a total maximum volume of 1.5 mL divided equally between both nares.
- **Study Outcomes:** The primary and secondary outcomes of the study are presented in Table 3.

Results

The results of the study are presented in Table 4 and the adverse events in Table 5.

Appraisal: This study was unique in evaluating intranasal ketamine versus intranasal fentanyl in children via a comparative trial format. It was conducted under appropriate concealment and blinding. It provides great insight into the use of intranasal analgesics in the pediatric population because this is still a relatively new aspect of pediatric analgesia and highlights the growing need for effective and fast analgesia with the least amount of discomfort, which is crucial in this population.

In this study, the assessment of pain severity was undertaken via different modalities of pain rating scales using a child's self-reporting of pain, which was shown to be superior to observational assessments in estimating pain severity in young children (8). However, the self-reporting of pain depends on the cognitive ability of children and their understanding that their pain severity can be objectively measured on a scale (9). As is evident in this study, pain rating scales were adequately tailored to pre-specified age groups, with younger children using the Face Pain Scale-Revised (FPS-R) and older children using the Visual Analog Scale (VAS), taking into consideration each age group's cognitive abilities, which confirms the appropriate utilization and strength of the methodology. The authors in this trial used an adequate dose of intranasal fentanyl of 1.5 µg/kg, as the average of 1–2 µg/kg, although some other trials had a higher dosing regimen (10, 11). This dosage was comparable to that in the majority of studies conducted on intranasal fentanyl administered via atomization (4, 12-15).

The study sample size was adequate and similar to those in other trials addressing similar questions (12, 13). The study sample size was sufficient to detect a difference of 20 mm on the VAS, which is a clinically significant difference as determined by Powell et al. (16).

The baseline characteristics were similar across both study groups in terms of age, gender, initial pain rating, and ibuprofen given.

The study authors demonstrated that ketamine achieved comparable pain reduction as fentanyl for acute pain from limb injuries, as shown in Table 4. Despite the novelty and strengths of this study, it has some limitations. Almost 80% of the ketamine group (compared with 40% in the fentanyl group) was reported to experience some form of adverse event (Table 5), which the authors described as mild. However, when looking at the figures, it is evident that intranasal ketamine produces almost twice as much side effects as intranasal fentanyl, which, in our opinion, is significant. Ketamine is known to be a dissociative anesthetic; hence, the fact that more patients (55%) in the ketamine group complained of dizziness compared with (10%) in the fentanyl group is not surprising. Dizziness as an adverse event may increase the risk of falls in children with limb injuries, which may necessitate their observation in the ED until the dizziness

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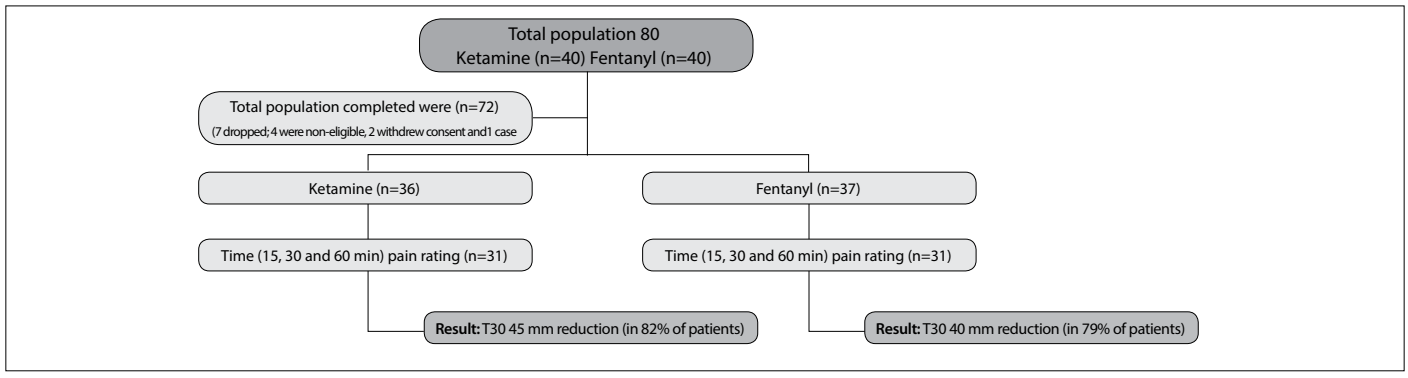

