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CONTENTS

Searching for the Lost Road of the Non-Invasive Positive Pressure Ventilation in the Acute Respiratory Distress Syndrome

Óscar Peñuelas, Fernando Frutos-Vivar, Andrés Esteban
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The role of non-invasive positive pressure ventilation (NPPV) in the management of the acute respiratory distress syndrome (ARDS) is controversial. Despite several studies have confirmed that although NPPV may avoid the need for invasive mechanical ventilation in ARDS patients, there is a concern regarding the clinical outcomes of critically ill patients who fail a trial of NPPV, and need invasive mechanical ventilation. This effect may be explained because of the generally high likelihood of failure and the risks associated with a delay in starting invasive mechanical ventilation.

It is clear the growing interest of the application of NPPV in ARDS. In fact, the rate of ARDS patients ventilated with NPPV as first ventilatory attempt has increased over time, ranging from 6% in 1998, 12% in 2004, and reached up to 24.5% in 2010 (1-3). The failure of NPPV in these observational studies, was 61% (1-3).

Based on an analysis of 13 studies involving 540 patients, Agarwal et al. (4) found that, in ARDS patients treated with NPPV, the intubation rate ranged from 30% to 86%, with a pooled intubation rate of 48% (95% CI, 39% to 58%), and the mortality rate ranged from 15% to 71%, with a pooled mortality rate of 35% (95% CI, 26% to 45%). In the third international study of mechanical ventilation carried out in 2010, our group found that ICU and hospital mortality were higher in ARDS patients who failed an attempt of NPPV, compared with those that underwent invasive mechanical ventilation as first ventilatory support (60% vs. 47% for ICU mortality, and 70% vs. 53.5% for hospital mortality, respectively, unpublished data).

Importantly in this sense, Bellani et al. (5) has highlighted the use of NPPV in the largest cohort of patients with ARDS. One of the main finding of the study was that NPPV failure occurred in 37.5% of patients with ARDS, showing a trend of greater risk of failure depending on the severity of ARDS. Secondly, NIV failure was associated with a striking increase in the risk of death, with mortality higher than for severe ARDS underwent invasive mechanical ventilation as first line (hazard ratio, 1.446 [95% confidence interval, 1.159–1.805]). After adjusting for potential confounders, a patient treated with NPPV at ARDS onset seemed to have a 30% increased risk of dying in ICU compared with a similar patient treated with invasive mechanical ventilation. Furthermore, in the propensity-matched cohort, the ICU mortality was significantly higher for NPPV than for invasive-mechanical ventilation in the cohort of patients with PaO_2/FiO_2 ratio lower than 150 (36.2% with NIV compared with 24.7% with invasive-mechanical ventilation (p=0.033).

Thus, this parameter could be used at bedside to stratify patients when deciding to treat patients with NPPV or in deciding to terminate NPPV and proceed to invasive mechanical ventilation.

These findings raise further concerns regarding NPPV use in patients with ARDS. Given the higher than expected mortality in patients who failed a trial of NPPV, it should be instituted with extreme caution in ARDS patients, and preferably selecting other therapeutic approaches. Frat et al. (6) found that conditioned nasal cannula high-flow oxygen therapy, as compared with standard oxygen therapy or noninvasive ventilation, resulted in reduced mortality in the ICU and at 90 days among patients with acute hypoxemic respiratory failure (hazard ratio for death at 90 days after randomization was 2.01 in the standard oxygen group versus the high flow oxygen group (p=0.046), and 2.5 in the NPPV group versus the high flow oxygen group (p=0.006).

Thus, based on the previous available data, NPPV cannot be recommended as a routine ventilatory strategy for ARDS, and it supports a cautious trial in highly selected patients with a PaO_2/FiO_2 ratio >150 readiness to promptly intubate if oxygenation fails to improve sufficient-

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ly. The application of this ventilatory strategy is pending of the confirmation of the results for the implementation of the conditioned nasal cannula high flow oxygen in this group of patients with further studies.

In conclusion, only a minority of very well selected ARDS patients are candidate to use NPPV as ventilatory strategy and in case of choosing it, carefulness is advised to recognize the failure of NPPV early, with promptly making the decision of invasive mechanical ventilation. It is essential in this type of patients to have a chair at bedside, as a clinical tool to apply adequate mechanical ventilation.

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Triage Decision-Making Levels of Healthcare Professionals Working in Emergency Departments

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Abstract

Aim: The aim of this descriptive and cross-sectional study was to determine the triage decision-making levels of healthcare professionals working in emergency departments.

Materials and Methods: The study was conducted in the emergency departments of the hospitals in Giresun between January and February 2016. The study was completed with 54 healthcare professionals who agreed to participate. Data were collected using the Socio-Demographic Data Form and Triage Decision-Making Inventory.

Results: There was a significant difference between the total scale scores and the status of having an emergency care certificate (U=-2.238, p<0.05). The mean score of the critical thinking subscale showed significant differences according to the healthcare professional's title, educational level, and the status of having an emergency care certificate (KW=5.974, KW=13.785, and U=-4.260, respectively; p<0.05).

Conclusion: The total scale score and intuition subscale were higher in healthcare professionals who had an emergency care certificate. This study suggests the training of healthcare team members who perform triage and the development of triage guidelines in emergency departments.

Keywords: Emergency department, healthcare professionals, triage, triage decision-making

Introduction

Today, the increase in patient load has become a major problem in emergency departments (EDs) (1). Due to population increase, internal migrations, and ED applications of patients who do not have urgent complaints, a high number of patients are observed in EDs (2). This increase in patient density leads to longer waiting times for patients in the ED, delays in the treatment of patients having more serious health conditions, decrease in patient satisfaction, decrease in the quality of service, safety problems, and decrease in the productivity of healthcare professionals (3, 4). Therefore, it is necessary to select patients who need medical care more urgently in ED applications and determine patients' medical priorities (triage) (5).

Triage is the rapid selection and coding process performed at the scene and at every healthcare organization where patients or injured people are taken to determine those who require priority treatment and referrals in case of a high number of patients and injured people (6, 7). Triage can also be defined as determining priorities in care in terms of available resources and the severity of illness or injury (7). It is based on a quick diagnosis along with a brief interview, and it can be repeated at every stage until the end of treatment (8).

Triage is a French word and is derived from the verb "trier," which means to choose, select, classify, sift, separate, and distinguish. Medical triage was first applied in the Napoleonic period in France in the early 1800s for determining the priority of emergency care for patients/ injured people and providing emergency care

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(6, 9-11). Triage is identified as determining the priority in care and making the best decision for subsequent intervention steps (6). The concept of triage was originally developed to ensure that medical treatment and resources are used in the best and most appropriate way, especially in events when there are many injuries such as mass accidents, disasters, and war. Triage expanded later and started to be used in EDs to determine the priorities of outpatients, patients brought with ambulances, or those whose arrival is unexpected (12).

Triage is an important skill for all healthcare professionals who provide both acute care and provide direct patient care or supervise care in all areas of community health services (6). Even though the importance of triage has been emphasized in EDs in Turkey, there has been no study on the triage decision-making levels of healthcare professionals working in emergency departments these units. The descriptive study was designed to determine the triage decision-making levels of healthcare professionals working in EDs.

Materials and Methods

Study design

The aim of this descriptive and cross-sectional study was to determine the triage decision-making levels of healthcare professionals working in EDs. The study was conducted in the EDs of the hospitals in Giresun between January and February 2016. The participants in this descriptive study consisted of a total of 65 healthcare professionals working in EDs. In the study, it was aimed to reach the whole population without the sample selection. However, the study was completed with 54 healthcare professionals who agreed to participate. Inclusion criteria were as follows: nurses' accepting to participate and completely filling data forms. No exclusion criteria were used. The response rate was 89% (54 of 65).

Instruments

Data were collected using the "Socio-Demographic Data Form" and "Triage Decision-Making Inventory" (TDMI). The Socio-Demographic Data Form consisted of nine questions prepared by the researchers in line with the literature and determined the sociodemographic characteristics of healthcare professionals (i.e., staff status, age, gender, educational level, marital status, total working years in the profession, working period in the ED, working type, and the status of having an emergency care certificate).

The TDMI was originally developed by Cone in 2000 as a tool for determining only ED nurses' opinions about triage decisions (13). The researchers later considered this as a limitation and tested the reliability of the inventory in nurses working in various clinics in and military nurses (6, 14). The TDMI is a 6-point Likert-type scale and consists 37 items. The items in the inventory consist of six options changing from "I strongly agree" to "I strongly disagree." The highest score obtained from the inventory is 222. The inventory has four subscales (cognitive characteristics, critical thinking, experience, and intuition). Total scale and subscale scores are obtained by dividing the sum of the scores given by the participants to the inventory. As the inventory is not a scale for diagnosis, the obtained score intervals do not express any meaning. In the first version of the scale, it was conducted with 208 ED nurses, and the Cronbach's alpha coefficient for the whole inventory was found to be 0.95. The Cronbach's alpha coefficient for the subscales ranged from 0.84 to 0.89. The "cognitive characteristics" subscale consists of seven items. These items are related to prioritization, organization, justice, and knowledge. The "experience" subscale consists of 11 items that assess the nurses' skills to ask appropriate questions in a decision-making and triage environment. The "intuition" subscale has seven items related to emotions, instincts, and the sixth sense. Finally, the "critical thinking" subscale has 12 items evaluating the ability to acquire the necessary information to be used in the evaluation of patients and to establish communication (6).

Data collection

Data were collected by the researchers using a face-to-face interview. The interview with each healthcare professional lasted for approximately 15 to 20 min. The purpose of the study was explained by the researchers before the application of data collection tools. The principle of confidentiality was followed by informing the participants that they are free to participate in the study and that their names would not be mentioned in the study. In order to conduct the study, written consents were obtained from the relevant institution. The study was conducted according to the ethics guidelines set out in the Declaration of Helsinki.

Statistical analysis

Data were assessed using the IBM Statistical Package for the Social Sciences for Windows (IBM SPSS Statistics; Armonk, NY, USA) version 21.0 package program. Descriptive variables are presented as means and percentages. The normality of within-group distributions was tested by using the Kolmogorov–Smirnov test. The between-groups comparisons created on the basis of sociodemographic characteristics were performed using the Mann–Whitney U test and Kruskal–Wallis test as there was no normal distribution. The value of $p<0.05$ was accepted as being statistically significant.

Results

A total of 54 healthcare professionals participated in the present study. The participants included 38 females (70.4%) and 16 males (29.6%). The mean age of the participants was 31.64 years, with a standard deviation of 7.95 years. Most participants were married (59.3%) and graduated from medical vocational high school (42.6%). In addition, the occupational experience of healthcare professionals was 10.42±7.56 years; 66.7% of the participants were working in the night-day shift and 83.3% did not have an emergency care certificate (Table 1).

The total mean TDMI score of the ED professionals was 172.89±18.00 (Table 2). When the descriptive characteristics of the ED professionals were compared with their mean TDMI scores, it was determined that there was a significant difference between the total scale scores and the status of having an emergency care certificate ($U=-2.238$, $p<0.05$). The mean score of the critical thinking subscale showed significant differences according to the healthcare professional's title, educational level, and the status of having an emergency care certificate ($KW=5.974$, $KW=13.785$, and $U=-4.260$, respectively; $p<0.05$). A statistically significant difference was found between the intuition subscale and the status of having an emergency care certificate ($U=-3.549$, $p<0.05$) (Table 3).

Table 1. Demographic and professional characteristics of healthcare professionals (n=54)

Characteristics		
Age (Mean±SD)	31.64±7.95	
Professional experience (M±SD)	10.42±7.56	
Professional experience in the ED (M±SD)	3.50±2.46	
	n	**%**
Staff		
Nurse	24	44.4
Paramedic	17	31.5
Midwifery/Health officer	13	24.1
Gender		
Female	38	70.4
Male	16	29.6
Marital status		
Married	32	59.3
Single	22	40.7
Educational status		
Medical vocational high school	23	42.6
Associate degree	14	25.9
Bachelor's degree	17	31.5
Having an emergency care certificate		
Yes	9	16.7
No	45	83.3
Working type		
Night shift	18	33.3
Night-day shift	36	66.7
SD: standard deviation		

Table 2. Mean scores of TDMI

Subscale	**n**	**Number of items**	**Mean**	**SD**
Cognitive characteristics	54	7	32.68	6.15
Experience	54	11	54.96	5.84
Intuition	54	7	33.09	3.21
Critical thinking	54	12	52.14	9.61
Total scale	54	37	172.89	18.00
TDMI: Triage Decision-Making Inventory; SD: standard deviation				

Discussion

Triage is one of the most important functions of the ED due to the increase in complex patients and the use of EDs (15). The purpose of triage is to put patients in order and it aims to refer the "right patient" to the right person in the right place and at the right time (16). This study was designed to determine the triage decision-making levels of healthcare professionals working in EDs.

The Emergency Nurses' Association (ENA) anticipates that the triage nurse has an experience of at least 6 months in ED, completed training and course programs about triage, and has an emergency certificate (8, 17). In this study, 83% of the healthcare professionals were determined to have an emergency care certificate. Similar to the results of the present study, Alemdar et al. (18) reported that 32.8% of the nurses did not receive any training on triage in their undergraduate education but 54.7% received triage training in the hospital. On the other hand, Sungur et al. (19) found that 64.7% of the nurses did not receive any triage training. A study by Aloyce et al. (20) reported that 22% of the nurses working in EDs received nursing training in emergency care, whereas 78% had received no such training. However, the person who will do triage should know the symptoms of the diseases that require emergency intervention (19). Lack of triage training has a relationship with inaccurate triage decisions, as knowledge on triage has been identified as a key factor that influences accuracy of triage decisions in the ED (21).

It was found that the TDMI total score was higher in the healthcare professionals with emergency care certificates in the study. Triage can be performed by a physician, a nurse, or a paramedic, but the healthcare professional doing triage needs to receive the related training (19). Healthcare professionals performing triage should be effective on decisions by its quality. The quality indicator of a triage healthcare professional, who decides who are the primary individuals to be treated with medical care, is determined by right and rapid decision-making, deep knowledge, and experience (8, 22). The reason the scale mean score of the healthcare professionals with emergency care certificates was high can be associated with triage training in the certification program in the study.

Triage decision-making is based on critical thinking, cognitive skills, intuition, and experience (13). Healthcare professionals' characteristics such as the amount of experience and level of qualification may also influence triage outcomes (23). In the present study, it was determined that the critical thinking subscale score was high in paramedics, medical vocational high school graduates, and healthcare professionals with emergency care certificates. It was observed that the critical thinking subscale score was high in the group that completed the course program and received training on triage and that their triage decision-making levels were high. This finding is consistent with a previous study (24) that explored a positive correlation between nurses with a post-secondary level qualification (compared with nurses with no additional training) and achieving the expected triage decision in EDs. Healthcare professionals performing triage should be able to rapidly identify priorities using their critical thinking skills in EDs, which are mostly complex, crowded, noisy, and stressful environments (22). The results of the present study showed a negative correlation between educational level and critical thinking skills, which was consistent with those from a previous study (25). These results are thought to be associated with the fact that paramedics are high school graduates and that they have received extensive knowledge on triage during their education. However, confidence may be a factor that influences decision-making (23, 26). Therefore, the findings from the present study may also be associated with the fact that paramedics feel more confident in decision-making and are prepared to undertake triage.

Table 3. Comparison of TDMI scores according to demographic and professional characteristics

	Cognitive characteristics	Experience	Intuition	Critical thinking	Total scale
Staff					
Nurse	33.87±5.08	56.75±4.92	33.79±3.40	52.66±9.76	177.08±17.83
Paramedic	28.76±9.17	51.53±7.81	32.30±3.44	57.00±6.33	169.62±18.98
Midwifery/health officer	34.00±2.93	55.05±4.24	32.70±2.68	47.70±9.91	169.47±17.28
p*	3.769, 0.152	3.562, 0.168	1.259, 0.533	5.974, 0.050	2.494, 0.287
Educational status					
Medical vocational high school	30.95±8.06	53.60±6.45	33.60±2.72	57.95±5.16	176.13±16.89
Associate degree	33.57±3.47	55.42±3.29	33.00±3.11	47.28±7.76	169.29±13.89
Bachelor's degree	34.29±4.28	56.41±6.47	32.47±3.90	48.29±11.63	171.47±22.27
p*	2.178, 0.337	0.716, 0.699	3.897, 0.142	13.785, 0.001	1.447, 0.485
Emergency care certificate					
Yes	31.50±13.36	55.75±10.78	37.00±2.61	64.00±2.72	188.25±27.29
No	32.88±4.10	54.77±4.73	32.46±2.81	50.26±8.86	170.40±14.83
p**	-1.571, 0.116	-1.370, 0.171	-3.549, 0.000	-4.260, 0.000	-2.238, 0.025
Working type					
Night shift	36.00±4.61	60.50±6.35	31.50±.57	41.50±4.04	169.50±7.50
Night-day shift	33.41±2.74	54.41±3.89	32.00±3.10	46.25±10.15	166.08±16.09
p**	-0.977, 0.328	-0.988, 0.323	0.087, 1,000	-0.491, 0.624	-0.731, 0.465

*Kruskal–Wallis test statistic, **Mann–Whitney U test statistic. TDMI: Triage Decision-Making Inventory

It was found that the intuition subscale was higher in healthcare professionals with an emergency care certificate in the present study. Healthcare professionals often use intuition to understand that something is wrong rather than guidelines (27, 28). The current study finding is consistent with a previous study (28) that reported triage decisions were often nonanalytic and based on intuition, particularly with increasing expertise in a pedia tric ED. In the same study, nurses stated that they trusted their intuitions when they were sure of their decisions or when the ED was crowded , they were using their intuition in the triage decision-making phase. In the present study, it was observed that healthcare professionals who were trained regarding triage and had an emergency care certificate used their intuitions instead of clinical guidelines in triage decision-making. This result may be associated with the fact that healthcare professionals have difficulties in using triage guidelines due to the limited time, the urgency of the patients' situation, the need to take the patient's medical history within a short time, and the high workload. On the other hand, intuition or heuristics in triage decision-making can be faulty (27). For this reason, the development of triage decision-making guidelines to be used by healthcare professionals who are triage practitioners in EDs will contribute in delivering quality care service, in ensuring the quality of care, and in systematizing care.

Study limitations

The results obtained from the study can be generalized to the healthcare professionals in this sample group and are limited to the items on the inventory used in the study.

Conclusion

It is important to determine priority and perform triage in EDs where patient admissions cannot be planned and patient density and workload are high. In this study, it was found that the total scale and intuition subscale score were higher in healthcare professionals who had an emergency care certificate. It was also found that the critical thinking subscale score was high in paramedics, medical vocational high school graduates, and healthcare professionals with emergency care certificates. In accordance with these results, it can be recommended to train healthcare team members who perform triage and develop triage guidelines. Methods such as the "triage card game" and techniques such as videos and model simulation studies can be used to make the concept and applications of triage remarkable within the scope of a course on emergency care during the training of healthcare professionals.

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: Written informed consent was obtained from healthcare professionals 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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Tube Thoracostomy: Is an Emergency Physician Adequate for the Job?

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Abstract

Aim: The aim of this study was to evaluate patients with spontaneous pneumothorax who were admitted to the Medeniyet University Goztepe Training and Research Hospital and to emphasize that effective treatment can be performed in emergency departments by emergency physicians.

Materials and Methods: Patients who were treated for spontaneous pneumothorax between January 1, 2013 and January 1, 2015 were retrospectively evaluated. Patient records were reviewed for variables, including patient age, sex, body mass index, smoking history, comorbidities, presenting complaints, localization and extent of pneumothorax, treatment method, surgical indications, relapse, morbidity and mortality rates, and duration of hospitalization.

Results: In total, 50 spontaneous pneumothorax cases were evaluated in this study (41 males and 9 females), and the mean age was 33.3±14.9 years. Of these, 38 (76.0%) were primary and 12 (24.0%) were secondary spontaneous pneumothorax cases. Spontaneous pneumothorax cases were observed more often during the winter months (46.0%). The leading presenting symptom of patients with comorbidities was dyspnea (71.4%), whereas that of patients without comorbidities was chest pain (66.7%). Complications due to tube thoracostomy occurred in 15.1% of the patients. The mean duration of hospitalization for patients with spontaneous pneumothorax was 5.0±2.2 days.

Conclusion: Spontaneous pneumothorax is a common condition that requires effective treatment in emergency medicine practice. Emergency physicians should be well aware of the significance of this clinical condition and its treatment methods. Tube thoracostomy, with its low complication rate, is a procedure that can be safely performed by emergency physicians in emergency departments in hospitals.

Keywords: Emergency medicine, spontaneous pneumothorax, tube thoracostomy

Introduction

Spontaneous pneumothorax is a collection of air in the pleural space without any traumatic or iatrogenic factors. If there is no identified underlying lung disease and the lung structure is normal, the condition is defined as primary spontaneous pneumothorax (PSP); if an underlying lung disease such as chronic obstructive lung disease (COPD) or tuberculosis is present, then the condition is called secondary spontaneous pneumothorax (SSP) (1).

Primary spontaneous pneumothorax typically occurs in young, asthenic adults. Males and smokers are at higher risk. The most common cause for SSP is COPD (2). These patients may have a more serious clinical course based on the pre-existing impaired lung function. The aim of this study was to evaluate patients with spontaneous pneumothorax who were admitted to our center and to emphasize that effective treatment can be performed in emergency departments by emergency physicians.

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Materials and Methods

Patients who were treated in the department of emergency medicine in our center (a tertiary hospital) between January 1, 2013 and January 1, 2015 for spontaneous pneumothorax were retrospectively evaluated. Patients who had trauma history, were treated in our center, and were <18 years of age were excluded from the study. The study was approved by Istanbul Medeniyet University Goztepe Research and Training Hospital Ethics Committee. Written informed consent was obtained from the patients who participated in this study. The diagnosis was confirmed by medical history, physical examination, posteroanterior (PA) chest X-ray, and thoracic computerized tomography (CT) in case of doubt. The pneumothorax size was estimated using the Light method (3).

Patient records were reviewed for variables, including patient age, sex, body mass index (BMI), smoking history, comorbidities, presenting complaints, localization and extent of pneumothorax, treatment method, surgical indications, relapse, morbidity and mortality rates and duration of hospitalization. The treatment method was determined, and tube thoracostomy was applied according to the British Thoracic Society and American College of Chest Physicians guidelines (4, 5). Patients with <2 cm PSP without any symptoms were observed. All the other patients underwent tube thoracostomy. Tube thoracostomy was performed in emergency departments by emergency medicine assistant doctors under the supervision of a senior emergency medicine assistant doctor or an emergency medicine specialist. Complication types and tube thoracostomy procedure rates in the emergency department were evaluated in accordance with the literature. The tube thoracostomy procedure was accepted to be successful in patients who did not need revision for their tubes. After their condition stabilized, patients were transferred to the thoracic surgery clinic.

Statistical analysis

IBM Statistical Package for the Social Sciences (IBM SPSS Statistics; Armonk, NY, USA) version 21.0 was used to analyze the data acquired in the study. Pearson's chi-square and Fisher's exact tests were used to compare qualitative data. All the results were given within 95% confidence interval, and the level of significance was determined as $p<0.05$.

