Advances in Bioscience and Clinical Medicine
ISSN: 2203-1413
www.abcmed.aiac.org.au

Original Article

Pulmonary Complications and Related Consequences in Patients with Traumatic Injuries

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ARTICLE INFO

Article history
Received: September 08, 2018
Accepted: December 13, 2018
Published: January 31, 2019
Volume: 7 Issue: 1

Conflicts of interest: None
Funding: None

Key words:
Pulmonary Complications,
Trauma,
Medical Educational Center

ABSTRACT

Background and Purpose: Trauma is considered to be one of the main causes of death in the world and the number of deaths caused by traumatic incidents has experienced an annual increase of 15%. Despite this fact that comprehensive information on the incidence of pulmonary complications in traumatic patients, the patients' fate in the country and factors affecting it is not available, the present study was conducted to determine the incidence of these complications and the main factors causing them in patients with traumatic injuries visiting the emergency room of the largest medical, educational, and research center in the province, which is considered to be the most important transfer center for traumatic patients from other medical centers in the region. **Methods:** This is a cross-sectional prospective study conducted on the injured people who visited the emergency room of Imam Reza Hospital in Tabriz in 2015. The incidence of pulmonary complications and factors affecting them were recorded in a valid and reliable researcher-developed checklist that included demographic information and information related to the incident. The significance level was set at $p < 0.05$. **Results:** Of all the 482 traumatic patients, 63.5% were men with a mean age of 41.6±15.4, with pulmonary complications reported in 48.1% of them. Pneumonia was the most common complication among these patients which was reported in 161 (33.4%) patients, and pneumothorax and ARDS were the second and third most common complications with the frequencies 41 (8.5%) and 39 (8.1%), respectively. The main causes of the incidence of pulmonary complications were reported to be an age of above 45 ($p < 0.001$), reduced consciousness level based on GCS criterion ($p = 0.01$), single trauma to the chest ($p < 0.001$), synchronous trauma to the chest and other organs ($p < 0.001$), hospitalizations of longer than one week ($p < 0.001$), intubation ($p < 0.001$) and finally transfer of the patient to the operation room ($p < 0.001$). It should be noted that a pulse rate of more than 100 beats in a minute was accompanied by a decrease in the incidence of pulmonary complications ($p = 0.01$). In the evaluation of the patients' fate, it was found out that only 15 (3.1%) patients were discharged from the emergency room. Finally, 34 patients (7.05%) died during the study, with the age group 15-29 years accounting for one third of the patients investigated. Pneumonia (33.4%) was the most common pulmonary complication. For 152 patients (34.8%) the duration of hospitalization was longer than seven days. **Conclusion:** The fact that the incidence of pulmonary complications in traumatic patients visiting the Location of research was 48.1% highlights the need for further attention to and proper management of complications in these patients. Delayed pulmonary complications are more common among traumatic patients, since the most common complication in this study was reported to be delayed pneumonia. Therefore, given the significance of such a high incidence, further studies and taking effective preventive and medical measures are strongly suggested.

INTRODUCTION

Trauma has been defined by the World Health Organization as any acute exposure to mechanical or thermal energy, electricity, chemical substances, and ionizing radiation (1) and is considered one of the main causes of death in the world. Every year, around 1.2 million people die in car accidents (1-4). The rate of accidents in Iran is very high, and the rate of incidents leading to death has been reported to be 23 cases in each 100,000 people (5). The studies conducted in this area indicate an annual 15 percent increase in the number of deaths caused by these incidents (6). Therefore, given the high rate of such incidents, further studies and taking effective preventive and medical measures in managing these incidents is strongly suggested.

Published by Australian International Academic Centre PTY.LTD.

http://dx.doi.org/10.7575/aiac.abcmed.v.7n.1p.27

Despite the fact that pulmonary complications are important consequent complications of trauma, an epidemiology of its risk factors has not yet been conducted in an appropriate way (7). Pneumonia, plural effusion, emphysema, respiratory distress syndrome, pulmonary edema, pulmonary embolism, and pneumothorax and delayed hemothorax are the most common complications that happen in patients with trauma (8-12). There complications are also seen in chest trauma and trauma in other organs (13). It should be noted that the incidence of these complications varies considerably from one society to another (13-17).