Figure 1. Study methods and design

Table 1. PICHFORK study inclusion criteria

1	Children between the ages of 3 and 13 years, weighing <50 kg
2.	Isolated musculoskeletal limb injuries
3.	Pain ≥6 on an 11-point pain scale [0=none, 10=worst pain] at triage
4.	Consideration of INF as the usual method of analgesia according to hospital guidelines
Study participants must have met all four inclusion criteria	

Table 2. PICHFORK study exclusion criteria

1.	Inability to obtain informed consent from parent or guardian
2.	Treatment with serotonergic antidepressants
3.	Previous administration of parenteral or intranasal analgesics or opioid analgesics
4.	Opioid antagonist use
5.	Allergy to ketamine, fentanyl, or ibuprofen
6.	Aberrant nasal anatomy or acute or chronic nasal problems or nasal trauma that may preclude adequate intranasal delivery
7.	Presence of multiple trauma or head injury with loss of consciousness or cognitive impairment
Study participants were excluded if any of the above criteria were present	

Table 3. Outcomes measured

Primary outcome	
1.	Median reduction in pain rating at 30 min after administration of the study drug
Secondary outcomes	
1.	Reduction in pain rating at 15 min and 60 min
2.	Pain reduction equal to or greater than 20 mm
3.	Subjective improvement and satisfaction
4.	University of Michigan sedation score
5.	Adverse events
6.	Need for and timing of rescue analgesia

Table 4. Primary outcome results

	Fentanyl	**Ketamine**
Median reduction in pain rating 30 min after administration of the study drug	40 mm (20-45)	45 mm (20–60)
Median (interquartile range) mm		
Difference in medians (95% CI) (ketamine to fentanyl)	5 (-10 to 20)	
	Fentanyl	**Ketamine**
Number of subjects achieving a reduction in pain rating of >20 mm at 30 min	27/34 (79%)	28/34 (82%)
Number (Percentage)		
Difference in medians (95% CI) (ketamine to fentanyl)	3 (-16 to 22)	

Table 5. Adverse events

	Fentanyl	**Ketamine**
Adverse events encountered for each group	15/37 (40%)	28/36 (78%)
Number (Percentage)		
Difference in medians (95% CI) (ketamine to fentanyl)	38 (-58 to 16)	

subsides, which may increase the length of stay in the ED (See comment in PubMed Commons below17). Moreover, caring for these patients may require additional personnel with transport, etc., which increases the utilization of resources in the ED.

In the ketamine group 30% complained of drowsiness compared with 13% in the fentanyl group, and 10% complained of hallucination compared with 0% in the fentanyl group. With respect to other adverse events, ketamine recorded a higher percentage for all other adverse events measured in this trial in contrast to fentanyl. In our opinion, the results obtained from this study highlighted the higher profile of adverse events associated with ketamine than that with intranasal ketamine in comparison with intranasal fentanyl. Intranasal fentanyl has weidely been widely been used over the past years, and for quite some time now, and it has been proven by several studies to be a safe and effective me of analgesia with limited side effects (10, 11, 18).

The intranasal route of drug administration for pain relief has been well established in the literature. However, atomized intrana-

sal administration when compared with intranasal drops has been associated with higher satisfaction in terms of greater acceptance and fewer aversive reactions in children. Moreover, it was associated with a more rapid onset and recovery than administration via intranasal drops (19). Alternatively, nebulized administration of drugs has shown a lot of promise recently, which may prove very helpful in EDs that have not yet acquired atomization devices. Nebulized fentanyl has been compared with IV fentanyl (20) and IV morphine (21) and showed good results with comparable efficacy in pain relief. Because fentanyl is a highly lipophilic drug, this makes its use via nebulization, which depends mainly on pulmonary absorption, an effective substitute. However, higher doses are required (3–4 µg/kg), bearing in mind the amount of the drug lost to the environment and the non-absorptive tissue encountered in the respiratory tract. On the other hand, one should be aware that the long-term effect of fentanyl on the lung parenchyma and vasculature has not been established, and this poses a relatively higher risk than the nasal mucosa (22). Moreover, the time needed for a drug to be nebulized is several minutes in contrast to a few seconds for atomization. To date, we are not aware of any study that has assessed nebulized versus atomized fentanyl for pain relief in children in a comparative trial format, and this is a question that needs to be answered. Unlike fentanyl, nebulized ketamine has not yet been studied and this is also an area for further research.