Results

Among the 50 patients with spontaneous pneumothorax evaluated in the study, 41 were males (82%) and nine were females (18%), and the mean age was 33.2±14.9 years. The overall rate of smoking was 44.0%, and there was a statistically significant difference for sex; 11.1% of the female patients and 51.2% of the male patients were smokers (Table 1).

Among the evaluated patients with spontaneous pneumothorax, 38 (76%) had PSP and 12 (24%) had SSP. Comorbidity was seen in 14 (28%) patients. BMI of the patients was calculated; 3 (6%) patients were underweight, 30 (60%) were normal, 13 (26%) were overweight, and 4 (8%) were obese. The average BMI was found as 22.9±4.6.

Spontaneous pneumothorax cases were observed more often during the winter months (46%); 24%, 16%, and 14% cases were observed during the spring, autumn, and summer months, respectively. The leading presenting symptom of patients with comorbidities was dyspnea (71.4%), whereas that for patients without comorbidities was chest pain (66.7%). Most of these patients (86.1%) were considered to have PSP. Both results were statistically significant (Table 2). Pneumothorax was observed in the right lung in 52% of the cases and in the left lung in 44% of the cases. A bilateral condition occurred in 4%.

Table 1. Relation between sex and smoking

		Male		Female		
		n	%	n	%	P
Smoking	Yes	21	51.2	1	11.1	X^2=4.818
	No	20	48.8	8	88.9	p=0.030

Table 2. Relation between spontaneous pneumothorax types and symptoms

		Primary		Secondary		
		n	%	n	%	P
Symptom	None	1	2.6	0	0.0	
	Chest pain	21	55.3	3	25.0	X^2=13.714
	Dyspnea	5	13.2	8	66.7	p=0.003
	Chest pain and dyspnea	11	28.9	1	8.3	

Tube thoracostomy was performed in 33 (66%) patients and 17 (34%) patients were observedComplications due to tube thoracostomy occurred in 5 (15.1%) patients. Tube detachment and tube malposition was seen in two and two patients, respectively. A revision surgery for tube thoracostomy was performed in these four patients. The tube thoracostomy success rate was 88%. Wound infection and the necessity for intensive care was observed in a single (2%) patient as morbidity. No mortality was seen in the study group. The overall mean duration of hospitalization 5.0±2.2 days and that for patients with spontaneous pneumothorax who had undergone thoracostomy was 4.9±2.2 days. The relapse ratio was 12% after discharge. The operation rate due to spontaneous pneumothorax was 22%, and the most common indication for surgical treatment was prolonged air leak (27%).

Discussion

Spontaneous pneumothorax commonly occurs in tall, thin, young male smokers. Smoking is the most common risk factor (6) and is associated with a 12% risk of developing pneumothorax in smokers (7). A history of smoking was present in 44% of the patients. Regarding the typical patient profile for spontaneous pneumothorax, the incidence in males is six times higher compared with that in females, which is suggested to be related to smoking (8). Similarly, the majority of the patients with spontaneous pneumothorax in this study were males.

Spontaneous pneumothorax is referred to as PSP if it occurs in otherwise healthy individuals and as SSP if it occurs in individuals with an underlying lung disease (5). PSP typically occurs in thin, tall men aged 12–30 years; it is uncommon after the age of 40 years (1). In accordance with the literature, PSP cases in the study were generally younger than 40 years, and the majority of them were male patients with a low or normal BMI (≥18.5 and <25).

Secondary spontaneous pneumothorax develops in association with an underlying lung disease and is seen more often in middle to advanced age groups (9). In our study the mean age of patients with SSP and the sex of patients with pneumothorax were in accordance with the literature (10). According to the literature, COPD is an etiological factor in 40%–60% cases of SSP (11). In this study, COPD was the leading etiological factor in SSP as well.

According to Türker et al. (12) and Gürbüz et al. (13), more cases were observed during the fall and spring months, respectively. On the other hand, Celik et al. (14) found no relation between the occurrence of spontaneous pneumothorax in a particular season or month. Although some of the studies have reported right lung predominance for spontaneous pneumothorax, others found no difference between right and left lungs (15). This study had a minor dominance in the right lung.

The main clinical findings of spontaneous pneumothorax are sudden onset of chest pain, dyspnea, tachycardia, perspiration, hypotension, pallor, and cyanosis (1). The most common symptom in patients with PSP is sudden onset of chest pain and that in patients with SSP is dyspnea. The clinical course in SSP is worse and independent of the extent of pneumothorax (1, 2). In this study, the main symptom presented by patients with PSP was chest pain and that by patients with SSP was dyspnea; these results were statistically significant.

Types of complaints, physical examination, and PA chest X-ray are generally sufficient to diagnose spontaneous pneumothorax. CT may be required to differentiate minimal pneumothorax or bullae (16). PA chest X-rays were available for each patient. Thoracic CT was performed in most of the patients to evaluate lung parenchyma and to improve the treatment approach.

The aim of treatment in spontaneous pneumothorax is to remove air from the pleural cavity to allow for re-expansion of the lung and to prevent recurrence. Treatment methods include observation, aspiration, catheter drainage, chest tube drainage, and surgery (17).

The choice of initial management for PSP has remained controversial (18). In a case series published in Turkey, tube thoracostomy stands out as the first treatment choice for all types of pneumothorax (19). Noppen et al. (20) have reported a treatment success rate of 63% for tube thoracostomy. The retrospective evaluation in this study showed that tube thoracostomy was used more than observation for the treatment of PSP, and simple aspiration was not used.

Secondary spontaneous pneumothorax has a more dramatic clinical course compared with PSP, and success is less likely with simple aspiration (21). Therefore, a more aggressive treatment is recommended although consensus remains limited. Published studies indicate tube thoracostomy may be required in the majority of these patients (22). Data from this study show that tube thoracostomy was performed in all patients with SSP, except for two patients whose condition was stable with their small pneumothoraxes . The success rate of tube thoracostomy was in accordance with the literature (23).

The most common indication for surgery in the first episode of spontaneous pneumothorax is a prolonged air leak (24). Others include insufficient expansion, single large bulla, ipsilateral recurrence, bilateral spontaneous pneumothorax, and occupational risk of the patient. The most common surgical treatment indication in this study was prolonged air leak.

Additionally, this study aimed to evaluate the complications of tube thoracostomy procedure performed in patients with spontaneous pneumothorax in the emergency department in relation to the literature. In general, the reported rate of complications of tube thoracostomy ranges between 3% and 18% (1). Huber et al. (25) reported an 11.2% risk of tube malposition. In this study, the most common complication observed was tube malposition. A chest drain was inserted in one patient with a giant bulla (Figures 1 and 2). The study by Aylwin et al. (26) classified complications as major or minor based on their life-threatening potential.

Figure 1. Posterior-anterior lung X-ray of a right spontaneous pneumothorax after tube thoracostomy

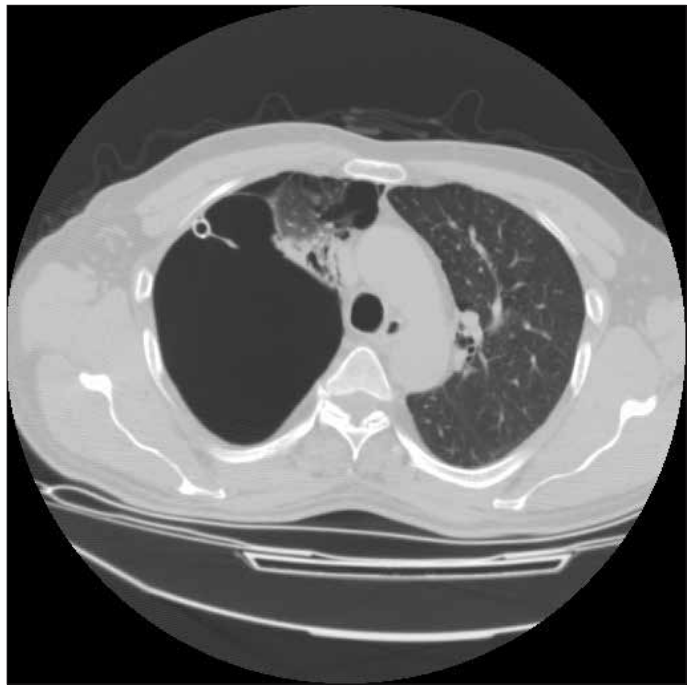

Figure 2. Axial computerized tomography image of a chest drain was inserted in a giant bulla

Although the rate of complications was in accordance with the literature, no major complications were observed in this study group. A recent article found no significant difference between surgical and emergency room residents regarding the quality of tube thoracostomy placement and its subsequent complications in trauma patients (27).

The presence of comorbidities is a major factor contributing to an increased rate of complications in tube thoracostomy procedures. Pulmonary diseases may induce complications by either directly hampering re-expansion or precipitating infections. The risk for a prolonged air leak is higher in patients with advanced emphysema (28). In this study, among the patients who had tube thoracostomy complications, pulmonary changes were observed in all of them on the CT scan.

According to the literature, the recurrence rate is 16%-52%, based on the treatment method used for the first episode of spontaneous pneumothorax (29). Studies reporting higher recurrence rate in SSP than in PSP are available, although the reverse is also reported (30). In this study, recurrence was seen in only patients with PSP.

Mortality was not recorded in this study group, except for one patient who was an elderly patient with SSP (aged >70) with history of malignancy and required intensive care. Risk factors for serious morbidity in pneumothorax are low oxygen saturation at admission, the presence of comorbidities, and SSP (31, 32).

Study limitations

The main limitation of this study was the patient count; larger number of patients may bring out more accurate statistical results.

Conclusion

Spontaneous pneumothorax is a condition often encountered in emergency medicine practice. Similarly, tube thoracostomy, which is an essential part of emergency treatment of spontaneous pneumothorax, plays an important role in the daily routine of emergency physicians, who generally are the first ones to see these patients. Therefore, emergency physicians should be well aware of the significance of this clinical condition and its treatment methods. Tube thoracostomy is a procedure that can be performed by emergency physicians with a high success rate.

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

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

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

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Calculation of the Index of Turkey's Vulnerability in Natural Disasters

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Abstract

Aim: The aim of this study was to determine the vulnerability levels of Turkey in terms of natural disasters and to guide decision makers and strategists in this field. In the study, disaster data obtained for 1987–2011 were used, and the disaster of type was most observed in our country.

Materials and Methods: Data vulnerability indices against the disasters were calculated using a Data Envelopment Analysis Program (DEAP) 2.1 program with a Data envelopment analysis-based output-oriented Malmquist Total Factor Productivity Index method.

Results: The regions of Turkey, which have the highest vulnerability index for the disasters, were TRA2 (0.323), TRB2 (0.305), and TRB1 (0.287) regions. In addition, it was seen that in the Black Sea region, the TR82 (0.267) region was more vulnerable than the other places of the region. In this study, a picture of the whole country over a period of 25 years in terms of disasters was captured.

Conclusion: In the picture, it is seen that economic and social costs endured due to disasters are separated into two regions starting from the region of Eastern Anatolia and the north branch extends across the Black Sea region and the other south branch reaches to the Mediterranean.

Keywords: Disaster, vulnerability, Turkey, data envelopment analysis

Introduction

Millions of people are affected by the disasters arising annually due to natural and man-made situations in our country and in the world. Many losses of lives and injuries are seen and thus an economic loss of billions of dollars arises. In addition, the disasters affect infrastructures and superstructures of countries and interrupt the transportation, communication, and education and health services at different levels (1). According to the publication prepared by the Department of Disaster Investigation and Damage Assessment affiliated to Ministry of Public Works and Settlement, General Directorate of Disaster Affairs from 1950 to 2008, percentages of the numbers of affected people based on disaster types in our country were as follows: 55% for earthquake; 21% for landslide; 8% for flood and inundation; 7% for rock fall; 2% for avalanche; 4% for more than one disaster type (such as both landslide and inundation); and 3% fire, geo-medical problems, cave collapses, storm, twister, etc.

The percentage distribution of the disasters in our country is as follows: 45% for landslide, 18% for earthquake, 14% for flood inundation, 10% rock fall, 2% for avalanche, 7% for multiple disasters, and 4% for other disasters. In addition, 43.75% of accommodation units (province, town centers, town, city, and villages) of our country have been exposed to at least one disaster type.

In contrast, Erzurum, Bingöl, Trabzon, Rize, Tunceli, Kastamonu, Erzincan, Malatya, Artvin, and Sivas rank first in terms of disaster number, whereas Kocaeli, Bingöl, Erzurum, Sakarya, Van, Düzce, Yalova, Adana, Muş, and Diyarbakır occupy the top in terms of disaster victim number (2).

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In addition, when the archived records of T.R. Red Crescent Society and disaster data of Turkey Disaster Data Bank (TDDB) obtained for 1980–2012 were reviewed, an earthquake was noted every 7 months on an average, flood every 2 months, landslide every 4 months, and fire disaster every 4 months in our country according to disaster criteria of Emergency Events Database (EMDAT) and Centre for Research on the Epidemiology of Disasters (CRED; observing at least one of the following conditions: at least ≥10 deaths, existence of 100 or more affected people, and exception reporting or international call for aid). Moreover, according to the studies, the disaster numbers in our country tended to increase, whereas this increase was more apparent after 2000 (3).

Disasters cause the gross domestic product (GDP), consumption, and fortune to decrease by economically reducing the capital stock and production efficiency of capital in a global and national sense (4). For example in Belize, a country in Central America, the loss that arose from two hurricanes occurred in 2000 and 2001 corresponded to 33% (280 million dollars) and 30% (250 million dollars) of GDP, respectively. Thus, the financial status of the country worsened, and a reconstruction operation was needed for public debt in 2006 (5). According to a study that investigated the effects of disruptive disasters occurring in 196 countries between 1970 and 2008 on GDP, these disasters led to about 2.3% decrease on the output both in the short and long term (6).

In our country, total economic loss arising from Kocaeli and Düzce earthquakes in 1999, and Van earthquake in 2011 was 22.5 million dollars. The Marmara earthquakes in 1999 resulted in an estimated decrease in GDP to 6.1% (7).

From a global perspective, according to "Global Disaster Hotspots" conducted using EMDAT database, i.e., according to the determination of risky regions worldwide in terms of disasters, the Anatolia geography in Turkey is among the most risky regions for losses arising from earthquake, flood, drought, and storm disasters (Figure 1).

It is not possible to completely eliminate the disasters. Therefore, it is important that some risks are determined to be prepared for disasters, and accordingly, some measures are taken. Therefore, 48% of a source of 4.4 billion dollars, which was created by International Federation of Red Cross and Red Crescent Societies (IFRC), World Vision International, International Committee of the Red Cross, and World Food Programme are used for charities, whereas 52% thereof are used for predisaster precaution and charity programs (8).

Heavy losses that arose from the Marmara earthquake in 1999 in our country revealed our deficiencies about education, preparedness, planning, and damage reduction related to disasters and disaster management (9). After these disasters, an intervention-based crisis management has been transformed to a preparedness-based risk management in the disaster management in our country.

Risk is defined as potential losses that may be incurred based on the damage the elements under danger in the region will endure in the case that any danger is occurred in a particular location at a given time.

Vulnerability is defined as a degree of possible loss of life, injury, damage, destruction, loss, and harm, which may be en-

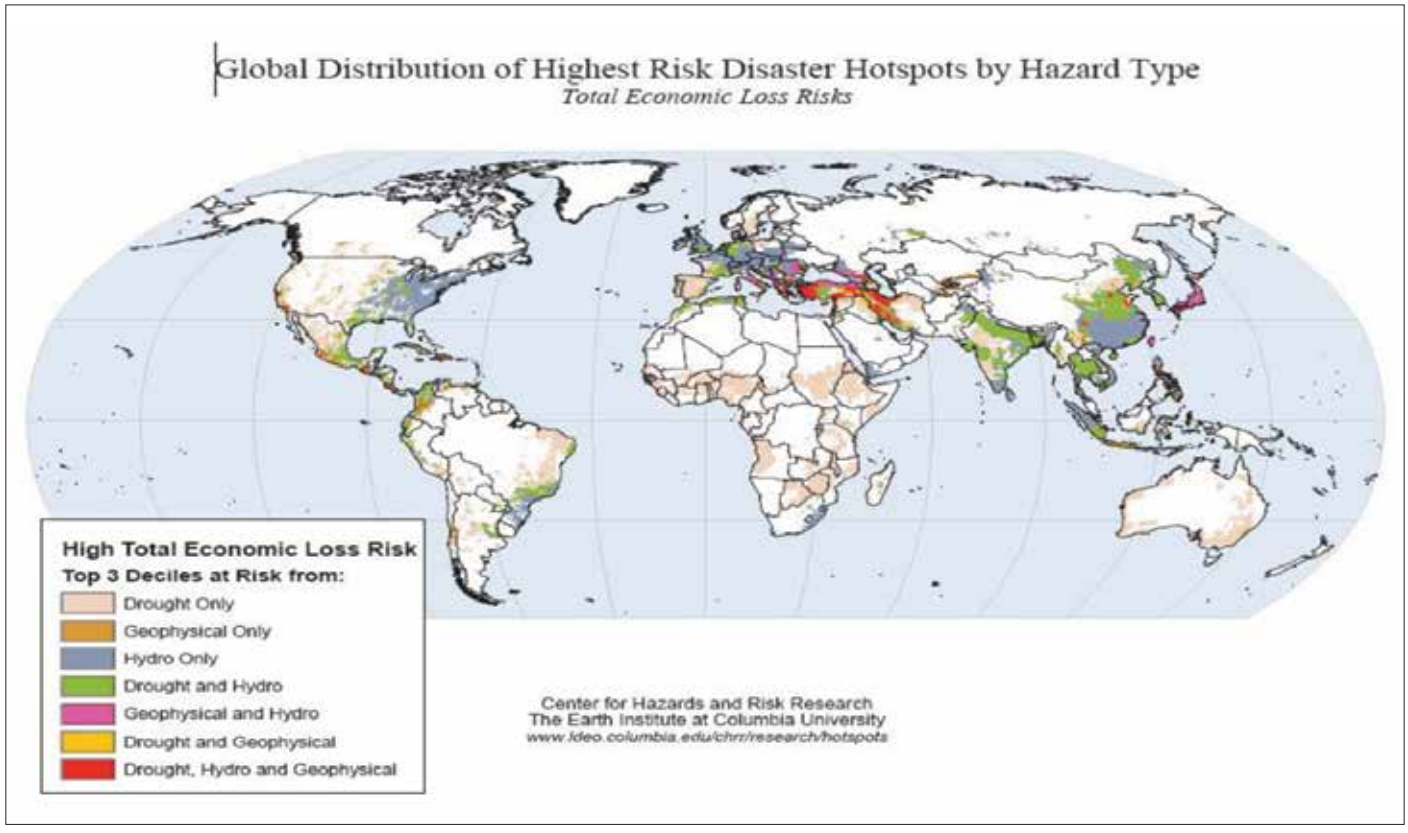

Figure 1. Map Sample for Global Disaster Hotspots Project

Reference: Westen Cv, Alkema D, Damen M, Kerle N, Kingma N. 2011. Multi-hazard risk assessment: Distance education course Guide book, United Nations University. Tokyo.

countered by the society in the case that a potential disaster occurs (10). Specifically, vulnerability is the level of resistance against a disaster. Vulnerability is a phenomenon that may be used in a large field and at different levels. Vulnerability is also considered an environmental hazard, while it is considered as a common product of fragility, security flaw, exposure, and stress. This term has been revealed as a set of terms, such as overlapping sensitiveness, resistance, flexibility, marginality, fragility, and security flaw. O'Keefe (1976) first used the term "vulnerability" with respect to the disasters, while investigating the key role played by the effects of excess geophysical events, rescue, and socioeconomic factors, which led to an intervention failure (11). In the late 1980s and in the early 1990s, two conceptual models were developed to offer a frame for the disaster managers to understand the vulnerability against disasters and reduce it. The first one is a capacity and vulnerability analysis and the second one is a pressure and release model (12). Although the vulnerability is differently perceived by different people, factors and components thereof are classified differently (13). The concept of vulnerability in this study was used as a measurement of resistance capacity of different regions having different economies and disaster reasons against the disasters.

The aim of the vulnerability analysis was to define a suitable activity that can reduce the vulnerability before a damage arising from the potential dangers occurs (14). One of the biggest benefits of vulnerability analysis for different regions is to guide the policy implementers of the government for distributing relief funds to be obtained for these regions and to improve the capacities of these regions to resist against the disasters (11). Vulnerability may be expressed in different ways by performing a vulnerability analysis, such as vulnerability indices, vulnerability curves, fragility curves, and vulnerability tables (15).

A literature review indicated that various studies have been conducted using the Data Envelopment Analysis (DEA) method. For natural disasters in 31 regions of China, effect indices and regional vulnerability indices were obtained using the DEA method in 2004 (11). In this study, DEA and regional vulnerability indices were calculated using economic and social costs experienced in a period of quarter century in Turkey. Thus, the objective of the study was to obtain vulnerability indices of different regions for the disasters socially and economically in Turkey as part of disaster preparedness and risk management. Thereby, another objective of the study was to guide decision makers, policymakers, strategists, and implementers working in the field.

A DEA-Based Model for Evaluating Relative Effect Intensity of Natural Disasters

Features of decision-making units (DMUs) are combined and a "virtual" DMU or region is created using this method to visualize the DMUs. The weights to be used for visualizing the DMUs are selected such that an efficiency value for these units (or a disaster effect index) is maximized. There is a relevant linear programming model for each region considered, as in the following (16):

Minimize $Q(i_0)$ subject to,

$$\sum_{i=1}^{n} \lambda_i (i_0)\, \chi^1 (i) \le \chi^1 (i_0)$$

$$\sum_{i=1}^{n} \lambda_i (i_0)\, \chi^2 (i) \le \chi^2 (i_0)$$

$$\sum_{i=1}^{n} \lambda_i (i_0)\, y^2 (i) \ge y^1 (i_0)$$

$$\sum_{i=1}^{n} \lambda_i (i_0)\, y^2 (i) \ge y^2 (i_0) \qquad (1)$$

$$\lambda_i (i_0) \ge 0$$

$$0 < Q (i_0) \le 1$$

Where in χ^1 (i) indicates GDP of i^{th} region; χ^2 (i) indicates total population of i^{th} region ($i=1,2,\ldots,n$); y^1 (i) indicates total economic loss of i^{th} region arising from the disasters; and y^2 (i) indicates total population of i^{th} region affected by the disasters. In addition i_0 is the evaluated region; $\lambda_i (i_0)$ ($i=1,2,\ldots,n$) is the evaluated region; and i_0^{th} region is the weight of i^{th} region.

Subsequently, $Q (i_0)$ shows relative intensity of the disaster for the region i_0. This value is always $Q (i_0) \le 1$ and if $Q (i_0) = 1$ for the region i_0, indicating that this region has been affected from the disaster most intensely. A low value indicates that the region has been effected mildly. $Q (i_0)$ is used as "activity" in DEA literature, while it is used as "intensity index for disasters" in this study. DEA separates the inputs and outputs, for example, it does not arbitrarily decide on relative contribution of human loss on loss of property. Thus, there is a sum of n models for the regions i_0=0.1,…,n. When all these linear programming models are encoded, we thereby calculate the intensity index of the natural disasters for all n regions.