When comparing the traditional method of pain relief via IV administration versus intranasal administration, the cost of a mucosal atomization device is around $4, whereas the cost of a cannula for the IV administration of medication is $0.50 to $1. In addition, the time needed to secure a cannula, personnel, failed attempts, and wasted cannulas may narrow the cost gap between the expenses of the two modalities of pain relief. Atomization has the advantage of eliminating the anxiety-provoking experience of needles, let alone the minimal pain associated with intranasal administration, and consequently the higher patient and family satisfaction.

Conclusion

This study provides valuable information about the efficacy of intranasal analgesia in the pediatric population and the alternative drugs that might be used. Intranasal fentanyl, with its lower profile of adverse events, remains a preferable choice for intranasal analgesia in children with limb injuries.

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References

1. Regan L, Chapman AR, Celnik A, Lumsden L, Al-Soufi R, Mccullough NP. Nose and vein, speed and pain: comparing the use of intranasal diamorphine and intravenous morphine in a Scottish paediatric emergency department. Emerg Med J 2013; 30: 49-52. [CrossRef]
2. Wilson JA, Kendall JM, Cornelius P. Intranasal diamorphine for paediatric analgesia: assessment of safety and efficacy. J Accid Emerg Med 1997; 14: 70-2. [CrossRef]
3. Anez SC, Rull BM, Rodriguez PA, Fuentes BA. Intranasal opioids for acute pain. Rev Esp Anestesiol Reanim 2006; 53: 643-52.
4. Finn M, Harris D. Intranasal fentanyl for analgesia in the paediatric emergency department. Emerg Med J 2010; 27: 300-1. [CrossRef]
5. Andolfatto G, Willman E, Joo D, Miller P, Wong WB, Koehn M, et al. Intranasal ketamine for analgesia in the emergency department: A prospective observational series. Acad Emerg Med 2013; 20: 1050-4. [CrossRef]
6. Roelofse JA, Shipton EA, de la Harpe CJ, Blignaut RJ. Intranasal sufentanil/midazolam versus ketamine/midazolam for analgesia/sedation in the pediatric population prior to undergoing multiple dental extractions under general anesthesia: a prospective, double-blind, randomized comparison. Anesth Prog 2004; 51: 114-21.
7. Tsze DS, Steele DW, Machan JT, Akhlaghi F, Linakis JG. Intranasal ketamine for procedural sedation in pediatric laceration repair: A preliminary report. Pediatr Emerg Care 2012; 28: 767-70. [CrossRef]
8. Beyer JE, Mcgrath PJ, Berde CB. Discordance between self-report and behavioral pain measures in children aged 3-7 years after surgery. J Pain Symptom Manage 1990; 5: 350-6. [CrossRef]
9. Berde CB, Sethna NF. Analgesics for the treatment of pain in children. N Engl J Med 2002; 347: 1094-103. [CrossRef]
10. Saunders M, Adelgais K, Nelson D. Use of intranasal fentanyl for the relief of pediatric orthopedic trauma pain. Acad Emerg Med 2010; 17: 1155-61. [CrossRef]
11. Borland M, Jacobs I, King B, O'brien D. A randomized controlled trial comparing intranasal fentanyl to intravenous morphine for managing acute pain in children in the emergency department. Ann Emerg Med 2007; 49: 335-40. [CrossRef]
12. Borland ML, Jacobs I, Geelhoed G. Intranasal fentanyl reduces acute pain in children in the emergency department: a safety and efficacy study. Emerg Med (Fremantle) 2002; 14: 275-80. [CrossRef]
13. Barrett MJ, Cronin J, Murphy A, McCoy S, Hayden J, an Fhailí S, et al. Intranasal fentanyl versus intravenous morphine in the emergency department treatment of severe painful sickle cell crises in children: study protocol for a randomised controlled trial. Trials 2012; 13: 74. [CrossRef]
14. Crellin D, Ling RX, Babl FE. Does the standard intravenous solution of fentanyl (50 microg/mL) administered intranasally have analgesic efficacy? Emerg Med Australas 2010; 22: 62-7. [CrossRef]
15. Schacherer NM, Ramirez DE, Frazier SB, Perkins AM. Expedited delivery of pain medication for long-bone fractures using an intranasal fentanyl clinical pathway. Pediatr Emerg Care 2015; 31: 560-3. [CrossRef]
16. Powell CV, Kelly AM, Williams A. Determining the minimum clinically significant difference in visual analog pain score for children. Ann Emerg Med 2001; 37: 28-31. [CrossRef]
17. Alexander D, Kinsley TL, Waszinski C. Journey to a safe environment: fall prevention in an emergency department at a level I trauma center. J Emerg Nurs 2013; 39: 346-52. [CrossRef]
18. Mudd S. Intranasal fentanyl for pain management in children: a systematic review of the literature. J Pediatr Health Care 2011; 25: 316-22. [CrossRef]
19. Pandey RK, Bahetwar SK, Saksena AK, Chandra G. A comparative evaluation of drops versus atomized administration of intranasal ketamine for the procedural sedation of young uncooperative pediatric dental patients: a prospective crossover trial. J Clin Pediatr Dent 2011; 36: 79-84. [CrossRef]
20. Miner JR, Kletti C, Herold M, Hubbard D, Biros MH. Randomized clinical trial of nebulized fentanyl citrate versus i.v. fentanyl citrate in children presenting to the emergency department with acute pain. Acad Emerg Med 2007; 14: 895-8. [CrossRef]
21. Furyk JS, Grabowski WJ, Black LH. Nebulized fentanyl versus intravenous morphine in children with suspected limb fractures in the emergency department: a randomized controlled trial. Emerg Med Australas 2009; 21: 203-9. [CrossRef]
22. Available at: http://intranasal.net/DeliveryTechniques/default.htm. Accessed March 22, 2016.