Calculation of Regional Vulnerability Indices Using Relative Effect Intensity of Natural Disasters

With the previous model, disaster intensity indices of the regions were calculated in accordance with years. However, a combined intensity index of the regions was also calculated; the vulnerability index of each region is thus obtained. Here to calculate vulnerability index of n region, effect intensity indices in each period should be considered. In this study, arithmetic averages of the calculated effect intensity indices in accordance with the number of periods were calculated, thereby vulnerability indices of these regions were calculated. For t. year of first region among N regions, when the effect intensity index ($t=1,2,\ldots,T$) is Q (i,t) and the number of assessed period is T, then the vulnerability index of the first region is $\emptyset (i) = 1/T \sum_{t=1}^{T} Q (i,t)$.

Materials and Methods

In the study, data of disasters occurred in Turkey between 1987 and 2011 were used. Earthquake, flood, landslip, fire, avalanche, and refugee invasion events were regarded as disaster types. Data relating to disasters

Table 1. Vulnerability Indices of Natural Disasters Occurred in 26 Regions of Turkey between 1987–1999 (1st Period) as Calculated Using DEA

Region	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Mean
TR10-İstanbul	0.687	0.001	0.004	0.002	0.001	0	0.066	0.004	0.076	0	0.01	0.015	0.296	0.089
TR21-Tekirdağ, Edirne, Kırklareli	0.001	0.002	0.007	0.002	0.003	0.01	0.001	0.002	0	0	0	0.014	0.002	0.003
TR22-Balıkesir, Çanakkale	0.001	0.003	0.006	0.023	0.002	0	0.001	0.002	0	0	0	0	0	0.003
TR31-İzmir	0.001	0.001	0.004	0.002	0.001	0.004	0.001	0.004	0.032	0	0	0	0	0.004
TR32-Aydın, Denizli, Muğla	0.001	0.001	0.742	0.001	0.001	0.003	0.211	0.002	0.008	0	0.006	0	0.004	0.075
TR33-Manisa, Afyon, Kütahya, Uşak	0.009	0.003	0.003	0.009	0.001	0	0	0.392	1	0.018	0	0	0.002	0.110
TR41-Bursa, Eskişehir, Bilecik	0.001	0.001	0.003	0.001	0.001	0	0	0.001	0	0	0	0	0.001	0.001
TR42-Kocaeli, Sakarya, Düzce, Bolu, Yalova	0.089	0.001	0.004	0.055	0.21	0.001	0.01	0.001	0	0	0.041	0	1	0.109
TR51-Ankara	0.127	0.001	0.005	0.002	0.001	0	0.026	0.004	0.006	0	0	0	0	0.013
TR52-Konya. Karaman	0.001	0.001	0.716	0.002	0.002	0	0.001	0.003	0	0	0.028	0	0	0.058
TR61-Antalya, Isparta, Burdur	0.001	0.001	0.004	0.204	0.927	0	0.001	0.002	0.029	0.015	0.015	0	0	0.092
TR62-Adana, Mersin	0.08	0.001	0.003	0.001	0.519	0.002	0.001	0.003	0	0	0	1	0.192	0.137
TR63-Hatay, Kahramanmaraş, Osmaniye	1	0.001	0.005	0.002	0.002	0	0.001	0.004	0.001	0.014	1	0	0.004	0.156
TR71Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir	1	0.002	0.246	0.002	0.002	0	0.001	0.002	0	0	0	0	0.003	0.097
TR72-Kayseri, Sivas, Yozgat	0.001	0.008	0.031	0.068	0.148	0	0	0.003	0.002	0.042	0.006	0.007	0	0.024
TR81-Zonguldak, Karabük, Bartın	0.001	0.002	0.008	0.003	1	0	0.07	0.462	0.004	0	0	1	0	0.196
TR82-Kastamonu, Çankırı, Sinop	0.817	0.011	0.016	1	0.504	0.005	0.236	1	0.006	0	0	0	0.007	0.277
TR83-Samsun, Tokat, Çorum, Amasya	0.19	0.006	0.025	0.001	0.072	0	0.003	0.061	0	1	0	0	0	0.104
TR90Trabzon,Ordu, Giresun, Rize, Artvin, Gümüşhane	0.217	0.03	0.979	1	0.043	0.009	0.168	0.409	0.013	0.013	0.028	0.013	0.001	0.225
TRA1-Erzurum, Erzincan, Bayburt	0.001	0.115	1	1	0.575	1	0.737	0.673	0.003	0	0	0.002	0.014	0.394
TRA2-Ağrı, Kars, Iğdır, Ardahan	0.003	1	0.19	0.035	1	0	0.001	0.005	0	0	0.087	0	0	0.179
TRB1-Malatya, Elazığ, Bingöl, Tunceli	0.378	0.083	0.216	0.002	0.896	0.058	1	0.253	0.007	0.206	0.026	0.255	0.001	0.260
TRB2-Van,Muş, Bitlis, Hakkari	1	0.033	0.173	0.266	0.421	0.024	1	0.004	0.013	0.224	0	0.011	0	0.244
TRC1-Gaziantep, Adıyaman, Kilis	0.079	0.001	0.005	0.017	0.002	0	0.028	0.14	0.001	0.011	0	0	0	0.022
TRC2-Şanlıurfa, Diyarbakır	0.001	0.001	0.006	0.002	0.001	0	0.001	0.005	0.002	0	0	0	0	0.002
TRC3-Mardin, Batman, Şırnak, Siirt	0.001	0.002	0.153	0.003	0.002	0.028	0.14	0.41	0.006	0.012	0	0	0	0.058
Mean	0.219	0.050	0.175	0.142	0.244	0.040	0.142	0.148	0.047	0.060	0.048	0.089	0.047	0.112

were obtained from annual activity reports of TDDB and T.R. Red Crescent of previous years (17). Data relating to country population and GDP of the regions were obtained from national statistics departments with population and demography published in the official website of Turkey Statistical Institute (TÜİK) (18). The population belonging to the years when population census was not conducted for regional population was determined by averaging of the next and the previous population numbers. Moreover, 2002 and 2003 region-specific missing GDP data were also obtained by averaging the next and the previous years' data. The study was applied on 26 regions as published by regional GDP values of TÜİK.

In the study, vulnerability indices of the disasters were calculated using the DEAP 2.1 program with data envelopment analysis-based, output-oriented Malmquist Total Productivity Index method. Total population and total GDP of the regions were used as inputs; total number of population affected from the disasters in that region and total economic loss incurred by the disasters were used as outputs in the method. This study was prepared in accordance with the Helsinki Declaration.

Results

The vulnerability indices and economic data of 26 regions of Turkey obtained from the study are explained below in the form of tables.

According to Table 1 and Table 2, when arithmetic average values of the vulnerability indices of the regions are examined, this value was 0.112 for 1987-1999 (first period) and 0.113 for 1999-2011 (second period).

Table 2. Vulnerability Indices of Natural Disasters Occurred in 26 Regions of Turkey between 2000–2011 (2nd Period) as Calculated Using DEA

Region	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Mean	1987-2011 Mean
TR10-İstanbul	0	0	0	0	0	0.001	0	0.009	0.187	0.469	0.009	0	0.056	0.073
TR21-Tekirdağ, Edirne, Kırklareli	0	0.155	0	0	0	0	0.059	0.039	0.001	1	0.054	0	0.109	0.054
TR22-Balıkesir, Çanakkale	0	0	0.011	0	0	0	0	0	0.001	0	0.056	0	0.006	0.004
TR31-İzmir	0	0	0	0.02	1	0	0	0.018	0.001	0.476	0.011	0	0.127	0.063
TR32-Aydın, Denizli, Muğla	0	0	0	0.021	0	0	0	0.179	0.001	0.081	0.069	0.001	0.029	0.053
TR33-Manisa, Afyon, Kütahya, Uşak	0	0	1	0	0	0	0	0.122	1	0	0.032	0.016	0.181	0.144
TR41-Bursa, Eskişehir, Bilecik	0	0	0	0	0	0	0.062	0.001	0.001	0.005	0.128	0	0.016	0.008
TR42-Kocaeli, Sakarya, Düzce, Bolu, Yalova	0.017	0.003	0	0.002	0.002	0.004	0	0.038	0.004	0.071	0.032	0	0.014	0.063
TR51-Ankara	0.042	0	0	0	0.001	0.046	0	0.041	0.024	0.004	0.007	0	0.014	0.013
TR52-Konya, Karaman	1	0	0	0	0.004	0	0	0.027	0.001	0	0	0	0.086	0.071
TR61-Antalya, Isparta, Burdur	0	0	0	0.006	0	0	0	0.019	0.138	0.006	0.003	0	0.014	0.055
TR62-Adana, Mersin	0	1	0.004	0	0.078	0	0	0.011	0.688	0.216	0.017	0	0.168	0.153
TR63-Hatay, Kahramanmaraş, Osmaniye	0	0.664	0	0.002	0	0.303	0.513	0	0.008	0.305	0.001	0.105	0.158	0.157
TR71Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir	0	0	0	0	0	0.022	0	0.011	0.002	0	0	0	0.003	0.052
TR72-Kayseri, Sivas, Yozgat	0	0	0.007	0	0	0.455	0	0	0.016	0.117	0	0	0.050	0.036
TR81-Zonguldak, Karabük, Bartın	0	0	0	0	0	0.001		0.134	0.146	1	0.038	0	0.110	0.155
TR82-Kastamonu, Çankırı, Sinop	1	0.048	0.004	0	0	0.346	0.097	0.874	0.658	0.013	0.042	0.001	0.257	0.267
TR83-Samsun, Tokat, Çorum, Amasya	0.149	0.007	0.001	0	0.001	0.913	0.031	0.018	0.084	0.015	0	0.001	0.102	0.103
TR90Trabzon,Ordu, Giresun, Rize, Artvin, Gümüşhane	0	0.118	0.004	0	0.006	0.1	0.127	0.094	0.055	0.715	0.007	0.001	0.102	0.166
TRA1-Erzurum, Erzincan, Bayburt	0	0.391	0.001	0.001	1	0.764	0	0.416	0.254	0.031	0.088	0.001	0.246	0.323
TRA2-Ağrı,Kars, Iğdır, Ardahan	0	0.053	0.011	0.005	0.58	0.001	0.061	1	0.502	0.073	0.454	0.001	0.228	0.202
TRB1-Malatya, Elazığ, Bingöl, Tunceli	0	0	0.002	1	0.116	1	0.01	0.243	0.417	0	1	0.003	0.316	0.287
TRB2-Van, Muş, Bitlis, Hakkari	0	0	0.014	0.006	0.113	0.372	0.494	1	1	0.424	0.031	1	0.371	0.305
TRC1-Gaziantep, Adıyaman, Kilis	0	0	0	0	0.03	0	0	0	0.001	0	0.02	0	0.004	0.013
TRC2-Şanlıurfa, Diyarbakır	0	0	0	0	0	0	1	0	0.009	0	0	0	0.084	0.041
TRC3-Mardin, Batman, Şırnak, Siirt	0	0	0	0	0	0	1	0.012	0.002	0	0.026	0.001	0.087	0.072
Mean	0.085	0.094	0.040	0.041	0.113	0.167	0.133	0.166	0.200	0.193	0.080	0.040	0.113	

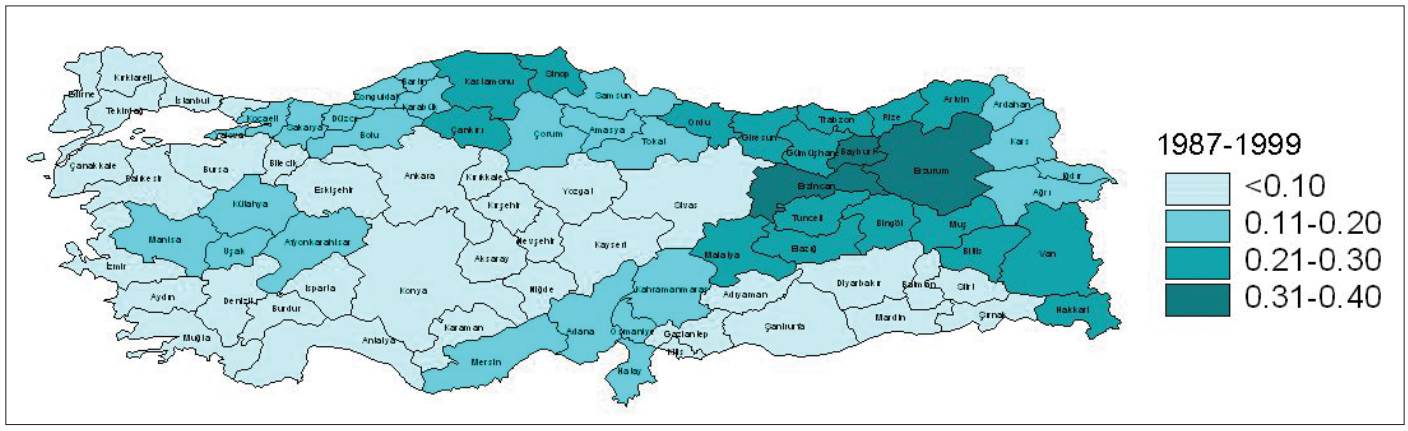

Figure 2. Vulnerability Index Map of Turkey Regions between the years 1987–1999

Figure 3. Vulnerability Index Map of Turkey Regions between the years 2000–2011

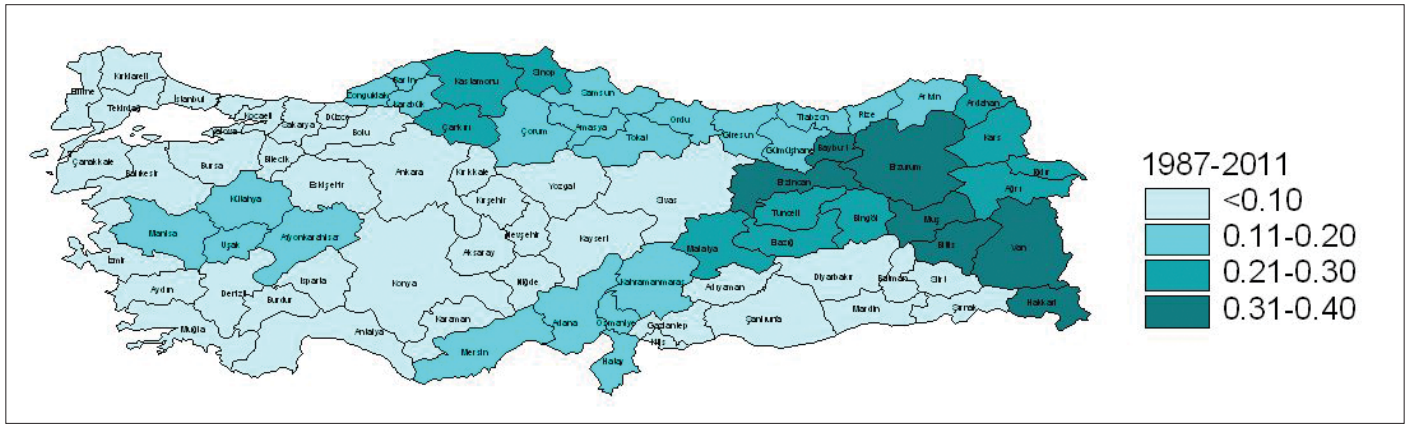

Figure 4. Vulnerability index Map of Turkey Regions between the years 1987–2011

Thus, the vulnerability index averages of the regions were slightly higher in the second period. When total averages of the vulnerability indices of the regions were considered, the regions with the highest value in the first period were TRA1, TRB2, and TRB1 regions. In the second period, the regions with the highest vulnerability indices are TRB2 (0.371), TRB1 (0.316), and TR82 (0.257). It was noted that there is a differentiation in terms of regions in the first and second periods.

When vulnerability indices of the years were examined over the averages, it was noted that 1991 (0.244), 1987 (0.219), and 1989 (0.175) stand out in the first period and averages of 2008 (0.200), 2009 (0.193), and 2007 (0.166) years are high in the second period.

When Figure 2 is examined, the regions with the highest vulnerability for 1987–1999 are noted generally in Eastern Anatolia and Eastern Black Sea Regions. The reason is that flood and landslide disasters are common in Eastern Black Sea Region, and flood, landslide, avalanche, and earthquake disasters are common in Eastern Anatolia Region. Moreover, the Central Black Sea section of Black Sea Region was noted to have high vulnerability index due to the intensity of floods and landslides along with frequent bush fire disasters in Kastamonu Province. In the west of the country, Afyonkarahisar and Kütahya were noted to be among the most intense regions in terms of vulnerability.

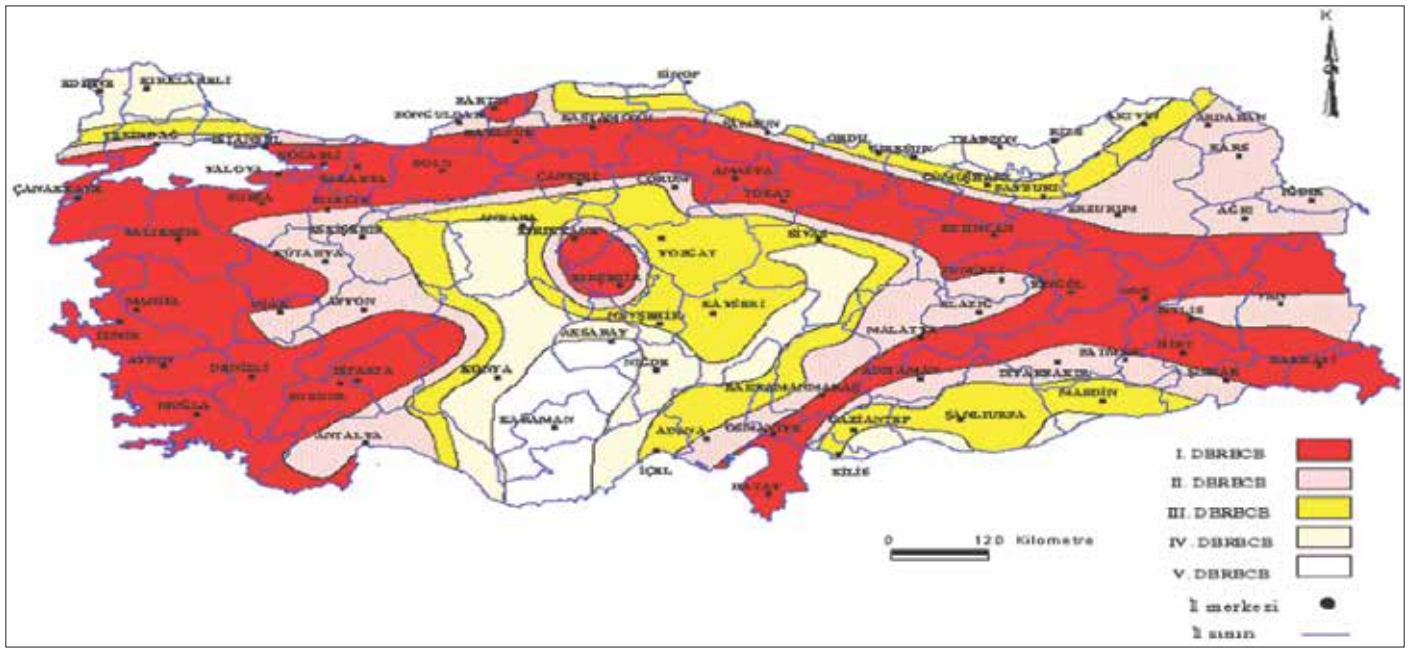

Figure 5. Map of Turkey Earthquake Regions
Reference: http://www.e-sehir.com/turkiye-haritasi/deprem-fay-haritasi.php

According to Figure 3, although the vulnerability index intensity of the regions for 2000–2011 shows similarity with Figure 2, the regions with the highest intensities are the southern zones of Eastern Anatolia Region. In addition, the intensity of the Eastern Black Sea Region was decreased with respect to the previous period. In this period, the Central Black Sea Region has a similar intensity with the previous period. In the west, the intensity is expanded by incorporating Trakya Region.

When total index map of all periods were examined, it was seen that the intensity generally contains Eastern Anatolia Region of the country. Moreover, the intensity was in the same regions in the central zone of the Black Sea Region. The intensity in the western zones was noted to increase in the internal zones of Aegean Region (Figure 4).

Although the study contains general disaster types, according to the vulnerability index map, the places with the highest intensity in terms of vulnerability is noted to overlap with the regions containing the Northern Anatolia Fault Line in the north, and the Eastern Anatolia Fault Line in the east. Moreover, it is noticed that the region containing Western Anatolia Fault Line in Aegean Region has similar high intensity in terms of vulnerability. According to the maps of vulnerability index, it is understood that the regions with the highest vulnerability in Turkey are the first-degree earthquake regions. From this aspect, it may be suggested that the vulnerability maps show similarity with the earthquake map of Turkey (Figure 5).

Based on Table 3, TRB2 region (1987, 1993, 2007, 2008, and 2011), we noticed that on five occasions, the vulnerability index was 1.0. Besides, as for TRB1 region (1993, 2003, 2005, and 2010), it was noticed that the vulnerability indexes were equal to 1 in a total of four occasions. For the TRA1 region (1989, 1992, and 2004), TR82 region (1990, 1994, and 2000), TR33 region (1995, 2002, and 2008), and TR81 regions (1991, 1998, and 2009), it was noticed that the vulnerability indexes were equal to 1 in three occasions. The vulnerability index is equal to 1 in two occasions in the TR63 (1987 and 1997) and TRA2 and TR62 regions (1988 and 1991).

Regions are classified according to their vulnerability indices, as shown in Table 4. According to this classification, Turkey's regions with the highest vulnerability index values (range, 0.31–0.40) are TRA1 (0.323) and TRB2 (0.305). While according the results of Table 1, one of the three regions with the highest vulnerability index (TRA1) can also be seen as the highest on Table 4. One of the three regions (TRB2) with the highest impact force index according to Table 2 is also of the highest vulnerability according to Table 4. According to the vulnerability index values, the country's most fragile regions are TRA1 (0.323), while the least fragile is the TR22A (0.004).

From the aspect of the economic losses caused by natural disasters, the average annual economic losses are highest in TR42–Kocaeli, Sakarya, Düzce, Bolu, Yalova, followed by TRB2–Van, Mus, Bitlis, Hakkari, TR71–Kırıkkale, Aksaray, Nigde, Nevsehir, Kırşehir, TR63–Hatay, Kahramanmaras, Osmaniye, TRB1–Malatya, Elazığ, Bingöl, Tunceli, TR10–Istanbul, TR33–Manisa, Afyon, Kutahya, and Usak regions. The average rate of economic losses as a percentage of GDP are highest in TRB2–Van, Mus, Bitlis, Hakkari, followed by TR42–Kocaeli, Sakarya, Düzce, Bolu, Yalova, TR71–Kırıkkale, Aksaray, Nigde, Nevsehir, Kırşehir, TRB1–Malatya, Elazığ, Bingöl, Tunceli, TR63–Hatay, Kahramanmaraş, and Osmaniye regions (Table 5).

Discussion

On an average, the vulnerability indices obtained for the regions of Turkey in the two periods 1987-1999 (first period) and 2000-2011 (second period) were discussed. When vulnerability index averages for both periods were considered, the second period average was slightly higher than the first period average. This result appears to support the idea that the disasters in Turkey have generally an increasing trend after the year 2000 with respect to the studies previously conducted.

In a similar study, Wei and colleagues obtained vulnerability indices of different regions of China in 2004. In the study conducted by

Table 3. Regions Affected Most Intensely from Disasters for Each Year between the years 1987–2011 (Regions with Vulnerability index equaling to 1)

Years	DMU
1987	TR63–Hatay, Kahramanmaraş, Osmaniye
	TR71–Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir
	TRB2–Van, Muş, Bitlis, Hakkari
1988	TRA2–Ağrı, Kars, Iğdır, Ardahan
1989	TRA1–Erzurum, Erzincan, Bayburt
1990	TR82–Kastamonu, Çankırı, Sinop
1991	TR81–Zonguldak, Karabük, Bartın
	TRA2–Ağrı, Kars, Iğdır, Ardahan
1992	TRA1–Erzurum, Erzincan, Bayburt
1993	TRB1–Malatya, Elazığ, Bingöl, Tunceli
	TRB2–Van, Muş, Bitlis, Hakkari
1994	TR82–Kastamonu, Çankırı, Sinop
1995	TR33–Manisa, Afyon, Kütahya, Uşak
1996	TR83–Samsun, Tokat, Çorum, Amasya
1997	TR63–Hatay, Kahramanmaraş, Osmaniye
1998	TR62–Adana, Mersin
	TR81–Zonguldak, Karabük, Bartın
1999	TR42–Kocaeli, Sakarya, Düzce, Bolu, Yalova
2000	TR52–Konya, Karaman
	TR82–Kastamonu, Çankırı, Sinop
2001	TR62–Adana, Mersin
2002	TR33–Manisa, Afyon, Kütahya, Uşak
2003	TRB1–Malatya, Elazığ, Bingöl, Tunceli
2004	TR31–İzmir
	TRA1–Erzurum, Erzincan, Bayburt
2005	TRB1–Malatya, Elazığ, Bingöl, Tunceli
2006	TRC2–Şanlıurfa, Diyarbakır
	TRC3–Mardin, Batman, Şırnak, Siirt
2007	TRA2–Ağrı, Kars, Iğdır, Ardahan
	TRB2–Van, Muş, Bitlis, Hakkari
2008	TR33–Manisa, Afyon, Kütahya, Uşak
	TRB2–Van, Muş, Bitlis, Hakkari
2009	TR21–Tekirdağ, Edirne, Kırklareli
	TR81–Zonguldak, Karabük, Bartın
2010	TRB1–Malatya, Elazığ, Bingöl, Tunceli
2011	TRB2–Van, Muş, Bitlis, Hakkari

Wei and colleagues, 31 regions comprising the whole of China were discussed, and disaster data for 1989-2000 were used as data of the study. In this study, 26 regions containing the whole Turkey and the disaster data for 1987-2011 were used as data. Moreover, in the study

Table 4. Vulnerability Classification of Regions of Turkey over Averages on Basis of Vulnerability Index

Vulnerability index	Region
<0.10	TR22–Balıkesir, Çanakkale (0.004),
	TR41–Bursa, Eskişehir, Bilecik (0.008),
	TR51–Ankara (0.013),
	TRC1–Gaziantep, Adıyaman, Kilis (0.013),
	TR72–Kayseri, Sivas, Yozgat (0.036),
	TRC2–Şanlıurfa, Diyarbakır (0.041)
	TR71–Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir (0.052),
	TR61–Antalya, Isparta, Burdur (0.055),
	TR52–Konya, Karaman (0.071),
	TRC3–Mardin, Batman, Şırnak, Siirt (0.072)
	TR21–Tekirdağ, Edirne, Kırklareli (0.080),
	TR32–Aydın, Denizli, Muğla (0.080),
	TR42–Kocaeli, Sakarya, Düzce, Bolu, Yalova (0.080)
0.11–0.20	TR83–Samsun, Tokat, Çorum, Amasya (0.103),
	TR31–İzmir (0.110),
	TR10–İstanbul (0.120),
	TR33–Manisa, Afyon, Kütahya, Uşak (0.144),
	TR62–Adana, Mersin (0.153),
	TR81–Zonguldak, Karabük, Bartın (0.155)
	TR63–Hatay, Kahramanmaraş, Osmaniye (0.157),
	TR90–Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane (0.166)
0.21–0.30	TRA2–Ağrı, Kars, Iğdır, Ardahan (0.202),
	TR82–Kastamonu, Çankırı, Sinop (0.267),
	TRB1–Malatya, Elazığ, Bingöl, Tunceli (0.287)
0.31–0.40	TRB2–Van, Muş, Bitlis, Hakkari (0.305),
	TRA1–Erzurum, Erzincan, Bayburt (0.323)
0.41–0.50	
>0.50	

conducted for China, the vulnerability index table was shown with only one table due the presence of less number of periods, while two tables were shown as the 1987-1999 period and the 2000-2011 period in this study. Thus, the comparison of both periods became possible. In the study conducted by Wei et al. (11), the regions with disaster effect intensity index equaling to 1 were gathered in 1989 (six regions) at most, while in 1987 (three regions) in this study. In the classification of the vulnerability indices, regions were gathered in the range of 0.41-0.50 at most (13 regions), while regions were gathered in the range of 0–0.10 at most (nine regions) in this study. In the study conducted in 2004, the vulnerability indices of three regions with the highest vulnerability index were, respectively, 0.52, 0.60, and 0.62, while in this study, the vulnerability indices of three

Table 5. Average Annual Economic Losses Resulting from Disasters of Regions between the years 1987–2011

Region	Average annual economic losses (million TL)	Average economic losses as a percentage of GDP
TR10–İstanbul	17.980	0.024%
TR21–Tekirdağ, Edirne, Kırklareli	0.038	0.0004%
TR22–Balıkesir, Çanakkale	0.010	0.0002%
TR31–İzmir	0.110	0.0006%
TR32–Aydın, Denizli, Muğla	0.150	0.001%
TR33–Manisa, Afyon, Kütahya, Uşak	5,562	0,05%
TR41–Bursa, Eskişehir, Bilecik	0.026	0.0001%
TR42–Kocaeli, Sakarya, Düzce, Bolu, Yalova	427.809	2.3%
TR51–Ankara	0.040	0.0002%
TR52–Konya, Karaman	0.212	0.003%
TR61–Antalya, Isparta, Burdur	0.141	0.001%
TR62–Adana, Mersin	0.775	0.006%
TR63–Hatay, Kahramanmaraş, Osmaniye	21.405	0.3%
TR71–Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir	34.736	0.6%
TR72–Kayseri, Sivas, Yozgat	0.041	0.0005%
TR81–Zonguldak, Karabük, Bartın	0.644	0.013%
TR82–Kastamonu, Çankırı, Sinop	0.257	0.009%
TR83–Samsun, Tokat, Çorum, Amasya	0.280	0.003%
TR90–Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane	0.446	0.005%
TRA1–Erzurum, Erzincan, Bayburt	1.979	0.06%
TRA2–Ağrı, Kars, Iğdır, Ardahan	0.384	0.016%
TRB1–Malatya, Elazığ, Bingöl, Tunceli	20.589	0.4%
TRB2–Van, Muş, Bitlis, Hakkari	80.576	2.4%
TRC1–Gaziantep, Adıyaman, Kilis	0.058	0.001%
TRC2–Şanlıurfa, Diyarbakır	0.354	0.006%
TRC3–Mardin, Batman, Şırnak, Siirt	0.338	0.008%
General mean	23.652	0.239%

regions with the highest vulnerability index were, respectively, 0.33, 0.36, and 0.38.

Cardona performed an implementation of an indicator system in the USA within the scope of disaster risk management with a different method in 2004 and collected Disaster Deficit Index, Local Disaster Index, Prevalent Vulnerability index (PVI), and Risk Management Index values of the regions (19). In a section of the study conducted, ratio of the economic losses to the GDP and socioeconomic vulnerability of 12 regions of the USA over the society exposed to the disasters were calculated. These vulnerability values were separately calculated for the years 1985, 1990, 1995, and 2000 over 100 full points, for example, socioeconomic vulnerability values of different regions for the year 2000 were found in the range of 20–62. Bollin and Hidajat (20) calculated danger, exposure, vulnerability, capacity, and risk indices of some regions of Indonesia within the scope of society-based disaster risk index with a different method in the year 2006. In this study, index values of two regions called as Sikka and Kulon Progo were compared. The index values were calculated over 100 points, and the vulnerability indices were 21 for two regions, while the risk indices were respectively obtained as 56 and 54. In a study conducted for Barbados in 2010, the PVI values of the country for the years 1985, 1990, 1995, 2000, 2005, and 2007 were obtained. According to the results found, common vulnerability index values of this country had values ranging from 39.342 to 45.493 (21).

Moreover, in a study conducted by Birkmann in (22) 2007, applications for obtaining risk and vulnerability indices using different scales were compared. At the end of the study, there is a need of more researches and studies relating to this subject for learning environmental security flaws, learning how to increase medium- and long-term flexibility for natural and sudden dangers, and discovering institutional and environmental vulnerabilities. In a study conducted on Turkey provinces by Ozceylan and Coskun in (23) 2012, socioeconomic vulnerability indices of the provinces in terms of earthquake were determined. The provinces with socially and economically the highest vulnerability as a result of this study were Şanlıurfa, Şırnak, Hakkari, Siirt, Batman, Van, Gaziantep, Ağrı, Mardin, and Diyarbakır. On comparison of two studies in terms of the highest values, Van and Hakkari were the overlapping provinces.

Conclusion

The DEA method is known to be applicable in a variety of fields and enables the achievement of a single value over interaction of a number of variables. The single value obtained enables the researchers to make comparisons among units, regions, and/or classifications. The feature of the model for being used effectively popularizes the use of the model.

In this study, the DEA method enabled the conversion of economic and social costs as a result of disasters in 26 regions of Turkey to vulnerability indices. A picture of the whole country over a period of 25 years in terms of disasters was captured. In the picture, economic and social costs endured due to disasters are noted to be separated into two regions starting from the region of Eastern Anatolia and the north branch extends across the Black Sea region and the other south branch reaches to the Mediterranean. Moreover, the presence of an area as an inlet in the Aegean Region is observed. The Central Anatolia, Southeastern Anatolia, Marmara, and partially the Aegean Region may said to be exposed to disasters losses.

The fact that Turkey vulnerability index maps obtained overlap with the Turkey earthquake map, the Earth disaster map may be regarded as a confirmation of the reliability of the study results.

The 1999 Kocaeli and 2011 Van earthquakes stand out in terms of economic losses; it is seen that Van and Erzincan regions have the highest vulnerability index in terms of earthquakes, and the Black Sea region is an important disaster area in terms of floods, landslips. and deluges. It is suggested that the vulnerability indices provided for Turkey are used in region- and province-level arrangements; in organizational structure, logistic and human resources planning and development; and in improvement of risk analysis, strategic planning and management applications by Prime Ministry Disaster and Emergency Management Authority (AFAD) being a new organization in Turkey. Moreover, it is thought that these study results shall form a ground for policymakers and resource allocation managers, shall guide the applicators in the field, and shall lead to information production studies in the field of disaster management.

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 approval was not obtained because patient information was not used in this study.

Peer-review: Externally peer-reviewed.

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Factors Influencing the Reactions of Relatives of Arrested Patients Receiving CPR and Reactions to the News of Their Deaths

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Abstract

Aim: Although various studies in the literature have focused on the delivery of bad news, data originating from the emergency services about the factors influencing relatives' reactions are insufficient. To evaluate the reactions of patients' relatives to the receipt of bad news in the emergency department and the factors influencing these reactions.

Materials and Methods: The study was performed in the Gaziantep University Faculty of Medicine Department of Emergency Medicine (Group 1) and the emergency departments of state hospitals in Gaziantep (Group 2) between May 2014 and May 2015. The physicians in Group 1 had received training in communicating bad news to relatives. The physicians in Group 2 had not received such training. The approaches of the physicians to the delivery of bad news and the reactions of the patients' relatives were recorded in prepared forms.

Results: Each group included 100 patients who underwent resuscitation. The rates of briefing relatives and information provision about the possibility of arrest were higher in Group 1. The main reaction of the relatives in Group 1 was crying, whereas the relatives in Group 2 had multiple negative reactions. Many of the relatives in Group 2 committed violence in order to see their loved ones during Cardiopulmonary Resuscitation (CPR). When the data for both groups were combined, the rates of negative responses were highest for cases of unexpected death and male patients.

Conclusion: The degree of affinity to the patient, the frequency and type of information provided to relatives during and after resuscitation, and informing relatives after allowing them into the resuscitation room to see their loved ones affected relatives' reactions.

Keywords: Cardiac arrest patient, emergency care, bad news, patient's relatives, factors affecting reactions

Introduction

Bad news, which is any news that threatens an individual's physical and emotional well-being and adversely affects that person's life, can potentially lead to unexpected reactions (1). It is painful to know that someone's death is close. In our daily lives, we try to ignore death, but it remains a reality that affects thousands of households every day (2). Such news results in different reactions and responses (2) as the person strives to cope with the new situation. Different definitions and perceptions of death in diverse cultures, societies, and disciplines, in addition to the individual's character, age, and religion, may dictate the reactions to news of a death (3). Explanations of death that draw on loss of an organism's ability to renew itself do not have a provision in the hearts, minds, hearts, and emotions of a patient's relatives.

Emergency departments are the places that individuals most commonly hear the devastating news of their relative's death. The death may negatively affect emergency service staff, especially the physicians who have to deliver the bad news. Emergency service staff may not feel ready or able to cope with relatives' intense responses and fear being blamed for the death (4, 5).

The most common suggestions for coping with this sad experience are creating opportunities for the patients' relatives to witness

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the resuscitation and educating hospital staff in the delivery of bad news, so that they can do so in a gentle, empathetic, and humane way (6, 7). Delivering bad news in an unprofessional way can expose emergency service staff to violence, and it can cause psychological damage and occupational burnout (8-10). Emergency staff can address this challenge by engaging in kind and reassuring communication with relatives and providing appropriate information based on their knowledge and expectations of normal emotional responses in such situations.

Based on a review of the literature, it is evident that there have been no thorough studies of the reactions of relatives to news of a patient's death and the factors influencing these reactions. The aim of this study was to examine the reactions of relatives to the news of the death of a loved one and the factors that positively or negatively affected their reactions.

Materials and Methods

Population and sample

This was a prospective study of the emergency services of Gaziantep University Şahinbey Research and Application Hospital (Group 1) and two state hospitals (Dr. Ersin Arslan Hospital and Şehitkamil State Hospital) (Group 2) between 1 May 2014 and 1 May 2015. The study was approved by Gaziantep University Faculty of Medicine Ethics Committee (Date: 14.05.2012; approval no: 14.05.2012/203). The study protocol was executed according to the Helsinki Declaration.

Study Centers

Group 1: Gaziantep University Şahinbey Research and Application Hospital (adult emergency service)

- There were four emergency medicine physicians and 20 assistants (eight of whom had at least two years of experience) on duty.
- There were 20 examination stretchers, 10 observation beds, 2 resuscitation rooms, 1 surgical intervention room, and 1 critical care room.
- Between May 2014 and May 2015, 113,000 patients were admitted to the emergency department for health care. Of those, 3500 (3%) were trauma patients. All the patients were older than 16 years (patients younger than 16 yearswere admitted to the children's emergency department).
- All Cardiopulmonary Resuscitation (CPR) was performed by emergency medicine physicians and assistants.
- During the 12-month study period, 150 patients (0.1%) underwent CPR, and CPR was unsuccessful (patients died) in 110 (73.3%) of those cases.

Group 2: Gaziantep Dr. Ersin Arslan Hospital and Şehitkamil State Hospital

- There were 5 emergency medicine physicians and 13 general practitioners in Dr. Ersin Arslan State Hospital and 7 emergency medicine physicians and 15 general practitioners in Şehitkamil State Hospital.
- There were 18 examination stretchers, 1 trauma room, 2 resuscitation rooms, and a 12-bed monitored area in Dr. Ersin Arslan State Hospital.
- There were 10 examination stretchers, 2 resuscitation rooms, a 30-bed monitored area, and 1 surgical intervention room in Şehitkamil State Hospital.
- Between May 2014 and May 2015, approximately 500,000 patients were admitted to Dr. Ersin Arslan State Hospital, and 440,000 patients were admitted to Şehitkamil State Hospital for diagnosis and treatment. Of those, 18,500 (2%) were trauma patients, and the remainder had urgent internal problems.
- In both hospitals, adults and children were examined in the same emergency departments.
- During the 12-month study period, 720 (0.07%) patients underwent CPR, and CPR was unsuccessful in 390 (54.2%) of those cases.

Cardiopulmonary Resuscitation and advanced cardiac life support were performed in all patients based on American Heart Association guidelines (11). All the procedures took place in emergency service resuscitation rooms. In all cases, the attending physician delivered the news of the patient's death to the relatives.

Inclusion criteria

- Patients with cardiac arrest who were accompanied by relatives but passed away despite medical interventions.
- Patients older than 16 years.
- Patients who were citizens of the Republic of Turkey.
- CPR procedures started and ended in the emergency department.
- CPR procedures performed by emergency medicine physicians or assistants with over two years of experience and trained in the delivery of bad news.

Exclusion or disqualification criteria

- Patients with cardiac arrest who were accompanied by relatives and lived after the intervention .
- Patients younger than 16 years.
- Patients who were not citizens of the Republic of Turkey.
- CPR procedures performed by general practitioners or assistants with fewer than two years of experience (we feel that the CPR delivered by this group is not as effective and may lead to an increased mortality rate in the patients treated by this group).

Case selection

The 12-month study (May 2014 to May 2015) consisted of patients who had cardiac arrest inside or outside the hospitals and died, despite prompt CPR and their relatives. The study was made up of two groups to investigate the impact of training in the delivery of bad news and the experience of the practitioner on relatives' reactions to being told of the death of a loved one.

Group selection

Group 1

Patients who had a cardiac arrest during observation or were admitted with cardiac arrest to Gaziantep University Faculty of Medicine Department of Emergency Medicine were included in Group 1. The doctors (four emergency medicine physicians and eight assistants with at least two years of emergency medicine experience) were informed about emergency crisis management,

when and how to give information to relatives during resuscitation, and how to react to relatives' reactions. They were also shown a 90-min slideshow, with case reports and videos of three real cases of cardiac arrest. This study lasted for two days in total (one day of briefing and debate, and one day of case presentation).They were reminded about the content of the slideshow prior to dealing with the cardiac arrest cases. Their assignments were repeated to them throughout the study. The information always was given to the family by the most senior doctor.

The medical personal provided the first briefing to the relatives outside the resuscitation room after a short examination of the patients. The second and third briefings were made in the resuscitation room after the relatives had seen their loved ones for 10 sec during CPR. The last briefing took place in the resuscitation room just before ending the CPR after the relatives had entered the room and had seen their loved ones. This briefing was made in the presence of hospital security staff. It included an explanation of the interventions and standard statements, such as "patient did not respond to CPR, it would not have made any difference had the CPR been continued and it was appropriate to end the CPR." In addition, the relatives were informed that the deceased patient would be sent to the morgue. Condolences were given to all the relatives of the deceased patients.

Group 2

Patients (Only CPR performed by emergency medical physicians on subjects aged older than 16 years) who had cardiac arrest during observation or were admitted to Dr. Ersin Arslan State Hospital's and Şehitkamil State Hospital's (secondary hospitals) emergency departments with cardiac arrest were included in Group 2. CPR procedures performed by general practitioners and pre-hospital were not included. Unlike Group 1, Group 2 received no training or information on behavior patterns while delivering the news about the death of the patient to the relatives.

Data collection, measuring the reactions, and comparison of the results

A 21-question survey was prepared to evaluate the responses of the relatives and the duration and quality of the medical interventions. The following data were recorded: age, gender, present complaints, cause of arrest and conditions upon arrival to the hospital, expected/unexpected death, relatives' degree of affinity, number of present relatives, informing or not informing relatives, first reaction of relatives during cardiac arrest, duration of resuscitation, location where relatives were informed during and after resuscitation, identity of the person who delivered news of the death, and first reactions of the relatives. Furthermore, to eliminate confounding the forms were completed by four different emergency medicine technicians who were not aware of the differences between the groups. The between-group differences were compared.

Power analysis: Sample size was determined to detect a significant difference between expected negative reaction rates of relatives of arrest patients when informing was completed vs not completed. The expected negative reaction rates were 40% and 60%, respectively. A minimum sample size for each group was determined as 97 for a 20% effect size (α=0.05, 1-β=0.80). G power version 3.01 was used to perform the power analysis.

Table 1. Present diseases and conditions causing cardiac arrest, number of patient's relatives and degree of affinity

	Group 1	Group 2
Cause of arrest		
Acute phase of chronic disease (COPD, leukemia, heart failure etc.)	18	20
Trauma	11	9
Cancer	10	0
Acute thrombosis (MI, pulmonary embolism)	28	31
Acute stroke	4	0
Major artery damage (aortic dissection, artery cut etc.)	0	3
Drug overdose	11	6
Fatal arrhythmias (VF/VT)	7	5
Aspiration related respiratory failure	6	16
Other	5	10
Number of relatives		
1	12	8
2–5	52	61
6–10	28	20
>10	8	11
Degree of affinity		
First-degree relatives*	27	18
Second degree relatives and friends	8	13
Multiple first-degree relatives	26	28
Multiple first and second degree relatives	39	41
Duration of CPR		
<20 minutes	4	13
20–30 minutes	19	29
30–50 minutes	70	48
>60 minutes	7	10
Frequency of informing		
10 minutes intervals	32	10
15 minutes intervals	52	17
>20 minutes	15	24

COPD: chronic obstructive pulmonary disease; VF: ventricular fibrillation; VT: ventricular tachycardia; MI: myocardial ischemia; CPR: cardiopulmonary resuscitation. *Spouse, child, sibling, parents

Statistical analysis

The study began in May 2014 and finished in May 2015 when sufficient numbers of cases (an average of 100 cases in each group) were available. The Statistical Package for Social Sciences (IBM SPSS Statistics; Armonk, NY, USA) 22.0 program was used to analyze the data. The correlation between the both groups was determined by using a Chi-square test. Statistical significance was accepted at a value of $p<0.05$.