Hair-Thread Tourniquet Syndrome

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A 3-month-old boy presented to our emergency department after 3 days of restlessness, erythema, and swelling on his left third and fourth toes, which was detected by his mother while changing his diaper. Physical examinations revealed hyperemia, edema, and tenderness with a strangulation ring at the proximal part of the third and fourth toes, and the skin of the fourth toe was cut. On examination using magnification, several tightly eight-shaped entangled hair fibers were found (Figure 1a, b). The hair fibers were gently removed. Hyperemia and edema regressed after a 2-h observation period. The patient was discharged home with topical antibiotic treatment.

Hair-thread tourniquet syndrome is a rare but dangerous disorder if early treatment is not provided. It is frequently reported in fingers, toes, and external genitalia in 6–36-week-old babies (1). Edema caused by constriction blocks arterial and venous circulation. If treatment delays tissue necrosis and auto-amputation can develop at the affected area. Although the mechanism underlying thread wrapping is not clearly defined, it is thought to be accidental or a combination of babies' plantar flexion behavior and overall clothing (2). The treatment strategy simply involves incision and removal of hair fibers (3). If the hair fiber cuts the skin and becomes invisible, surgical exploration should be necessary.

References

1. Cevik Y, Kavalci C. Hair tourniquet syndrome. Ann Saudi Med 2010; 30: 416-7. [CrossRef]
2. Barton DJ, Sloan GM, Nichter LS, Reinisch JF. Hair-thread tourniquet syndrome. Pediatrics 1988; 82: 925-8.
3. Serour F, Gorenstein A. Treatment of the toe tourniquet syndrome in infants. Pediatr Surg Int 2003; 19: 598-600. [CrossRef]

Figure 1. a, b. Views from different angles of the eight-shaped hair fiber entangled on the 3rd and 4th toes

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İNTRAFEN

İBUPROFEN I.V.

İ.V. İBUPROFEN TÜRKİYE'DE

- Hafif ve orta dereceli ağrı tedavisinde,
- Opioid analjeziklerle beraber orta ve ileri dereceli ağrı tedavisinde,
- Ateş tedavisinde kullanılır.