Table 2. Relatives' reactions before, during, and after CPR

	Group 1	Group 2
Relatives' first reaction before resuscitation		
Yelled	7	22
Only cried	44	19
Committed verbal violence	0	1
Committed physical violence	0	2
Requested what is necessary to be done	9	8
Harmed themselves	1	6
Damaged the environment	0	1
Remained unresponsive	21	10
Multiple negative reactions	18	31
Relatives' reactions during CPR		
Requested to see their patient	40	28
Committed verbal/physical violence	3	23
No request	57	49
Relatives' first reaction after delivering bad news		
Only cried	60	17
Damaged the environment	2	5
Harmed themselves	6	23
Committed verbal/physical violence against health staff	0	0
Requested to see their dead patient	2	3
Declared idea of inadequate intervention	0	5
Thanked for intervention	3	2
Remained unresponsive	10	5
Multiple negative reactions	17	40

CPR: cardiopulmonary resuscitation

Table 3. Comparison of reactions of groups based on expected and unexpected death

Groups	Reactions	Expected death	Unexpected death	Total
		n (%)	n (%)	n (%)
Group 1	Only cried	17 (54.8)	43 (62.3)	60 (60)
p=0.027	Damaged the environment	1 (3.2)	1 (1.4)	2 (2)
	Harmed themselves	-	6 (8.7)	2 (6)
	Asked permission to see their patient	-	2 (2.9)	2 (2)
	Thanked	3 (9.7)	-	3 (3)
	Remained unresponsive	3 (9.7)	7 (10.1)	10 (10)
	Multiple negative reactions	7 (22.6)	10 (14.5)	17 (17)
	Total	31 (100)	69 (100)	100 (100)
Group 2	Only cried	4 (22.2)	13 (15.9)	17 (17)
p=0.002	Damaged the environment	1 (5.6)	4 (4.9)	5 (5)
	Harmed themselves	7 (38.9)	16 (19.5)	23 (23)
	Asked permission to see their patient	-	3 (3.7)	3 (3)
	Declared idea of inadequate intervention	1 (5.6)	4 (4.9)	5 (5)
	Thanked	-	2 (2.4)	2 (2)
	Remained unresponsive	4 (22.2)	1 (1.2)	5 (5)
	Multiple negative reactions	1 (5.6)	39 (47.6)	40 (40)
	Total	18 (100)	82 (100)	100 (100)

Results

During a twelve-month period150 of 113,000 (0.1%) patients who were admitted to Gaziantep University Faculty of Medicine Department of Emergency Medicine underwent CPR. Of those, 100 (0.09%) met the inclusion criteria and were included in Group 1. Fifty patients were excluded because they were not citizens of the Republic of Turkey.

During the same period, 538 (0.08%) of 940,000 patients who were admitted to Dr. Ersin Arslan State Hospital's and Şehitkamil State Hospital's emergency departments underwent CPR. Of those, 438 CPR patients were not included because the CPR was administered by general practitioners (n=238), the patients were not citizens of the Republic of Turkey (n=97), or the patients were younger than 16 years (n=103). One-hundred CPR patients who were treated by emergency medicine physicians were included in Group 2.

In the study, 34% of the patients were females, and 66%were males. Among those patients, 127 (63.5%) were chronic but stable, 16 (8%) had terminal diseases, and 57 (28.5%) were disease-free. In both groups, the most common cause of the cardiac arrest (29.5%) was thrombosis (myocardial infarctions and pulmonary embolisms) in. The patients' diseases and causes of arrest are listed in Table 1.

The numbers of patients in both groups who were brought to the hospital by ambulance emergency services were similar: Group 1 (72 in Group 1 and 74 in Group 2) (p=0.332).

The numbers of unexpected deaths (non-chronic terminal disease and cancer) in Groups 1 and 2 were 72 and 80, respectively. The ratio of witnessed cardiac arrest cases was higher in Group 1 (47%) than Group 2 (32%) (p=0.043). In Group 1, relatives accompanied 50% of patients to the emergency department, and relatives accompanied 65% of patients in Group 2. On average, each cardiac arrest patient was accompanied by between two and five relatives (p=0.034) (Table 1). The numbers of relatives of cardiac arrest patients and their degree of affinity to the patients are listed in Table 1.

The average duration of CPR was 37.5±9.5 min in Group 1 and 34.4±12.5 min in Group 2 (p=0.047). The rate of providing information to relatives about another possible cardiac arrest in the witnessed cardiac arrest cases was higher in Group 1 (p=0.011) (Table 1).

Table 4. Comparison of reactions according to the gender

Reactions		Female, n (%)	Male, n (%)	Total, n (%)
Group 1	Only cried	24 (68.6)	36 (55.4)	60 (60)
(p=0.376)	Damaged the environment	-	2 (3.1)	2 (2)
	Harmed themselves	2 (5.7)	4 (6.2)	6 (6)
	Asked permission to see their patient	1 (2.9)	1 (1.5)	2 (2)
	Thanked	2 (5.7)	1 (1.5)	3 (3)
	Remained unresponsive	3 (8.6)	7 (10.8)	10 (10)
	Multiple negative reactions	3 (8.6)	14 (21.5)	17 (17)
	Total	35	65	100
Group 2	Only cried	9 (27.3)	8 (11.9)	17 (17)
(p=0.038)	Damaged the environment	1 (3)	4 (6.0)	5 (5)
	Harmed themselves	9 (27.3)	14 (20.9)	23 (23)
	Asked permission to see their patient	1 (3)	2 (3)	3 (3)
	Declared idea of inadequate intervention	4 (12.1)	1 (1.5)	5 (5)
	Thanked	-	2 (3)	2 (2)
	Remained unresponsive	2 (6.1)	3 (4.5)	5 (5)
	Multiple negative reactions	7 (21.2)	33 (49.3)	40 (409)
	Total	33	67	100

The relatives in Group 2 expressed more negative reactions (harming themselves and the environment) than those in Group 1 (p=0.000). More relatives in Group 2 than Group 1 also believed that the intervention was insufficient, and they became violent (verbal abuse and physical attacks).The rates of briefings during CPR were 96% in Group 1 and 51% in Group 2 (p=0.001). More relatives in Group 2 than Group 1 committed violence to see their loved ones (p=0.001) (Table 2).

In the first minute after receiving the bad news, the most common response of the majority of the relatives in Group 1 was crying (60%), whereas the relatives in Group 2 expressed multiple negative reactions (40%) (p=0.001).

For both expected deaths and unexpected deaths, more relatives in Group 1 than in Group 2 responded simply by crying (p=0.027) (Table 3). The differences in the reactions of the relatives in Group 1 (p=0.027) and Group 2 (p=0.02) to expected deaths and unexpected deaths were statistically significant. The results of the comparison of the two groups' reactions to expected deaths (p=0.001) and unexpected deaths (p=0.001) were statistically significant. When both groups were combined, adverse reactions were significantly higher in cases of unexpected deaths (p=0.048).

In Group 1, the difference between reactions, such as crying or expressing multiple negative responses, based on the patient's gender was not statistically significant (p=0.376).The response of most patients' relatives in Group 2 was mainly crying when the deceased was a woman, whereas they showed much more negative reactions when the deceased was a man (p=0.038) (Table 4). Rates of negative reactions were higher in Group 2 compared to Group 1 for both female and male patients (p=0.001). When the data of both groups were combined, the number of negative reactions was higher when the patient was male (p=0.029).

When the data of each group were evaluated separately, the association between a single reaction (crying) and the patient's age (under 46 and over 46 years) was not statistically significant. In Group 2, when the deceased person was older than 46 years, the rate of a single reaction (crying) was higher than the rate of multiple reactions, whereas the rate of multiple diverse reactions was higher when the deceased was less than 46 years old (p=0.005). When the data of

Table 5. Prediction of negative reactions using Multiple Logistic Regression Analysis

Variables		**Negative Reaction (n=98)	*Positive Reaction (n=102)	OR	95% GA	p
Age	<46	20 (20.4)	12 (11.8)	1.920	0.823-4.479	0.131
	≥46	78 (79.6)	90 (88.2)	1 (reference)		
Gender	Male	72 (73.5)	60 (58.8)	2.114	1.09-4.08	0.026
	Female	26 (26.5)	42 (41.2)	1 (reference)		
Degree of affinity	Close	46 (46.9)	53 (52.0)	0.970	0.530-1.776	0.921
	Distant	52 (53.1)	49 (48.0)	1 (reference)		
Informing	Done	59 (60.2)	88 (86.3)	1 (reference)		
	Undone	39 (39.8)	14 (13.7)	4.963	2.380-10.349	0.001
Expected/unexpected death	Expected	18 (18.4)	31 (30.4)	1 (reference)		
	Unexpected	80 (81.6)	71 (69.6)	1.576	0.762-3.263	0.220

*positive reactions: only cried, asked for permission to see their patient, thanked, remained unresponsive
**negative reactions: damaged the environment, harmed themselves, declared idea of inadequate intervention, multiple negative reactions

the two groups were compared, the rates of multiple negative reactions for patients older/younger than 46 years were higher in Group 2(p=0.0001). The correlation between the patient's age and positivity/negativity of reactions was not statistically significant when we evaluated both groups together (p=0.096).There was no significant association between the degree of affinity (first-degree relatives and others) and the relatives' reactions when the data of both groups were combined (p=0.478).

The analysis of the factors influencing the nature of the reactions revealed that the rate of positive reactions was statistically significant when the relatives were briefed at the start of the CPR and then regularly throughout the CPR procedure (p=0.001). Prediction of negative reactions with help of multiple logistic regression analysis was used to predict negative reactions (Table 5).

Discussion

Death and subsequent separation can have major adverse effects on the bereaved. People may find it very difficult to cope with the separation. Upon hearing the news of the death, they may exhibit various behaviors, such as violence against health staff and self-harm. Although health staff cannot bring back the deceased patients, by training and changing behavioral patterns, they can minimize violence exhibited by the relatives of the deceased, reduce their grief, and prevent them from self-harming (12).

Although various studies in the literature have focused on the delivery of bad news (12, 13) data originating from the emergency services are insufficient. Thus, the results of the present study are important. When delivering bad news, there is general agreement that it is important to have staff who have sufficient knowledge of the interventions performed on the patient and who are qualified to respond to relatives' emotional needs and to answer their questions. Thus, in the present study, emergency medicine physicians delivered the bad news in both groups and performed the resuscitation in both groups.

A high workload because of large numbers of patients in the emergency department, high numbers of unexpected deaths, relatives being unprepared for news of the death, and a lack of experience and training among health staff (14) can negatively affect communication with the patients and relatives. The high rates of negative reactions of the relatives in public hospital emergency departments (Group 2) can be explained by the physician's lack of training in delivering bad news.

According to the literature, the two most common conditions that have an important role in survival are vascular disorders and malignant tumors (15-17). In the present study, the most common detected cause of cardiac arrest was acute artery thrombosis, and the second most common cause was acute-phase chronic diseases. In the literature, the most common underlying causes of in-hospital cardiac arrest are chronic obstructive pulmonary disease, heart failure, malignancy, acute-stage diabetes mellitus and chronic kidney disease, and acute-stage artery diseases (18), which are similar to the results of the present study. In the present study, the underlying causes of all deaths were detected; although Oguzturk et al. (19) reported that the causes of death following cardiac arrest in 12.5% of cases could not be detected.

It is understandable that first-degree relatives wish to accompany their loved ones to the emergency room, although this is not common practice in developed countries, where large numbers of first-degree relatives and distant relatives are not welcome in the emergency room. The large numbers of people who live in the same household in Turkey and the strong affinities between them can explain why so many relatives accompany patients to the emergency room. The most important reasons of this situation are the large number of people who live in the same house and strong relationships by affinity. In addition, relatives who are not in the emergency room with loved ones may be criticized and partially marginalized. Sometimes these individuals try to show their presence by causing disturbance. This may also explain the violent behavior of some relatives after hearing the news of the death of the family member.

If the deceased patient's gender is excluded, the relatives being well informed can explain the expression of a single reaction (crying) rather than multiple negative reactions. When the patient was male, the provision of a large amount of information led to a decrease in the reactions of the relatives in Group 1 compared to Group 2, but the information provision did not completely suppress negative reactions. The more intense reactions to the death of a male patient are likely due to the patriarchal structure of Turkish society and higher societal value placed on males than females (20). We believe that the higher rates of negative reactions among the relatives in Group 2 both before resuscitation and after delivering the bad news were due to a lack of information provision, which could have prepared relatives for the news. When they are not informed regularly, relatives may insist on seeing their loves ones and become violent if restrained from doing so. In Group 1, allowing the relatives to see their loved ones and informing them during resuscitation decreased the relatives' concerns, made them believe in our care for their family member, and helped them to trust us. The greater number of negative reactions (verbal or physical violence) of the relatives in Group 2 after receiving the bad news confirms the importance of our mind.

Large numbers of unexpected deaths may occur among patients admitted to the emergency department because of sudden morbidity. In the present study, although the negative reactions to unexpected deaths were statistically higher than the reactions to expected deaths, there were less negative reactions in Group 1 due to regularly informing relatives. These findings show that communicating with relatives at regular intervals (during and after resuscitation) after admitting the patient to the emergency room and informing relatives about possible impending death are effective methods to help relatives accept the sad truth of death and avoid potential violence. The higher number of CPR cases in Group 1 was due to the higher number of serious cases admitted to tertiary emergency services. The higher number of expected deaths corroborates our opinion on this issue. We cannot explain the statistically significantly increased duration of CPR in the tertiary emergency services.

The presence of relatives during CPR is a controversial topic (21). Allowing certain family members to be in the resuscitation room and having a designated team member answer their questions might increase their comfort and support them emotionally during cardiac arrest and after resuscitation (6, 7). Those who support relatives being present while resuscitation takes place point out that this is the patient's and relatives' fundamental right and that it helps the patient deal with a stressful experience (12). However, the effect of the presence of relatives on the performance of the health staff also needs to be considered. According to some studies, relatives witnessing resuscitation influences health staff positively (21), does not increase the stress level of the individual performing the CPR (22), and helps

relatives to accept the death of the patient (23). On the other hand, a study aiming to evaluate the psychological effects of witnessed resuscitation on relatives had to be terminated because the staff refused to cooperate with the study staff were unconvinced (24). In the present study, witnessed resuscitation was not permitted in the tertiary emergency departments, but selected relatives were allowed to see their loved ones at least three times for a brief period, were informed about the status of the patient, and were advised to relay this information to other family members. In the secondary emergency services, the relatives were not allowed to witness the resuscitation or see their loved ones because of concerns that this would increase the stress levels of health staff and adversely affect the CPR. This had a statistically significant negative effect on relatives' reactions before, during, and after resuscitation.

Study limitation

In this study of relatives' reactions to the news of the death of a loved one, the following are important limitations: not considering the age, gender, religion, occupation, level of education, and socio-cultural status of the relatives; not considering the effects of the presence of relatives on the performance of the health staff during resuscitation; not considering cardiac arrest patients younger than 16 years, and not considering the different volume between both groups. An additional limitation is the low numbers of cardiac arrest cases in both groups.

Conclusion

Other than the deceased patient's gender and degree of affinity, the results showed that various factors, such as the deceased patient's age, cause of death, whether or not the death was expected, condition of the patient upon admittance to the hospital, and duration of the resuscitation, affected relatives' reactions to the news of the patient's death. They also revealed that whether reactions were positive or negative depended on the deceased patient's gender, degree of affinity, frequency and type of information given to the relatives, and whether or not relatives accessed the resuscitation room during resuscitation. The present study shows that allowing relatives to see their loved ones for a brief time before, during, and after resuscitation in the resuscitation room and informing them clearly about the medical interventions can help them to accept death more easily and decrease the number of negative reactions while waiting to hear news.

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EURASIAN JOURNAL OF EMERGENCY MEDICINE

Diagnosis of Hyperemesis Gravidarum in Patients with Pregnancy-Induced Vomiting Using a Point-of-Care Ketone Blood Test

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Abstract

Aim: Hyperemesis gravidarum affects 2.5% of pregnant woman and is characterized by persistent vomiting, weight loss of more than 5%, dehydration, ketonuria, and electrolyte abnormalities. Currently, there is no consensus on its definition, and there is no single, widely used set of criteria for diagnosing hyperemesis gravidarum. The aim of this study was to determine the accuracy of point-of-care ketone blood tests in diagnosing hyperemesis gravidarum.

Materials and Methods: Patients with a gestational age of <16 weeks were included and both capillary blood ketone and urine ketone levels were determined and analyzed. The diagnosis of hyperemesis gravidarum was based on two criteria: (1) persistent nausea and vomiting requiring hospitalization in the emergency department (ED) and (2) weight loss of more than 5% with nausea and vomiting.

Results: A total of 177 pregnant women with nausea and vomiting were admitted to the ED during the study period. Patients with lost files (n=73) and unsuitable gestational age (n=2) were excluded from the study. Mean gestational age was 63.1±2 days. Overall, 68.6% of the patients had emesis and 31.4% were diagnosed with hyperemesis gravidarum. The diagnostic accuracy of the point-of-care capillary blood ketone median level and urine ketone median level in emesis and hyperemesis gravidarum was 0.1, 95% CI (0.03–0.20), 0.7, 95% CI: 0.30–1.00, p<0.0001, and 0, 95% CI: 0.00–0.00, 2, 95% CI: 1.00–3.00, p<0.0001, respectively.

Conclusion: A rapid, bedside capillary blood ketone measurement can reliably help to diagnose hyperemesis gravidarum in patients with pregnancy-induced nausea and vomiting.

Keywords: Ketone body, hyperemesis gravidarum, emergency

Introduction

Pregnancy-induced nausea and vomiting (PINV) is a common problem at the early stages of pregnancy. Approximately, 50%–80% of pregnant women who are in their first trimester are affected, resulting in loss of work time and negative effects on social and family relationships (1). Hyperemesis gravidarum (HG) affects approximately 2.5% of pregnant woman and is characterized by persistent vomiting, weight loss of more than 5%, dehydration, ketonuria, electrolyte abnormalities, acid–base imbalance, and sometimes hepatic and renal failure (2).

Currently, there is no consensus on the definition of HG and there is no single, widely used set of diagnostic criteria for diagnosing HG at the emergency department (ED). There are commonly used diagnostic modalities with low sensitivity, such as clinical findings of patients, weight loss, dehydration, and/or electrolyte imbalance, and ketonuria (3). Urine ketone dipstick tests are used in the ED to screen for ketonuria in patients with PINV to detect metabolic derangements in the early phases. Although urine ketone dipsticks tests routinely measure urinary acetoacetate, they do not detect the ketone predominant in HG, which is β-hydoxybutyric acid (β-HBA). In the

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literature, studies mainly focus on determining acetoacetate levels, which is a urine ketone (4-6). Since acetoacetate is a metabolite of β-HBA, and the determination of acetoacetate levels in urine is time consuming, using point-of-care capillary blood levels of β-HBA may result in early diagnosis and treatment before ketonuria becomes apparent (7). To date, capillary β-HBA testing has not been used to diagnose HG in PINV at the ED. The aim of this study was to determine the accuracy of point-of-care blood ketone tests in diagnosing HG in patients who are admitted to the ED with PINV.

Materials and Methods

This study used a retrospective cohort for a single-center clinical trial of pregnant patients aged >18 years who were admitted to the ED with nausea and vomiting between January 1, 2008 and December 31, 2012, at a tertiary medical center with 90,000 patients per year. Before the study start, the Akdeniz University Clinical Research Ethics Committee approved all permits.

Pregnant women of <16 weeks of gestational age were included. Patients admitted with nausea and vomiting as the principal complaint were tested for capillary blood ketone and urine ketone. Patients with other systemic diseases that could cause nausea and vomiting and those without files were excluded from the study.

The diagnosis of HG was based on the following criteria: (1) persistent nausea and vomiting requiring hospitalization in ED and (2) weight loss of more than 5% with nausea and vomiting.

Data recorded included complaints, age, obstetric history, date of last menstrual period, vital signs (blood pressure, arterial pulse, fever, respiratory rate, and oxygen saturation), capillary blood, urine ketone values upon admission, and length of hospital stay. Pregnancy-unique quantification of emesis and nausea (PUQE) scores were calculated according to the complaints of patients upon admission and were classified as mild, moderate, or severe.

Capillary blood ketone was measured at the bedside and the results were noted in patients' file. The test was conducted using 0.1 mL of blood dropped into the blood compartment of the Medisense Optimum β-Ketone Test Strip® (Abbott Diabetes Care Ltd., Witney, Oxon, UK) to measure capillary blood ketone. Subsequently, data obtained from an OptiumXceed® blood ketone meter (Abbott Diabetes Care Ltd. Witney, Oxon, UK) were recorded in patients' files. Tests results were positive if capillary β-HBA was ≥0.1 mg/dL. Urine ketone values were classified as negative (0), positive one (+1), positive two (+2), positive three (+3), or positive four (+4).

Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS Inc.; Chicago, IL, USA) 16.0 and Medcalc 11.0.4. Continuous variables are expressed as mean ± standard deviation (SD). Variables that did not meet the normal distribution were expressed as medians (interquartile ratio [IQR]) and frequency variables were expressed as percentages. The diagnostic capabilities of the parameters used in this study were tested with sensitivity, specificity, positive likelihood ratio (+LR), and negative likelihood ratio (-LR). Variables were evaluated and recorded. Student's t-tests and chi-square tests were used to determine statistically significant results and differences between the groups at a $p<0.05$ level of significance.

Table 1. Diagnostic accuracy of blood ketone and urine ketone levels

	Emesis gravidarum (n=70)	Hyperemesis gravidarum (n=32)	p
Capillary blood ketone, median (95% CI)	0.1 (0.03–0.20)	0.7 (0.30–1.00)	<0.0001
Urine ketone, median (95% CI)	0 (0.00–0.00)	2 (1.00–3.00)	<0.0001

Table 2. Relationship between capillary blood ketone and urine ketone

	0, (63)	1+, (11)	2+, (11)	3+, (9)	4+, (8)
Capillary blood, ketone median (IQR)	0. (0.00-0.20)	0.2 (0.20-0.37)	0.5 (0.20-0.37)	1 (0.55-1.45)	1.3 (0.95-3.20)

Table 3. Diagnostic accuracy of HG with the capillary blood ketone levels

Capillary blood ketone	Sensitivity, % (95% CI)	Specificity, % (95% CI)	+LR (95% CI)	-LR (95% CI)
>0	96.8 (83.8–99.9)	38.5 (27.2–51.0)	1.58 (1.5–1.9)	0.081 (0.01–0.6)
>0.6	53,1 (34.7–70.9)	94.3 (86.0–98.4)	9.3 (3.4–25.4)	0.5 (0.3–0.7)
>0.8	40.6 (23.7–59.4)	98.5 (92.3–100)	28.4 (3.9–208.1)	0.6 (0.5–0.8)

Table 4. Relationship between fingertip blood ketone with PUQE subgroups

	PUQE score (n)			
	1, (6)	2, (73)	3, (23)	p
Capillary blood ketone, median (IQR)	0.0 (0.0–0.1)	0.1 (0.0–0.32)	0.8 (0.20–1)	0.000212

Results

During the study period, a total of 177 pregnant women with nausea and vomiting were admitted to the ED. Seventy-three of these patients' files could not be found in the archives. Two patients were excluded because they did not meet the inclusion criteria. Statistical analyses were performed using 102 patients' data.

The mean age of the 102 patients was 27.6±5.1 years; the average duration of pregnancy was 63.1±2 days. Seventy patients (68.6%) were diagnosed with emesis gravidarum (EG), and 32 hospitalized patients (31.4%) were diagnosed with HG. The mean level of the capillary blood ketone and the median level of the urine ketone upon admission were 0.45±0.85 and +2, respectively. Both capillary blood ketone and urine ketone levels were found to be statistically significant for the diagnosis of HG in patients with PINV. The diagnos-

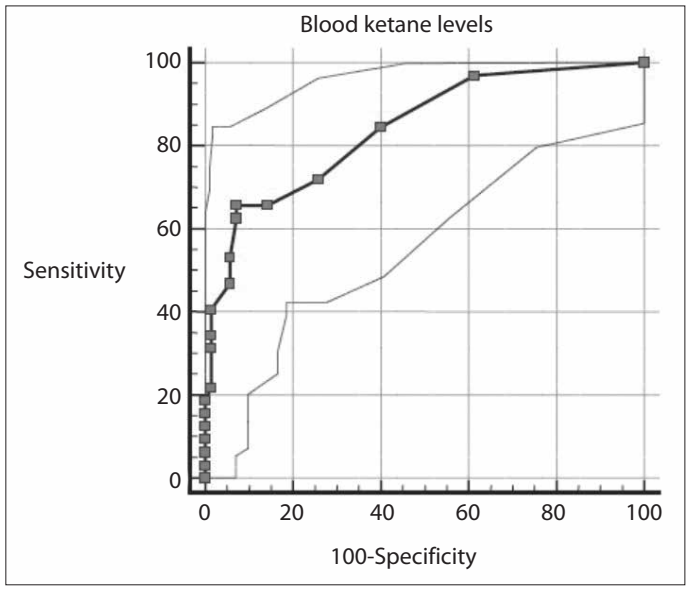

Figure 1. The relationship between capillary blood ketone and urine ketone levels

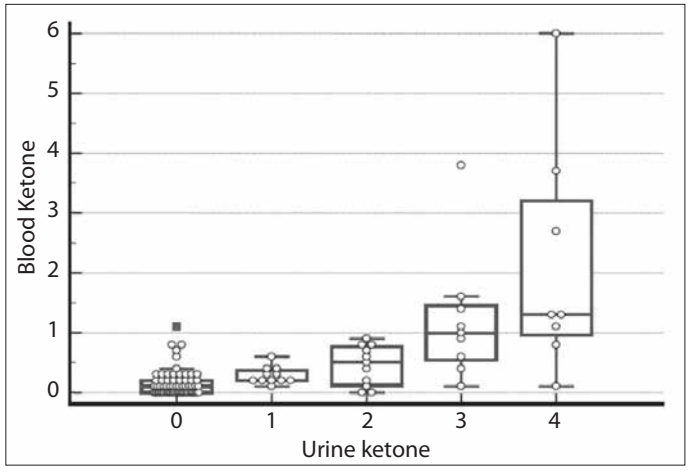

Figure 2. Diagnostic accuracy of HG with the capillary blood ketone levels

tic accuracy of the capillary blood ketone and urine ketone measurement for HG is shown in Table 1. A post-hoc analysis showed that the values of urine ketone and capillary blood ketone were significantly correlated. This relationship was more pronounced in patients with low urine ketone values. The relationship between capillary blood ketone and urine ketone is clearly shown in Table 2 and Figure 1.

Area under the curve (AUC) and receiver operating characteristic (ROC) analyses were performed. At the 95% confidence interval (CI) for diagnostic accuracy, capillary blood ketone levels can diagnose HG at 0.841 (95 % CI: 0.755–0.906, p<0.001). Statistical data for the diagnostic accuracy of capillary blood ketone levels in the diagnosis of HG are shown in Table 3, and the ROC curve is shown in Figure 2.

The median values (95% CIs) of PUQE for the EG and HG were 10 (9–11) and 12 (11–13), respectively, and the relationship was found to be statistically significant (p<0.0001).

Upon examination of a subcategory of PUQE, fingertip blood ketone levels in patients with PINV were statistically significant; statistical data are presented in Table 4.

Discussion

As seen in this study, 177 pregnant patients admitted to the ED with various medical complaints were part of the 5-year study. Emergency physicians need to identify mortal and morbid complications of pregnancy accurately and rapidly. EG and HG are among the most well-known complications, and in the first 16 weeks, they are known as PINV syndromes. It is extremely important to be able to distinguish these two clinical cases in the ED. A patient with EG can be discharged after appropriate liquid and antiemetic therapy in the ED, while a patient with HG and dehydration, weight loss, and electrolyte imbalances may need to be hospitalized (7). However, there are no clear and concise diagnostic criteria for HG in the ED. The most commonly used diagnostic markers are prolonged and persistent nausea and vomiting, weight loss with electrolyte abnormalities, ketonuria, and dehydration (3). Previous studies have shown that urine ketone levels are widely used as a laboratory test for diagnosing HG in patients with PINV. These studies revealed that urine ketone levels of patients with HG were increased (3+ [50 mg/mL] or 4+ [100 mg/mL]); however, no clear information was provided regarding the diagnostic accuracy of ketone levels for HG in patients with PINV (4-6). Our study was a comparison of the capillary blood and urine ketone levels of 32 patients diagnosed with HG and 70 patients diagnosed with EG after being admitted to the ED with PINV. As evident from the results, the median value (95% CI) of capillary blood ketone was 0.7 mmol/L (0.30-1.00) and found to be statistically significant (p<0.0001). Alternatively, the diagnostic accuracy of capillary blood ketone for diagnosing HG in patients admitted to the ED with nausea and vomiting who have a capillary blood ketone level >0.8 mmol/L was found to be 28.4 (3.9-208,1) with +LR and 0.6 (0.5-0.8) with -LR; AUC (95% CI) was found to be 0.841 (0.755-0.906, p<0.001). There is a strong correlation between the measured values and urine ketone levels, particularly at low levels. There are no studies in the literature equivalent to this study because it is the first clinical trial with capillary blood ketone measurements. The values show a positive correlation with the results of the capillary ketone measurement's prospectus. In the prospectus of the test, normal ketone level was 0.1-8.0 mmol/L. β-HBA levels were classified as low (0.4-0.8 mmol/L), moderate (1.8-2.8 mmol/L), or high (>3.2 mmol/L) (8). Acetest and Ketostix (Ames Co.) are semiquantitative tests that are widely used to measure acetoacetate and acetone. Acetoacetate and acetone are a small part of the serum and urine ketones. The main ketone in the serum is β-HBA. These tests are not sensitive to β-HBA and are only useful in predicting total ketone bodies. Acetoacetate and acetone are formed after β-HBA metabolism and eliminated in the urine. Thus, urine ketone bodies are formed in small amounts or cannot be determined at the early stage of HG (8). As a result of this study, fingertip blood ketone >0.8 mmol/L can be used for an early diagnosis and treatment for HG, contributing to reducing the rate of maternal complications. PUQE was the scoring system for PINV severity with three classifications: low (≤6), moderate (≤7≤12), and high (≤13) (9). In our study, the median PUQE of 10 (IQR, 9-11) and 12 (IQR, 11-13) were used to diagnose EG and HG, respectively; these scores were found to be statistically significant at p<0.0001. Emesis or hyperemesis can only be diagnosed using PUQE scores. In addition, the median for capillary blood ketone levels of preg-

nant patients with severe nausea and vomiting (PUQE ≥13) was 0.8 (IQR, 0.2-1.1). For patients admitted to the ED with PINV and capillary blood ketone levels of ≥0.8, the diagnosis of HG had a sensitivity of 40% and specificity of 98.5%. Considering that this is the first clinical study to measure capillary blood ketone, currently, there are no studies in the literature that can evaluate the results of PUQE scores with capillary blood ketone levels.

Study limitations

The most important limitation of this study is that is a retrospective study. All of the study data were obtained from the hospital database. Pregnant patients who were not tested for blood or urine ketone levels were not included and that may affect our results.

Another limitation is the inadequate criteria in diagnosing EG and HG. A literature review revealed different diagnostic criteria and applications of these criteria among different clinics.

When the study was initiated, the diagnosis of HG was defined as admission to the ED after persistent nausea and vomiting with weight loss of more than 5%.

Another limitation is that reference venous blood β-HBA was not measured in the laboratory. Formal laboratory testing of venous blood β-HBA is time consuming and not practical and therefore is not routine for busy ED clinics. Recently, ketone sensors have been offered to diabetic patients to measure electrochemical β-HBA in blood. The determination β-HBA within 5 seconds with 10 µL of capillary blood sample has been reported. A few comparisons have been performed under laboratory conditions with volunteers and random blood samples. Hilary et al. (10) reported a strong correlation between the capillary-blood and laboratory-measured serum β-HBA.

Conclusion

A rapid, bedside capillary blood ketone measurement can reliably help to diagnose hyperemesis gravidarum in patients with pregnancy-induced nausea and vomiting. There is a strong correlation between capillary blood ketone and urine ketone values, particularly at low levels. Therefore, in these patients, capillary blood ketone measurement can be used instead of urine ketone measurement.

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

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

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Is There Any Association Between the Efficacy of Imaging Techniques and the Age of the Patient in the Diagnosis of Acute Appendicitis?

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Abstract

Aim: In this study, we aimed to assess whether there is any difference between the time and effectiveness seen in the diagnostic stage of acute appendicitis when an appropriate imaging method is selected for the patients in different age groups.

Materials and Methods: During the 6-month period between October 1, 2015, and April 1, 2016, we retrospectively reviewed the files of patients who visited our emergency clinic, which is a third-step emergency department of a university hospital, and who then underwent operations at our hospital. Patients were evaluated according to their age: Group 1, 40 years and younger; Group 2, 40–60 years; Group 3, 60 years and older.

Results: In this study, 97 patients (59.1%) were male and 67 patients (40.9%) were female. Their ages ranged from 19 to 86 years (mean age, 36.7±14.7 years). The percentage of patients who underwent only ultrasonography (US) was 52.3% in the first age group, 39.5% in the second age group, and 0.0% in the third age group ($p<0.0001$). The rates of patients who underwent only computerized tomography (CT) were 15.3% in the first age group, 28.9% in the second age group, and 60% in the third age group ($p<0.0001$). There was a statistically significant difference between the sensitivities of CT and US by age group ($p<0.001$).

Conclusion: We believe that US should be the first method to be preferred in young and uncomplicated cases and that CT should be preferred in elderly patients with atypical presentations.

Keywords: Acute abdomen, computerized tomography, ultrasonography

Introduction

Acute appendicitis (AA) is one of the most common causes that requires an operation in patients visiting hospital with an abdominal pain (1). These cases are usually seen in patients under 50 years of age and peak in the second and third decades (2). The developments in imaging methods that support the diagnosis of AA have reduced the number of patients who were operated unnecessarily and shortened the waiting period in the complicated cases before surgery. Although this is such a common case about which many studies have been done, there are still debates about the diagnostic methods for AA.

Ultrasonography (US) and computerized tomography (CT) are the two basic imaging modalities used in AA; they are still the most important and valid diagnostic tools. Even though CT is considered more successful for diagnosis in many studies, we can never abandon US because of the radiation exposure aspect of CT (3, 4). To determine the imaging method that is used during diagnosis according to patient history and symptoms will also increase the effectiveness of the method.

In this study, selected imaging modalities in the diagnostic process of cases operated on the basis of an AA diagnosis and whose histopathologic examinations were compatible with AA were retrospectively reviewed. The aim of this study was to examine whether

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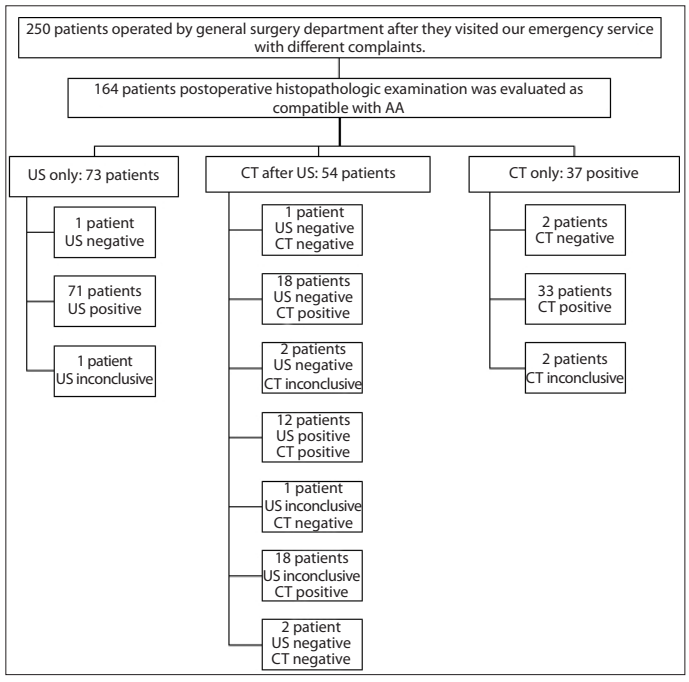

Figure 1. Study flowchart: patient selection and the results of imaging methods

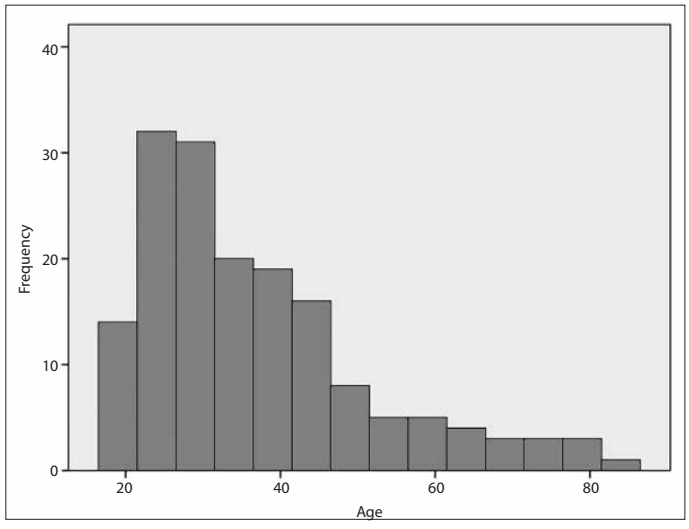

Figure 2. The age distribution of acute appendicitis patients. When the age distribution of the patients was analyzed with Kolmogorov–Smirnov test, because the skewness-kurtosis values were calculated between −1.5 and +1.5, this dataset fit normal distribution

there is any difference between the time and effectiveness seen in the diagnosis stage of AA when an appropriate imaging method is selected for patients from different age groups.

Materials and Methods

During the 6-month period between October 1, 2015, and April 1, 2016, we retrospectively reviewed the files of the persons who visited our emergency clinic, a third-step emergency department of a university hospital, and then operated at our hospital. The ethics committee's approval for the study was given by the same institution.

Patient selection

The case files of 164 persons whose postoperative histopathologic examination was evaluated as compatible with AA and who had at least one result of an imaging method (US or/and CT) during diagnosis at emergency service records. Of the 250 patients older than 18 years of age who were operated by the general surgery department of our hospital after they visited our emergency service with different complaints were reviewed (Figure 1). The official radiology report of the imaging method of all these cases was available in our hospital system. The patients were evaluated according to their age, gender, imaging method performed with AA preliminary diagnosis in emergency department; result of AA in terms of radiology report; and time interval between the first visit and imaging times (minutes). Patients were grouped according to their age: Group 1, 40 years and younger, Group 2, 40–60 years, Group 3, 60 years and older. Patients were assessed on the basis of the imaging methods: US only; CT only; and US and CT. Imaging methods were examined for significant differences in the activities at specific age ranges.

US examination

US examination was performed applying a printed sonography technique for AA using 3.5-MHz convex and a 5–7.5 MHz linear probe and followed by a full abdominal sonographic examination. The ultrasounds planned with AA were evaluated by a senior assistant physician or a specialist physician who had completed at least two years in the radiology clinic of our hospital. According to the US report, cases with a thickness of more than 6 mm, no peristalsis, compression anechoic fluid collection, appendicolith, and US McBurney findings were accepted as US-positive. The cases in which appendicitis was not seen or seen as normal were reported as negative. The cases in which a free fluid was detected in the perianal region, the cecum wall was edematous, and the perianal mesenteric lymph nodes were seen were reported as suspicious (5, 6).

CT examination

The CTs in our study included the abdominal section between the L2 vertebra and the symphysis pubis. All patients were administered contrast material (1-mL Ultravist 300, 50 cc vial containing 0.623 g iopromide in an aqueous solution) intravenously (IV) at a rate of 0.8–1 mL/s. After 60 s, the patients were scanned by helical CT using a 5 mm slice thickness and 5-mm table motion. These CT images were evaluated and reported by a senior assistant physician or a specialist physician who had completed at least two years in our hospital radiology clinic. CT positivity criteria (at least two of the three criteria must be present) were: anterior–posterior appendicitis diameter greater than 7 mm; an increase in heterogeneity and attenuation of periapical fatty tissue; and an increase in wall thickness more than 2 mm compared to other intestinal segments. In the patients who met only one criterion, the CT was evaluated as unclear. The appendix that was smaller than 6 mm, had no inflammation sign in the surrounding structures, and a normal wall thickness was classified as negative in CT (7).

Statistical analysis

IBM Statistical Package for the Social Sciences 20.0 (IBM SPSS Statistics; Armonk, NY, USA) was used for the statistical analyses of the data. The normal distribution suitability of continuous variables

Table 1. CT and US comparison results in the acute appendicitis diagnosis

			AA diagnosis in CT			p
			Negative	Positive	Unclear	
AA diagnosis with US	Negative	n	4	51	4	<0.0001
		% US	6.8	86.4	6.8	
		% CT	5.2	63.0	66.7	
	Positive	n	71	12	0	
		% US	85.5	14.5	0.0	
		% CT	92.2	14.8	0.0	
	Unclear	n	2	18	2	
		% US	9.1	81.8	9.1	
		% CT	2.6	22.2	33.3	
Total		n	77	81	6	
		% US	47.0	49.4	3.7	
		% CT	100.0	100.0	100.0	

AA: acute appendicitis; CT: computerized tomography; US: ultrasonography

Table 2. CT and US sensitivity rates by age group

		1st age group	2nd age group	3rd age group	Significant difference
Sensitivity	CT	42.3%	52.6%	93.3%	+
	US	55.0%	47.4%	26.7%	+

CT: computerized tomography; US: ultrasonography

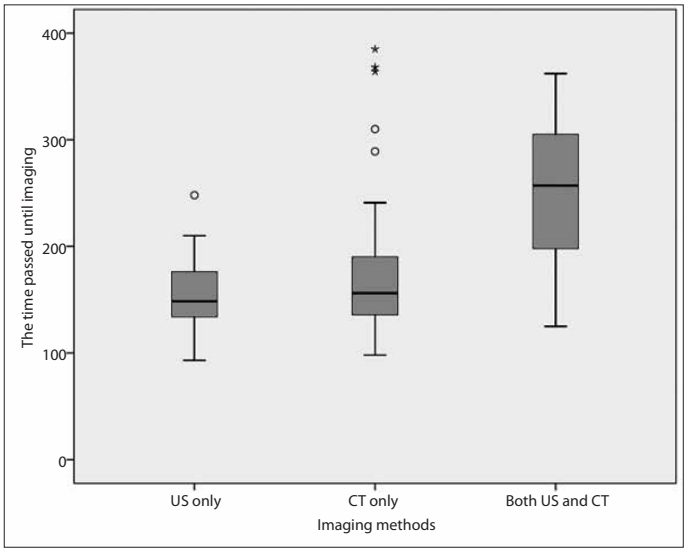

Figure 3. Boxplots comparing the time passed until imaging stratified by imaging methods. There was a significant difference in the data showing the time passed until imaging between the US only group and both US and CT group (p=0.000)
CT: computerized tomography; US: ultrasonography

was measured by the Kolmogorov-Smirnov test. The Mann-Whitney U was used for the comparison of the mean of the related binary groups of continuous variables without normal distribution, and Kruskal-Wallis test was used for the comparison of the mean of more than two groups. The chi-square test was used to compare categorical variables. The descriptive statistics were given as percent, frequency, mean, and standard deviation. Significance was tested at a level of alpha equal to 0.05.

Results

In this study, 97 patients (59.1%) were male and 67 patients (40.9%) were female. The ages ranged from 19 to 86 years (mean age, 36.7±14.7 years). When the age distribution of the patients was analyzed with Kolmogorov–Smirnov test, because the skewness-kurtosis values were calculated between −1.5 and +1.5, this dataset fit normal distribution (Figure 2). According to age groups, the most patients were observed in the first age group (111 patients, 67.7%) and then second age group (38 patients, 23.2%) and followed by third age group (15 patients, 9.1%).

In our study, US was used to diagnose 77.4% (127 patients) of the patients. US application percentages in different groups were 84.7% in the first age group, 71.1% in the second age group, and 40% in the third age group (p<0.0001). The rate of patients undergoing only US because it was preferred during diagnosis was 52.3% in the first age group, 39.5% in the second age group, and 0.0% in the third age group (p<0.0001).

In all, 55.5% of our patients (91 patients) were evaluated with CT: 47.7%, 60.5%, and 100.0% of the patients in the first, second, and third groups, respectively (p<0.001). The proportion of patients for whom only CT was preferred in the diagnosis process was 15.3%, 28.9%, and 60% in the first, second, and third age groups, respectively (p<0.0001). When the patients for whom both imaging methods

were used were categorized according to their age groups, no statistically significant difference was observed between groups.

When the results of the imaging methods were compared, of the 59 patients with a negative US result, CT was positive in 51, negative in four, and unclear in four patients. Of the 83 patients with a positive US diagnosis, 12 had a positive CT scan and 71 had a negative CT scan result. We found that CT was positive in 81.8% of the cases who ended up with an unclear US, and it was negative and unclear in the remaining four (18.2%) patients (Table 1). The difference between the positive diagnostic decisions for the patients was statistically significant ($p<0.0001$).

When the patients included in the study were evaluated on the basis of the age group, there was no statistically significant difference between the sensitivity of CT and US ($p<0.001$) (Table 2).

The time passed until imaging was calculated as 151±27 min in the US group only, 180±74 min in the CT group only, and 253±59 min in both the US and CT groups (Figure 3). There was a significant difference in the data showing the time passed until imaging between the US group and both US and CT groups ($p=0.000$).

The data showing the time passed until imaging according to different age groups were 187±65 min, 185±69 min, and 242±79 min in first, second, and third age groups, respectively. A 55-min difference was detected between first and third age groups, in which confidence intervals (CI) were statistically significant ($p=0.009$, 95% CI, 11.42–98.60). A 56.6-min difference was detected between second and third age groups; this difference was statistically significant as well ($p=0.017$, 95% CI, 8.33–104.95).

Discussion

In this study, it was found that making an examination based on age group in the diagnosis of AA provides high sensitivity and accelerates the diagnosis. The incidence of AA is around 9% in Western societies, and its incidence is increasing in both developed and developing countries (8, 9). Early diagnosis and treatment of this disease is important. Pre-hospital and hospital delays should be prevented. US, CT, and diagnostic scoring systems are available to assist the clinician to prevent hospital delays (10-12). However, despite these developments, the diagnosis of AA may not be as easy as it assumed.

The incidence of AA at an early age is higher than that in the elderly population (13, 14). However, the presentation of these diseases in younger patients may be different from that in middle-aged and older patient groups. The diagnosis can be difficult, especially in the elderly patient population; this situation may lead to delays in the diagnosis (15, 16). For this reason, it would be more useful to determine the diagnostic tests based on age group and disease presentation before diagnosing a patient suspected as having AA. In our study, the majority of the cases were younger compared to elderly. Although there were more studies in the literature that showed more women are diagnosed with AA, there were more males in the population with an AA diagnosis in our study (14).

In the literature, it was noted that US can be safely used for its high sensitivity values in AA diagnosis. In one study, the sensitivity of the US was given as 88%, whereas it was given as 71.2% in another study (17, 18). Some studies with lower sensitivity rates have also been reported in the literature (14). The sensitivity was reported as 67.6% with the head-up US (13). Besides not having a high sensitivity, US has other limitations including its limited use in non-working hours and on weekends because a trained technician is not present (19). However, it is the method that should be preferably used first in children and the younger population because it can be done quickly, and it does not include any radiation (19-21). In our study, US sensitivity was found to be high; this rate is even higher in the young patient population. In our study, the level of sensitivity was found high in the young population. Therefore, US was more preferable in young patients who had symptoms possibly indicative of AA.