İNTRAFEN-16-07

İNTRAFEN 400mg/4ml, 800mg/8ml iv flakon, **Etkin madde:** Her bir flakon ibuprofen içeren çözelti içerir. **Endikasyonları:** Hafif ve orta dereceli ağrı tedavisinde, opioid analjeziklerle beraber orta ve ileri dereceli ağrı tedavisinde ve ateş tedavisinde kullanılır. **Kullanım şekli ve dozu:** İntrafen, en kısa sürede en düşük etkili dozda kullanılmalıdır. Başlangıç tedavisine cevap alındıktan sonra, doz ve sıklık hastanın bireysel ihtiyaçlarına göre ayarlanmalıdır. Toplam günlük doz 3200 mg'ı geçmemelidir. Böbreklerdeki yan etki riskini azaltmak için, intrafen uygulamadan önce hastaların yeteri kadar hidrate olması sağlanmalıdır. **Ağrı tedavisinde:** Gereksinime göre, 6 saatte bir 400 mg ila 800 mg arasındaki dozlarda uygulanmalıdır. İnfüzyon süresi minimum 30 dakika olmalıdır. **Ateş tedavisinde:** 400 mg'lık uygulamayı takiben, gereksinime göre her 4-6 saatte bir 400 mg veya her 4 saatte bir 100-200 mg uygulanmalıdır. İnfüzyon süresi minimum 30 dakika olmalıdır. **İstenmeyen etkiler:** Klinik çalışmalarda raporlanan en yaygın advers reaksiyonlar, bulantı, gaz, kusma ve baş ağrısıdır. **İlaç etkileşimleri ve diğer etkileşimler:** Antiplatelet ajanlar ve selektif serotonin geri alım inhibitörleri gastrointestinal kanama riskini arttırırlar. NSAİİ'lar aminoglikozitlerin atılımını azaltabilir. Kortikosteroidler NSAİİ'lar ile kullanıldığında kanama ve gastrointestinal ülserasyon riski artar. **Kontrendikasyonlar:** İbuprofen, diğer NSAİİ veya intrafen içeriğindeki bileşenlerden herhangi birine aşırı duyarlılığı olanlarda, asetil salisilik asit veya diğer NSAİİ kullanımı sonrası astım, ürtiker veya alerjik tip reaksiyon öyküsü olanlarda, koroner arter by-pass graft cerrahisi peri-operatif ağrı tedavisinde, gebeliğin son trimesterisinde şiddetli kalp yetmezliği durumunda, şiddetli karaciğer yetmezliği durumunda, şiddetli böbrek yetmezliği durumunda. **Uyarılar / önlemler:** NSAİİ'lar ölümcül olabilecek kardiyovasküler trombotik olaylar, miyokard infarktüsü ve inme riskinde artışa neden olabilir. Bu risk kullanım süresine bağlı olarak artabilir. Kardiyovasküler hastalığı olan veya kardiyovasküler hastalık risk faktörlerini taşıyan hastalarda risk daha yüksek olabilir. İntrafen koroner arter by-pass graft cerrahisi perioperatif ağrı tedavisinde kontrendikedir. NSAİİ'lar kanama, ülserasyon, mide veya bağırsak perforasyonu gibi ölümcül olabilecek ciddi GI advers etkilere yol açarlar. Bu advers olaylar herhangi bir zamanda, önceden uyarıcı bir semptom vererek veya vermeksizin ortaya çıkabilirler. Yaşlı hastalar ciddi GI etkiler bakımından daha yüksek risk taşımaktadırlar. **Gebelik ve Laktasyon: Gebelik kategorisi:** C (3. Trimesterde D'dir). **Doz aşımı ve tedavisi:** Yetişkinlerde oral ibuprofene bağlı doz aşımı sonrası oluşan belirti ve semptomlar; karın ağrısı, bulantı, kusma, uyuşukluk ve sersemliktir. İntrafen ile akut doz aşımının tedavisi için özel bir önlem bulunmamaktadır. İbuprofen'in bilinen bir antidotu yoktur. **Saklama koşulları:** 25 °C'nin altındaki oda sıcaklığında saklanmalıdır. İntrafen, %5 Glukoz, % 0.9 NaCl ve ringer laktat çözeltileriyle seyreltildikten sonra hemen kullanılmalıdır. Raf ömrü 24 aydır. **Ambalaj niteliği ve içeriği:** Kutuda, mavi flip-off PP kapaklı gri kauçuk tıpa üzeri metal kapişonlu renksiz Tip I 10 ml' lik cam flakonda, 1 adet olarak takdim edilmektedir. **KDV dahil perakende satış fiyatı:** 1 flk. 400mg/4ml 14.36 TL (22.02.2016), 1 flk. 800mg/8ml 28,60 TL (22.02.2016). Reçeteli satılır. **Ruhsat sahibi:** GEN İLAÇ VE SAĞLIK ÜRÜNLERİ SANAYİ ve TİCARET ANONİM ŞİRKETİ, Mustafa Kemal Mah. 2119. Sok. No:3 D: 2-3 Balgat 06520 Çankaya / ANKARA. Üretici firma: Mefar İlaç Sanayii A.Ş. Ramazanoğlu Mah. Ensar Cad. No:20 Kurtköy/Pendik TR 34906 İstanbul / Türkiye. **Ruhsat Tarihi ve numarası:** 05.02.2015-2015/96 (400mg/4ml). 04.02.2015-2015/72 (800mg/8ml).Daha geniş bilgi için firmamıza başvurunuz. www.genilac.com.tr

Gen İlaç ve Sağlık Ürünleri