Sensitivity of CT in AA was between 83.3% and 100%, which is higher than that of US (14, 18). The CT method, which is more sensitive compared to US, is usually used for older patients and for patients who are more likely to have complications (19, 22). In one study, the possibility of peritonitis and the length of hospitalization were found higher in the patient group where CT was preferred (22). Because of the possibility of malignancy in the elderly patient group, a CT scan is usually performed in the preoperative period. For this reason, CT should be preferred in these patients to avoid missing a diagnosis in a patient more likely to have complications and to avoid delay in the diagnosis. In our study, CT was more preferred in the elderly group and the sensitivity was found quite high.

Another group of patients cannot be diagnosed by either US or CT only. Literature reports suggest that CT can be used as a complementary method in patients who cannot be diagnosed with US (23). Even more interestingly, 5 (12.2%) of the 41 patients with a negative CT in a study conducted with 104 patients noted that US reassessment helps avoid missing the diagnosis in patients who were found as AA-negative in a CT scan before the US (24). These studies showed that US and CT are complementary diagnostic tools. The necessity of using them together is usually helpful in a patient population with atypical presentation and therefore difficult to diagnose. In our study, approximately one in four patients who needed to have both US and CT scan and presented with symptoms suspicious of AA were diagnosed.

It is possible to make a faster AA diagnosis with US compared to CT, especially in the experienced centers that allow visualization of appendicitis (25). It is the first choice in the young population. CT should be preferred in elderly patients, although it delays the diagnosis compared to US. The time to diagnosis is even longer in the patient population in which both methods need to be used together.

Study limitations

In our study, we evaluated a well-defined patient group commonly encountered in emergency services where a large population is examined. Also, the need for diagnostic imaging methods used in different patient groups was assessed. The limitations of the present study include being single-centered and retrospective. However, because our hospital is a high-volume center, has an expert emergency department group working with the same clinical practices, and patient records are kept regularly, we think that our study presents valuable evidence.

Conclusion

As a result, US should be the first choice to be preferred in young and uncomplicated cases in the AA diagnosis, but it should not be preferred in elderly and patients with atypical presentations. It is very important to determine an age-related diagnostic algorithm for this disease, which is frequently encountered in emergency departments. More prospective studies are needed in this area.

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

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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Analysis of Vitamin D and Calcium Levels in Benign Paroxysmal Positional Vertigo

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Abstract

Aim: The aim of the study was to evaluate the effects of vitamin D and calcium levels on the incidence and recurrence of benign paroxysmal positional vertigo (BPPV).

Materials and Methods: Sixty-four patients diagnosed with BPPV and 63 healthy volunteers who were age–sex matched and admitted to emergency department (ED) between October 1, 2014 and December 31, 2014 were included. Vitamin D and total calcium levels of blood samples collected from both groups upon admission were analyzed.

Results: The mean vitamin D level in the patient and control groups was 9.51±5.49 ng/mL and 11.02±9.62 ng/mL, respectively. The mean total calcium level in the patient and control groups was 9.5±0.63 mg/dL and 9.41±0.49 mg/dL, respectively. A significant difference was not detected between groups in terms of both parameters (p=0.992; p=0.345, respectively). The mean vitamin D level in patients with a first episode was 9.91±5.81 ng/mL and in those who had similar symptoms earlier was 8.81±4.90 ng/mL. The difference between groups was not significant (p=0.629).

Conclusion: There are studies showing low levels of vitamin D as a risk factor for incidence and recurrence of BPPV. However, in this study, no relationship was found between vitamin D and total calcium levels and BPPV incidence and recurrence. This result can be due to high frequency of vitamin D deficiency in the Turkish society. We also believe that because the study was conducted in winter, related to seasonal variability of vitamin D levels, the levels were even lower. However, for conclusive results, more comprehensive studies including year-round examinations are needed.

Keywords: Vitamin D, calcium, benign paroxysmal positional vertigo

Introduction

The most common and benign cause of vertigo, which is defined as the illusion of movement of the body or environment, is benign paroxysmal positional vertigo (BPPV). Although the pathophysiological process of the disease has not been fully clarified, currently, the widely accepted opinion is that the disease results from the accumulation of otoconia that are detached from the utricular macula in the semicircular canals and thereby sensitizing such canals to gravity (1). Otoconia crystals consist of a central nucleus mostly composed of organic glycoproteins with low calcium (Ca) levels and surrounding inorganic peripheral zones containing minerals mostly composed of calcium carbonate with high Ca levels.

Recent studies conducted to clarify the etiology have demonstrated that there may be an association between osteoporosis and Ca metabolism and the frequency of BPPV (1, 2). This is supported by the fact that BPPV is more common especially in postmenopausal women aged >50 years, in whom osteopenia and osteoporosis are common. Such studies have suggested that osteoporosis and accordingly the Ca metabolism may be a risk factor for developing BPPV by affecting particularly the peripheral zone in otoconia, which have a similar structure with bone tissue (3). The role of vitamin D,

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which is directly related to Ca metabolism and bone formation, in BPPV has been concerned and the vitamin D levels of BPPV patients have been investigated.

The primary objective of this study was to establish whether the vitamin D and total Ca levels of patients diagnosed with BPPV are lower compared to the normal population. Additionally, the secondary objective of our study was to determine whether there is a difference in vitamin D and Ca levels of the patients with recurrent vertigo attacks compared to the control group and the patients who have experienced the first vertigo attack.

Materials and Methods

After receiving approval from the ethics committee of Keçiören Training and Research Hospital this study was conducted prospectively between October 1, 2014 and December 31, 2014, at an emergency service of a training and research hospital with a mean daily patient number of 750.

The study included patients who presented to the emergency service with dizziness and were diagnosed with BPPV. The control group consisted of healthy subjects with demographic characteristics similar to the patient group.

The study inclusion criteria were patients aged >18 years, agreeing to participate in the study, and diagnosed with BPPV following the assessment in the emergency department.

The study exclusion criteria included patients <18 years of age; not agreeing to participate in the study; being pregnant; being diagnosed with central vertigo; having another existing disease that causes peripheral vertigo; having any disease, such as known osteoporosis that could affect vitamin D and Ca metabolism; or using any drugs such as Ca preparation or bisphosphonate that could affect vitamin D and Ca levels.

Patients who presented to the emergency department with dizziness were evaluated by emergency physicians. Detailed medical histories were obtained and physical examinations were performed and recorded into the study form for all the patients.

Benign paroxysmal positional vertigo was diagnosed based on the history and physical examination findings. The history was questioned in terms of the character, duration, emergence type, increasing and decreasing factors of the dizziness, and the accompanying symptoms as directive for BPPV. BPPV was considered primarily in patients describing dizziness that increased with head movements, emerged suddenly, or was short term but severe and decreased at rest. All patients were neurologically evaluated in detail, cerebral tests were performed, and the presence of ataxia was examined. Head-Thrust Test and Dix-Hallpike test were performed on patients to investigate the presence and characteristics of nystagmus. The presence of nystagmus that emerged after a latent period of time, lasted less than 1 minute, and exhausted with repetitive maneuvers, was considered as directive for BPPV diagnosis. Cranial tomography and diffusion magnetic resonance imaging (MRI) were conducted on the patients with suspected central pathology based on the history and neurological examination to eliminate potential pathologies. Patients with a detected central pathology were excluded from the study. A hearing test was performed on the patients describing fullness in the ear, loss of hearing, and tinnitus among those with suspected peripheral vertigo, again based on history and physical examination findings to eliminate Meniere's disease. The patients with detected Meniere's disease in the test were excluded from the study. Patients for whom the differential diagnosis of vertigo could not be established, despite all neurological examination, tests and imaging methods, were excluded from the study.

The patients diagnosed with BPPV based on history, physical examination, and other additional tests were divided into two groups as describing vertigo for the first time and describing recurrent vertigo. Patients who previously described one or more similar complaints were assessed in the recurrent vertigo group.

From all patients diagnosed with BPPV and the control group, consent was obtained at the emergency department admission, blood samples were collected, and the vitamin D and total Ca levels were studied immediately at the central biochemistry laboratory.

The total Ca level was studied with the photometric method using an AU 680 Beckman Coulter® kit. The normal level for total Ca was considered 8.5-10.2 mg/dL. The vitamin D level was studied with the chemiluminescence method using the DiaSorin Liaison® device, and the normal level was considered as 20–50 ng/mL.

Statistical analysis

The data were analyzed using Statistical Package for Social Sciences (SPSS Inc.; Chicago, IL, USA) for Windows 16 software package. The compatibility of discrete and continuous numeric variables with normal distribution was analyzed using the Kolmogorov–Smirnov test. Descriptive statistics were expressed in mean ± standard deviation or median (interquartile ration [IQR]: 25%-5%) for discrete and continuous variables, and categorical variables were expressed as number of cases and percentage.

The Mann-Whitney U-test was used to analyze whether there was a statistically significant difference for the non-normally distributed data of the peripheral vertigo and control group measurements. The Spearman's correlation test was used to examine whether there was a statistically significant correlation between age and vitamin D and Ca measurements in the peripheral vertigo and the control groups. $P<0.05$ was considered statistically significant for the results.

Results

In total, 64 patients diagnosed with BPPV were included in the study; 41 of them (64.1%) had not experienced similar symptoms before, 16 of them (25%) had an attack previously but did not have the diagnosis, and seven of them (10.9%) were diagnosed with vertigo previously. Sixty-three healthy subjects were included in the study as the control group. Of the patients, 47 (73.4%) were females and 17 (26.6%) were males. In the patient group, the mean age was 56.19±13.46 and 55.65±12 years for female and male participants, respectively. Of the subjects in the control group, 45 (71.4%) were females and 18 (28.6%) were males; the mean age was 55.62±13.96 and 59.56±13.66 years for female and male participants, respectively. There was no difference in age and gender distribution between the two groups (p=0.29 and p=0.8, respectively).

The median vitamin D value was 9.51 ng/mL (minimum-maximum [min-max]: 4–23.2) in the patient group and 7.8 ng/mL (IQR: 4.6–14.1) in the control group. The difference in vitamin D levels between two groups was not statistically significant (p=0.99). The median total Ca value was 9.5 mg/dL (min-max: 8.32–13) in the patient

Table 1. Comparing vitamin D and total Ca levels in patient and control groups

	Vit. D (ng/mL)	T.Ca (mg/dL)
	Mean±SD (min-max)	Mean±SD (min-max)
Patient	9.51±5.49 (4-23.2)	9.5±0.63 (8.32-13)
Control	11.02±9.62 (4-56.8)	9.41±0.49 (8.28-10.36)
p	0.992	0.345

Vit. D: vitamin D; T.Ca: total calcium; SD: standard deviation; min: minimum; max: maximum; p value: <0.05 was considered statistically significant. r value: correlation coefficient

Table 2. Relationship between age and vitamin D and total Ca levels in the patient and control groups

	Patient				Control			
	Vit. D		T.Ca		Vit. D		T.Ca	
	r	p	r	p	r	p	r	p
Age	-0.011	0.933	-0.047	0.712	0.040	0.753	-0.302	0.016

Vit. D: vitamin D; T.Ca: total calcium; SD: standard deviation; p value: <0.05 was considered statistically significant. r value: correlation coefficient

Table 3. Relationship between vitamin D and total Ca levels in the patient and control groups

	Patient		Control	
	Vit. D		Vit. D	
	r	p	r	p
Total Ca	0.089	0.486	0.088	0.493

Vit. D: vitamin D; T.Ca: total calcium; SD: standard deviation; p value: <0.05 was considered statistically significant. r value: correlation coefficient

group and 9.43 mg/dL: (IQR: 9.12–9.68) in the control group. The difference in total Ca levels between the two groups was not statistically significant (p=0.34; Table 1).

The median vitamin D value was 6.8 ng/mL (IQR: 5.56–11.5) in the recurrent BPPV group and 7.8 ng/mL (IQR: 4.6–14.1) in the control group. The difference in vitamin D levels between the two groups was not statistically significant (p=0.69). The median total Ca value was 9.65 mg/dL (IQR: 9.09–9.76) in the recurrent BPPV group and 9.43 mg/dL (IQR: 9.12–9.68) in the control group. The difference in total Ca levels between the two groups was not statistically significant (p=0.36).

The median vitamin D value was 8.2 ng/mL (IQR: 5.4–12.7) and the median Ca level was 9.5 mg/dL (IQR: 9.08–9.70) in patients with the first BPPV attack. When these values were compared with those of the recurrent BPPV patients, no statistically significant difference was found (p=0.99 for vitamin D; p=0.34 for Ca).

There was no significant relationship between age and vitamin D and Ca levels in both groups (p>0.05). In the patient group, a statistically significant correlation could not be found between age and vitamin D and Ca levels (p=0.99, r=–0.01; p=0.71, r=–0.04). In the control group, the relationship between age and vitamin D levels was examined; however, no significant correlation was established (p=0.75, r=0.04). An inverse statistical correlation was found between age and Ca levels; however, such a correlation was weak (p=0.01, r=–0.30; Table 2).

The correlation between vitamin D and Ca levels was also evaluated in the patient and control groups, but a statistically significant correlation could not be established (p=0.48, r=0.08; p=0.49, r=0.08; Table 3).

Discussion

It is important to clarify the etiology of BPPV, which is the most common vestibular disease, for effective treatment and recurrence prevention. The present study examined vitamin D and total Ca levels in patients diagnosed with BPPV, who presented to the emergency service with dizziness. No relationship was established between these values and the disease incidence and recurrence rate.

Firstly, the pathophysiology of the disease should be understood to associate BPPV with vitamin D. The vestibular part of the membranous labyrinth consists of three semicircular canals as anterior, posterior, and horizontal, and two otoliths as utricle and saccule; the source of the calcium carbonate crystals (otoconia) that are responsible for BPPV is the macula of the saccule (4). Canalithiasis refers to the displacement of otoconia located within the gelatinous membrane in the macula into the semicircular canals, whereas cupulolithiasis defines the adherence of these particles to the cupula of the semicircular canals. These two conditions are the mechanisms considered responsible for BPPV pathophysiology (5).

Otoconia consist of a central part with a regular and dense structure and a peripheral part with an irregular and porous structure (6). Calcium carbonate, the main inorganic component of otoconia, is present more intensely in the peripheral zone (1). Since BPPV is more common in postmenopausal women aged >50 years, it has been considered that osteopenia and osteoporosis may be risk factors for developing BPPV by affecting particularly the peripheral zone in otoconia, which have a structure similar to the bone tissue (3).

To establish this relationship, Vibert et al. (3) conducted a study on rats and found distinctively reduced density and increased volume of otoconia in osteoporotic rats compared to the control group. In a similar vein, Jeong et al. (7) conducted a study with 209 patients diagnosed with idiopathic BPPV and established that the presence of osteopenia or osteoporosis alone increased the risk of BPPV after excluding other variables, such as age, gender, alcohol use, smoking, and hyperphosphatemia. The study by Yamanaka et al. (8) indicated that the osteoporosis incidence in BPPV patients was similar to the rest of the population, but the BPPV patients with osteoporosis had a distinctively higher recurrence incidence compared to the BPPV patients with normal bone mineral density, that is, the presence of osteoporosis posed a risk for BPPV recurrence.

Nevertheless, recently published studies related to this topic have not defended the same idea with the older studies. The study by Karataş et al. (9) indicated that prevalence of osteoporosis and vitamin D deficiency is reasonably high in the general population, and the coexistence of BPPV with osteoporosis and vitamin D deficiency is coincidental. In a similar vein, Kahraman et al. (10) indicated that vitamin D deficiency and decreased ionized Ca level may be a risk for BPPV, not only in patients with osteoporosis but also in all patients.

After several studies have demonstrated the relationship between BPPV and osteopenia/osteoporosis, research is increasingly directed toward the role of vitamin D in BPPV, which is directly related to Ca and phosphorus metabolism and thereby bone formation. The study by Jeong et al. established lower serum levels of vitamin D in idiopathic BPPV patients regardless of age, gender, body mass index, hypertension, diabetes, proteinuria, regular exercise, and reduced bone mineral density (2). Buki et al. (1) found the serum levels of vitamin D in BPPV patients similar to the rest of the population, but showed that such levels were further lower in patients with recurrent BPPV compared to those with the first BPPV attack. Another study was conducted by Talaat et al. (11), which compared bone mineral density and vitamin D levels in recurrent and non-recurrent BPPV patients. Based on the data, the study found bone mineral density associated with both development and recurrence of BPPV. It was suggested that low vitamin D levels were associated only with BPPV development, but very low levels had an effect on disease recurrence (11).

After several studies have shown correlation between vitamin D deficiency and development and the recurrence of BPPV, whether the treatment of severe vitamin D deficiency could affect the recurrence rate of BPPV was questioned. The study by Talaat et al. (12) established that improvement of serum 25-hydroxyvitamin D3 levels is associated with substantial decrease in the recurrence of BPPV. Similarly, Sheikhzadeh et al. (13) indicated in their study that the correction of vitamin D deficiency in BPPV provides additional benefit to rehabilitation therapy (Epley maneuver) regarding the duration of improvement.

The present study also found a lower mean vitamin D level in the patient group compared to the control group; however, such a difference was not statistically significant, unlike the literature (p=0.992). To determine the effect of vitamin D levels on recurrence, the patient group was divided into two subgroups: those with the first vertigo attack and those with recurrent complaints; however, no significant difference was found in vitamin D levels between these subgroups (p=0.345). This may have resulted from the fact that vitamin D deficiency is currently a highly common issue in the Turkish population.

Vitamin D deficiency is a common health issue around the world. A study that investigated the vitamin D levels in Europe and Asia reported that Middle Eastern countries, including Turkey, have very low vitamin D levels (14). The study by Ciğerli et al. (15), which was conducted in Turkey, examined 2488 adult outpatients and found the mean vitamin D level to be 17.4±11.5 ng/mL. The study showed that 24% of the patients had vitamin D deficiency, 66% had vitamin D inadequacy, and the vitamin D inadequacy increased, particularly during the autumn and winter months. The study by Karagüzel et al. (16) investigated vitamin D levels in school-going children and similarly demonstrated that the prevalence of vitamin D inadequacy was 93% in the autumn, whereas it regressed to 71% in the spring. Atlı et al. (17) conducted a study with an elderly population and reported that vitamin D inadequacy was more common in older women, and the vitamin D levels were inversely proportional to age.

Besides age and seasonal factors, several factors, such as gender, skin color, dressing habits, food habits, using supplements, and body mass index, influence vitamin D levels (10). Our study was conducted between October and December, and most of the groups consisted of females and the mean age was higher; all of these are among the factors that cause the vitamin D levels to be low.

Due to the effects of vitamin D on the Ca metabolism, Parham et al. (18) examined the relationship between the presence of BPPV and vitamin D and serum ionized Ca, but could not establish any link. We also evaluated this relationship in our study. Similarly, we could not find any significant difference in total Ca levels between the patient and control groups. Additionally, we could not establish any significant relationship between vitamin D and Ca levels possibly because the total Ca levels are affected by several factors other than vitamin D.

Conclusion

A statistically significant difference was not found in vitamin D and total Ca levels between the patients diagnosed with BPPV in the emergency service and the control group.

This may be because the vitamin D inadequacy is very common even in healthy individuals in the Turkish population. Furthermore, given the seasonal changes in vitamin D levels, it is an important limitation that we have conducted the study between October and December.

To reach a specific conclusion, long-term and broader studies that would include the entire year are needed.

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.

Peer-review: Externally peer-reviewed.

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

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EURASIAN JOURNAL OF EMERGENCY MEDICINE

Diagnostic Value of Pentraxin-3 in Patients with Spontaneous Subarachnoid and Intracerebral Hemorrhage

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Abstract

Aim: In this study, the diagnostic and prognostic values of serum pentraxin-3 (PTX3) level were evaluated in spontaneous subarachnoid hemorrhage (SAH) and intracerebral hemorrhage (ICH) patients.

Materials and Methods: The study was conducted prospectively on patients in the emergency department between April 2014 and December 2015 at the Faculty of Medicine. Patients who were older than 18 years, who presented to the emergency department with neurologic findings, and who were diagnosed with SAH and ICH pursuant to a computed tomography (CT) scan of the brain were included. PTX3 levels were evaluated in the blood samples collected at the time of presentation to hospital and at the twelfth hour after presentation.

Results: In the study, the levels of serum PTX3 measured at presentation and at the twelfth hour after presentation were found to be statistically and significantly different in the SAH group compared to the control group ($p<0.001$; $p<0.001$, respectively). Serum PTX3 levels measured at presentation and at the twelfth hour after presentation were found to be significantly different in the ICH group compared to the control group ($p<0.001$; $p<0.001$, respectively).

Conclusion: The study findings show that measuring serum PTX3 levels in SAH and ICH patients may be an adjuvant test. We consider that this finding should be supported by comprehensive and controlled studies.

Keywords: Spontaneous subarachnoid hemorrhage, intracerebral hemorrhage, pentraxin-3

Introduction

Intracerebral hemorrhage (ICH), like subarachnoid hemorrhage (SAH), has high mortality and morbidity risk. In primer ICH patients, advanced age, place and size of hemorrhage, whether or not it is opened to the ventricle are related to mortality and morbidity (1).

Pentraxins are acute phase proteins in multimeric form (2). They are classified as long or short pentraxins, according to their structures. Pentraxin-3 (PTX3) is a prototype of the long pentraxins. C-reactive protein (CRP) is produced in the liver as a primer by IL-6. During a systemic response to local inflammation, PTX3 is directly released from damaged tissue, reflecting the inflammatory situation of the vascular structure (3). Therefore, in vascular pathologies, the level

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of plasma PTX3 may be increased. This increase may contribute to the determination of diagnosis and prognosis of vascular pathology.

Materials and Methods

The study was a prospective clinical study and was initiated after approval of the local clinical research ethics committee. Patients who presented to emergency department in the university hospital with a suspicion of neurologic disease between April 2014 and December 2015, who were diagnosed with SAH or ICH, and who were over 18 years of age were included in the study. Patients with acute renal failure, chronic renal failure, sepsis, hepatic insufficiency, acute pulmonary edema, peripheral artery disease, deep vein thrombosis, acute coronary syndrome, pulmonary embolism, mesenteric ischemia, cardiac arrest, multitrauma, puerperality, hemorrhage due to tissue plasminogen activator (TPA), or patients who were pregnant and who, either personally or through their relatives, did not provide consent to participate in the study were excluded from the study. Blood samples were collected from patients at the time of presentation and at the twelfth hour after presentation. Healthy volunteers aged >18 years, with no disease, and who presented to hospital for check-up were admitted to the study as control group, after obtaining their consent.

At the time of presentation, to measure the levels of PTX3, serum samples were collected in CBC tubes containing ethylene diamine tetra acetic acid (EDTA). Plasma was separated by centrifugation at 1800×g for 10 min and stored at −80°C until the PTX3 study.

Determination of PTX3 levels in human plasma

PTX-3 levels in human plasma were determined using enzyme-linked immunosorbent assay (ELISA) kit (R&D Systems, Cat No: DPTX30, Lot: 334734, Minneapolis, USA) in accordance with the manufacturer's recommendations. PTX-3 levels in samples were calculated in ng/mL.

Statistical analysis

For statistical analysis of the study, Statistical Package for Social Sciences (SPSS Inc.; Chicago, IL, USA) for Windows version 13.0 software was used. The expression of values of control and patient groups; categorical variables were expressed as percentage; quantitative variables were expressed as average and standard deviation (X±SD) if they comply with normal distribution and as mean and interquartile percentages if they do not comply with normal distribution. During comparison of averages among groups, the Kruskal–Wallis test was used for data that do not comply with normal distribution. To determine among in groups this difference occurs, Mann–Whitney U test with Bonferroni's correction was used. Spearman correlation analysis was used to determine how a variable is affected as another variable changes. Results were presented as 95% confidence interval (CI) and a p value of <0.05 was considered statistically significant.

Results

In this study, 30 SAH, 49 ICH, and 50 control group patients were included. Of the SAH patients, 40% were over 65 years of age, and 27% were under 45 years of age. Of the ICH patients, 38.7% were over 65 years of age, and 12.2% were under 45 years of age. Females constituted 53% of the SAH group, and males constituted 59% of the ICH patients. Of the control group, 2% were over 65 years of age, 56% were under 45 years of age, and 76% were males. For the SAH patients, mean systolic blood pressure was 155 mmHg and diastolic blood pressure was 86 mmHg; for the ICH patients, mean systolic blood pressure was 185 mmHg and diastolic blood pressure was 98 mmHg. PTX3 values at the time of presentation and at the twelfth hour for the SAH, ICH, and control groups are shown in Figures 1 and 2 as box plots.

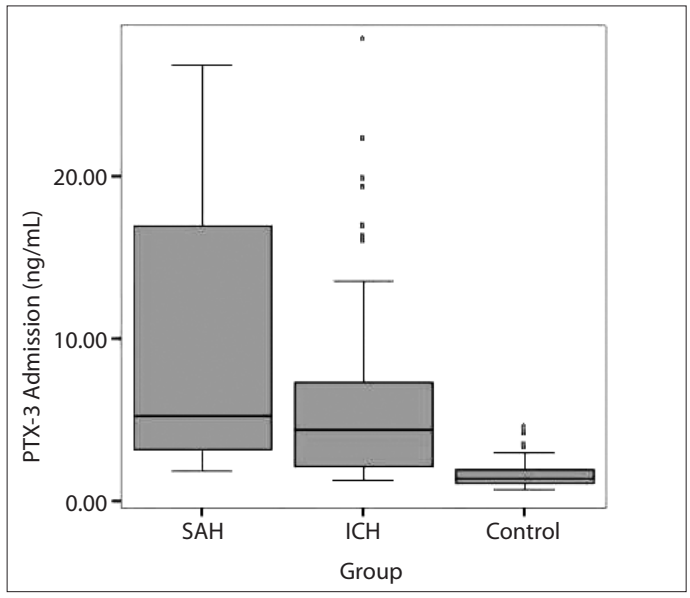

Figure 1. PTX3 values of SAH, ICH, and control groups at the time of presentation

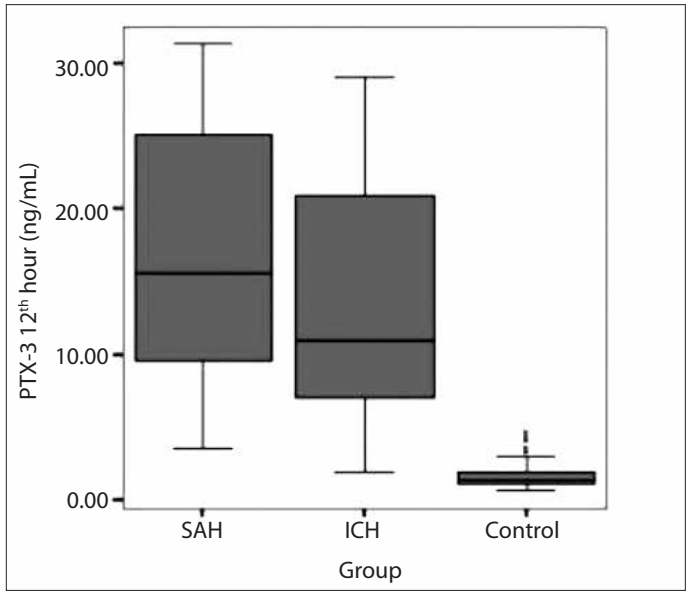

Figure 2. PTX3 values of SAH, ICH, and control groups at the twelfth hour after presentation

The levels of serum PTX3 measured at presentation and at the twelfth hour after presentation were found to be significantly different in the SAH group compared to control group ($p<0.001$; $p<0.001$, respectively). PTX3 median values of the SAH and control group and their comparison are shown in Table 1.

The levels of serum PTX3 measured at presentation and at the twelfth hour after presentation were found to be significantly dif-

Table 1. PTX3 median values of the SAH and control groups and their comparison

	Control	SAH at presentation	SAH at the twelfth hour
PTX3	1.40 (1.11–1.91)[a, b]	5.20 (3.19–17.57)[a, c]	15.60 (9.23–26.41)[b, c]

*Values were given as median (25%-75 %) ng/mL. **For PTX3, [a]: p<0.001; [b]: p<0.001; [c]: p<0.001. SAH: Subarachnoid hemorrhage; PTX3: Pentraxin-3

Table 2. PTX3 median values of the ICH and control groups and their comparison

	Control	ICH at presentation	ICH at the twelfth hour
PTX3	1.40 (1.11–1.91)[a, b]	4.39 (2.14–8.40)[a, c]	11.00 (7.05–21.06)[b, c]

*Values were given as median (25%-75%) ng/mL. **For PTX3, [a]: p<0.001; [b]: p<0.001; [c]: p<0.001. ICH: Intracerebral hemorrhage; PTX3: Pentraxin-3

ferent in the ICH group compared to the control group (p<0.001; p<0.001). PTX3 median values of the ICH and control groups and their comparison are shown in Table 2.

No significant difference could be detected for PTX3 mean values among the SAH and ICH patients at the time of presentation and at the twelfth hour after presentation (p>0.05). To determine prognostic value of the level of PTX3 in the SAH and ICH patients, the levels of PTX3 were compared in living and deceased patients. The levels of PTX3 at the twelfth hour after presentation were detected to be significantly higher for deceased patients in the SAH group compared with the living patients (p<0.05). The AUC in the ROC analysis was 0.623, and if PTX3 cut off was considered 28.04 ng/mL, we may determine decease by 14.8% sensitivity and 95.1% specificity. For the ICH patients, no significant difference could be detected for the levels of PTX3 at the time of presentation and at the twelfth hour after presentation (p>0.05).

Discussion

Seventy-five percent of subarachnoid hemorrhages develop due to ruptured aneurysm (1). The prevalence of aneurysmal SAH increases between 50 and 70 year of age. In some studies, SAH was observed to be more prevalent in females (4, 5). The most important risk factors leading to development of ICH are advanced age and acute or chronic hypertension (6). The risk of ICH increases with age (7); 72%–81% of ICH patients have history of hypertension (8). The patient population of our study resembles that in literature, and it was found that of the SAH patients, 40% were over 65 years of age and 53% were females; of the ICH patients, 38.7% were over 65 years of age and 59% were males. The factors determining mortality in SAH patients include severe neurologic presentation, advanced age, the large size of aneurysm, and the presence of intraparenchymal hemotoma in the first 24 hours (9, 10). Moreover, 12% of patients with SAH due to aneurysm die before hospital arrival, and 25% of patients die in the first 24 hours (11). Similar to SAH, ICH has high mortality and morbidity risk. Deterioration in the clinical picture is very common during the first few hours after the onset of ICH (12). Rapid diagnosis and determination of prognosis in SAH and ICH, where mortality is very high, is crucial for the determination of mortality and morbidity. At the same time, while dealing with severe pathologies, such as SAH and ICH, it is very important for treating physicians to provide realistic responses to questions and expectations of patients and patient relatives. Therefore, accessing biochemical data that may be correlated to patients plays an important role for early diagnosis.

Pentraxins are multifunctional protein superfamily playing role in inflammatory response (13). PTX3 is proven to increase during sepsis and several infective pathologies, and its increase is correlated to the severity of these pathologies (14). Furthermore, it was detected that the level of plasma PTX3 is increased in pathologies, such as ischemic heart diseases, small vessel vasculitis, and pulmonary contussion, where inflammation plays an important role, and that it is correlated to disease activity (15, 16). PTX3 is produced by inflammatory cytokines, such as toll-like receptor (TLR) agonists, interleukin (IL)-1β and tumor necrosis factor (TNF)-α (13). Myeloid dendritic cells, monocytes, macrophages, vascular endothelial cells, smooth muscle cells, kidney epithelial cells, fibroblasts, adipocytes, glial cells, cumulus ophorus cells, mesenchymal cells, and synovial cells are involved in PTX3 production (17). Vascular endothelial and smooth muscle cells produce PTX3 in response to signals containing oxidized low-density cholesterol (LDL), and they are released directly from damaged tissue, which reflects the inflammatory situation of the vascular structure (3, 18). SAH and ICH are cerebrovascular events, and we may suppose that they increase the level of PTX3. It is known that the basal level of PTX3 in circulation is <2 ng/mL; however, during inflammation, the level in circulation may peak within 6 or 8 hours by 3-5 fold of its basal level (17, 19). The mean value of PTX3 in the control group was 1.40 ng/mL, and PTX3 values at the time of presentation were detected to be 4.39 ng/mL in the ICH group and 5.20 ng/mL in the SAH group. The levels of PTX3 in SAH and ICH patients were detected to be significantly higher both at the time of presentation and at the twelfth hour after presentation compared to the control group (p<0.001; p<0.001, respectively). The higher level of PTX3 at the twelfth hour compared to that at the time of presentation shows that PTX3 has the tendency to increase from the onset of the event. In their study, Ryu et al. (20) detected that for ischemic stroke patients, the level of PTX3 at the time of presentation is higher in deceased patients compared to living patients. Zanier et al. (21) showed that the level of PTX3 reached its highest in plasma and cerebrospinal fluid (CSF) samples in SAH patients during first 48 hours and during development of vasospasm. In our study, it was detected that the levels of PTX3 at the twelfth hour after presentation were statistically and significantly higher in deceased patients compared to living patients of the SAH group (p<0.05). No significant difference could be detected for the levels of PTX3 at the twelfth hour of presentation among deceased or living patients of the ICH group (p>0.05). We may consider that the abundance of damage on aneurysmal vascular tissue and development of vasospasm together with creation of a stronger immune response may be the reason for this difference in SAH patients.

Study limitations

The first limitation of this study was that relatively low number of patients were admitted to the study and that control group bears no resemblance with other groups in terms of age and gender. SAH and ICH are conditions that require long-term treatment in the hospital, and we consider that infections during the treatment may affect the levels of serum PTX3. Moreover, the determination of levels of PTX3 of SAH and ICH patients was performed according to the presentation time to emergency department rather than the time of hemorrhage, thus limiting the study.

Conclusion

Subarachnoid hemorrhage and ICH are clinical situations that have very high mortality and morbidity levels if they are not diagnosed. Presence of diagnostic and prognostic biomarkers that are easily accessed and provide results rapidly might relatively reduce the poor prognosis. Pursuant to the results obtained from this study, we may conclude that the measurement of serum PTX3 levels, which is an inflammatory biomarker, may be used as an additional diagnostic test for SAH and ICH. This study must be supported by studies that more comprehensive.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Karadeniz Technical University Scientific Research.

Informed Consent: Informed consent was obtained from all individual participants included in the study.

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A New Tool in the Examination of Lungs in the Emergency Department: Lung Ultrasound

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Abstract

Pneumonia is a worldwide major healthcare and economic problem. It has a considerable effect on morbidity and mortality. The use of lung ultrasound (LUS) has gained popularity in intensive care units and emergency departments (EDs). LUS has recently been shown to be highly effective for evaluating pulmonary conditions and has been increasingly recognized as a potentially useful approach for diagnosing community-acquired pneumonia. Here we present the case of a patient with dyspnea due to pneumonia. Pleural effusion and parancimal images were obtained by LUS, and the pleural thickness was determined. We found that LUS is a useful tool for diagnosing pneumonia and detecting pleural effusion in EDs.

Keywords: Consolidation, lung ultrasound, pleural effusion, pneumonia

Introduction

Pneumonia is a worldwide major healthcare and economic problem and has a considerable effect on morbidity and mortality (1). Using lung ultrasound (LUS) has gained popularity in intensive care units and emergency departments (EDs). It has recently been shown to be highly effective in the evaluation of pulmonary conditions and has become increasingly recognized as a potentially useful approach for diagnosing community-acquired pneumonia (2, 3).

Case Presentation

Here we present the case of a patient with dyspnea due to pneumonia. A 47-year-old male was admitted to the ED with fever, chest pain, cough, and dyspnea for 7 days. Respiratory sounds decreased in the left basal area. He underwent coronary artery bypass graft surgery 3 months ago. His body temperature was 37.1°C, blood pressure was 110/70 mmHg, and oxygen saturation was 98%. Initial investigations on admission confirmed leukocytosis (10,600/µL, 84% neutrophils), anemia (hemoglobin: 9.2 g/dL, hematocrit of 26%, C reactive protein CRP level of 128.5 mg/L, and slightly elevated liver enzyme and blood urea nitrogen levels (SGOT: 280 U/L, SGPT: 200 U/L, BUN: 55 mg/dL, and Cr: 0.7 mg/dL).There were no ischemic changes on his electrocardiogram. CK, CKMB, and troponin levels were normal. The D-dimer level was in the normal range. Arterial blood gas analysis revealed hypoxemia (pH: 7.35, paO_2: 65 mmHg, $paCO_2$: 30 mmHg). His chest X-ray (CXR) showed a pleural effusion in the left hemithorax (Figure 1). Bedside LUS was performed with a MicroMaxx® ultrasound device equipped with a 3.5-MHz phased array probe and a 5.0–10 MHz phased array convex probe (Sonosight® Bio-medical Electronics Co., Bothel WA 98021 USA). Left lower lobe consolidation with air bronchograms and pleural

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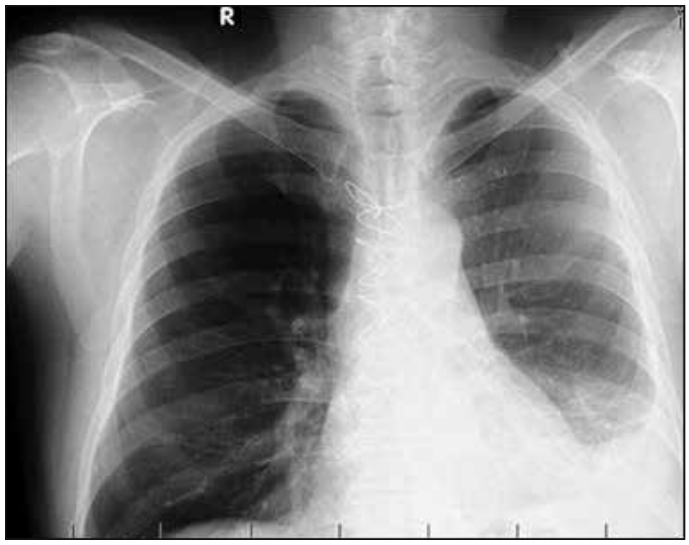

Figure 1. Pleural effusion in the left hemithorax

Figure 2. White arrow shows the presence of consolidation with evidence of air bronchograms

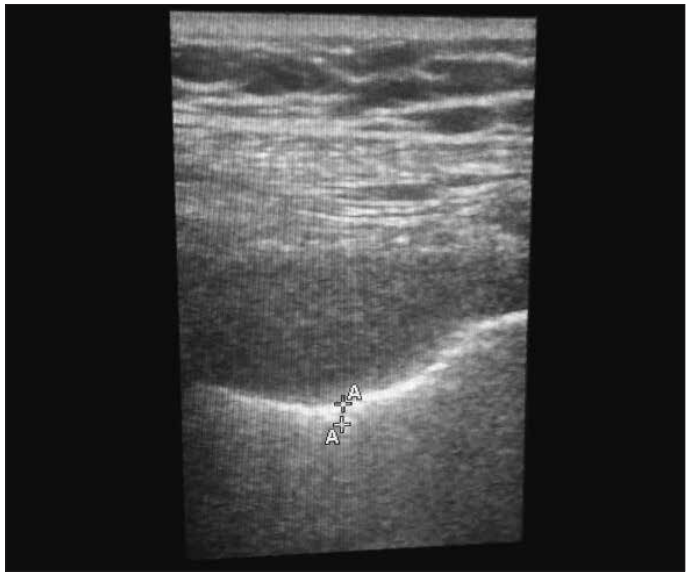

Figure 3. Pleural thickness (0.23 cm)

Figure 4. White arrow shows ultrasonographic visualization of a pleural effusion between the visceral and parietal pleura

Figure 5. Ultrasonographic visualization of a pleural effusion in the left lung

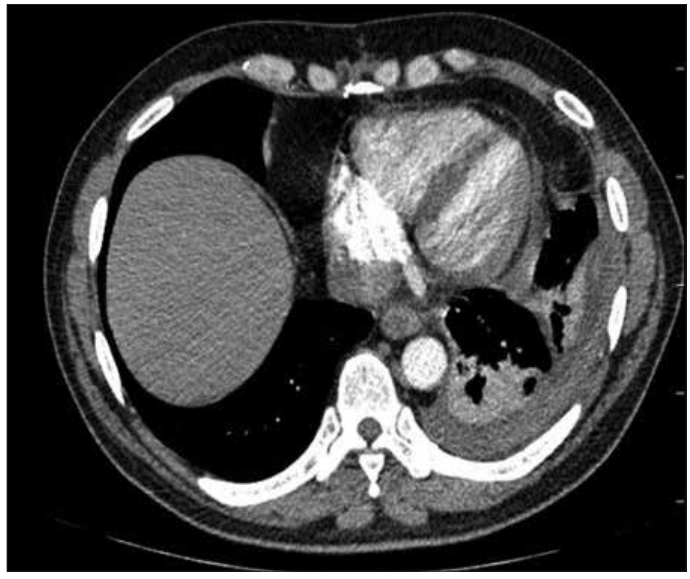

Figure 6. Pleural effusion and thickness, atelectasis

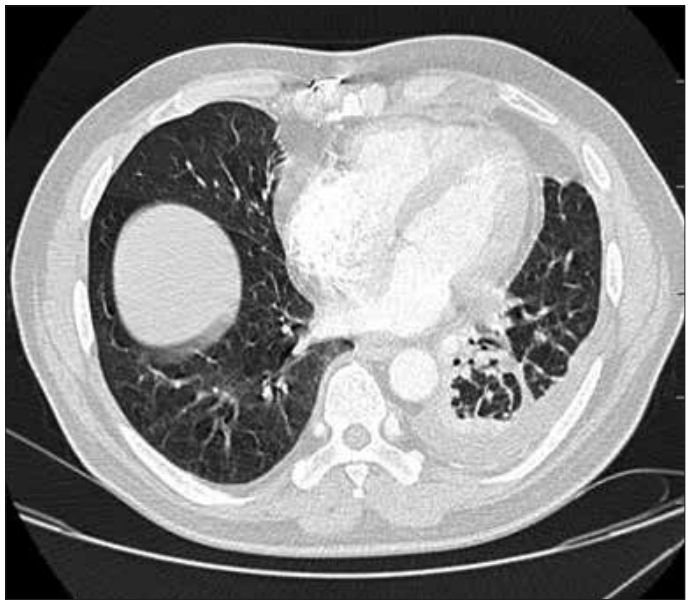

Figure 7. Pleural effusion

effusion were detected on performing LUS (Figures 2-5). Patient was hospitalized to the chest diseases service The patient began to follow in chest disease clinic. Antibiotic and anti-inflammatory treatments were initiated. A thoracic computed tomography (CT) scan revealed the presence of unilateral consolidations with pleural thickness and a pleural effusion (Figures 6, 7). These correlated with our LUS findings.

Discussion

Many articles from the literature have shown the usefulness of LUS ultrasound for detecting alveolar consolidations (4, 5). LUS has a high sensitivity (94%) and specificity (96%) for diagnosing pneumonia in adults. Its role is known well both as a rule-in and rule-out test for pneumonia in adults admitted to EDs and medical wards. Even in patients with acute dyspnea, for which the differential diagnosis may be broad, LUS is a good tool for discrimination. In a meta-analysis, Chavez et al. (6) mentioned that LUS conducted by highly skilled sonographers can be used for diagnosing pneumonia. ED physicians should be encouraged to learn LUS for diagnosing pneumonia because it appears to be an established diagnostic tool in the hands of experienced physicians (6).

The normal pleural thickness is only 0.2 to 0.4 mm. Focal and diffuse pleural thickening, whether due to a tumor or due to inflammation, are exquisitely demonstrated on performing CT, but they are difficult to detect by performing sonography unless the thickness reaches 1 cm or more. The pleural membranes appear as a single highly echogenic line that moves while breathing (lung sliding) (7, 8). In our case, the pleural thickness was 0.23 cm.

The key to the ultrasound visualization of pneumonia in the lungs is the relative loss of the aeration of a portion of the lung and a concomitant increase in the fluid content, which is seen in lung consolidation. Once this consolidation reaches the pleura, it can be seen on performing ultrasound. Although some early consolidation must be localized below the pleura and can be imaged using ultrasound. Current literature suggests that concolidation may be below the pleura (9).

Boundaries of a consolidated lung segment are defined by the pleural line, the adjacent aerated lung, and any effusion that may be present. The boundary created by the adjacent aerated lung would naturally appear irregular. In real time, air can be seen moving through the bronchi, and this finding is known as a dynamic air bronchogram. The sensitivity of B-mode ultrasound imaging is approximately 90%. Consolidation and dynamic air bronchograms have the highest specificity for detecting pneumonia. summarizes the typical ultrasound findings associated with pneumonia (9). According to the study by Lichtenstein et al. (10), LUS can immediately cause acute respiratory failure in 90.5% of patients in critical care units. Because the air-to-fluid ratio completely differs in different diseases, this results in different artefact patterns visible during LUS. Posterior lung areas can immediately indicate pleural effusion and 90% of acute alveolar consolidation (AAC) locations. The presence of an air bronchogram and a decrease in lung sliding are other ultrasonographic findings in AAA (11). In our patient, a pleural effusion and an air bronchogram were indicated by LUS (Figures 2, 5). The most common ultrasound findings associated with pneumonia are hypoechoic areas of varying size and shape, irregular and serrated margins, pleural effusions, heterogeneous echo textures, air bronchograms, and dynamic air bronchograms (12). An air bronchogram can be a valuable dynamic sign of alveolar consolidation on performing bedside ultrasonography for diagnosing pneumonia (13).

Conclusion

Lung ultrasound has some clear advantages over a CXR in patients who are pregnant, bedridden, and in resource-limited settings where CXR machines are not currently available. Moreover, it can be performed at the bedside; the evaluation is easy and fast to perform, and the patient is not exposed to ionizing radiation with LUS. LUS is a valid alternative for diagnosing pneumonia.

Informed Consent: Written informed consent was obtained from patient who participated in this case.

Peer-review: Externally peer-reviewed.

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

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