The prevalence of pulmonary complications depends on various factors. As results, the published articles have reported different findings. The amount of plasma transfusion products and the Injury Severity Score (ISS) have been suggested as predicting factors of respiratory failure in patients with trauma (18). Furthermore, aspiration, the presence of pulmonary nontusioc, pneumonia, inhalation injuries, lung injuries associated with ventilators, lung injuries associated with blood transfusion, pancreatitis, sepsis, and traumatic brain injury have been reported to be the main factors for causing pulmonary complications (19). Given the variety of trauma-related injuries that cause physical and psychological damages and death (20-22), the researchers in the present study considering the importance of the issue, conducted this study to find a way to reduce the pulmonary complications caused by trauma and, as a results, decrease mortality and morbidity rates so that they can reduce the number of deaths by identifying those patients who are exposed to pulmonary complications, and to fill the gap created by a lack of comprehensive information on the incidence of pulmonary complications in patients with trauma and the main factors causing them, a lack of published information on pulmonary complications in traumatic injuries in patients visiting the hospitals in the region and the patients' fate.

MATERIALS AND METHODS

A cross-sectional prospective study that was conducted with a one year follow-up of the issue from April 2015 to March 2016 in Imam Reza Hospital in Tabriz, which is the reference hospital for transferred and traumatic patients. The investigated population included all the injured people in incidents with any injury severity score who visited the emergency room of the above-mentioned hospital during the course of the study. It should be noted that patients who had a history of sever pulmonary diseases like lung cancer, chronic lung obstruction in advanced stages, and patients with a history of heart and respiratory failure, and traumatic patients with drug poisoning were excluded from the study as these diseases are considered to be contaminating factors. The data were collected using a valid and reliable researcher-developed checklist. This checklist included two sections: a section gathering demographic information, and another section on information relating to the incident, including details of the mechanisms of the damage, the type of the damage, the location and severity of the damage, he type of the vehicle involved in the incident, vital signs, the patients' level of consciousness at the time they were admitted to the hospital, the clinical measure taken in pre-hospital emergency and in the emergency room of the hospital, patients admission conditions, patients' hospitalization conditions, duration of their hospitalization, hospitalization in the intensive care unit, need for intubation, the pulmonary complication cause by the incident, complications caused during hospitalization, and the final consequences.

The pulmonary complications were investigated in the two groups of complications related to traumatic injuries to the chest (rupture of airways due to trauma, pneumothorax, hemothorax, pulmonary enzymes, respiratory distress syndrome, pneumonia) and delayed complications (24 hours after the incident) related to trauma in other organs (non-traumatic pneumonia, pneumothorax, hemothorax, delayed contusion, delayed ARDS and other complications).

Collecting the data was done confidentially and without mentioning the patients' names after the study was approved in the research ethics committee of Tabriz University of Medical Sciences (as thesis number 93/3-5/11). The data were recorded in SPSS 16 software and were analyzed using the statistical software STATA 11.0. Quantitative and qualitative data were summarized as mean, standard deviation, and percentage, respectively. Finally, pulmonary complications were combined, and the patients were divided intro the two groups of with and without pulmonary complications. The incidence of the complications was reported in terms of the type of complication both numerically and graphically. Also, the incidence of pulmonary complications following the incident were evaluated in terms of demographic, basic, and clinical variables. Then, the relationship among each of the variables related to the presence or not of the complications in patients were investigated using independent t-tests, Mann Whitney, Chi Square, and Fisher's exact test. Multivariate step-by-step logistic regression test was used to eliminate contaminating factors. In all the statistical analyses, the mean SOFA (Sequential Organ Failure Assessment) score, $p < 0.05$ was considered as the level of statistical significance.

RESULTS

Of 482 traumatic patients entered the study of whom 305 patients (63%) were men and around 80% of the patients were people residing in the region. The mean age of the patients was 41.6±15.4 ranging from 15 to 95 years old. It should be noted that the age group 15-29 years old with a frequency of 136 patients (28.2%) and the education level of diploma with 220 patients (46%) comprised the highest number of patients in the investigated population. Three main trauma mechanisms were having an accident in the driver or the passenger mode in a car (146 patients; 30.7%), falling from a high place (139 patients; 29.2%), and pedestrian accident with vehicles (81 patients; 17%). The mean GCS for the investigated patients was reported to be 12.9±3.4 (the lowest being 3 and the highest 15). 285 patients (59.1%) had a GCS level of 15. This criterion was 13-14 for 68 patients (14.1%), 9-13 for 54 patients (11.2%), and 3-8 for 75 patients (15.5%). The means for the items related to the vital signs of the patients are shown in Table 1.

Traumatic and non-traumatic injuries to the chest are reported in Table 2.

Table 1. Mean and standard deviation of the vital signs for the patients in the study

Vital signs	Mean	Standard deviation	Minimum	Maximum
Pulse rate	98.3	16.8	50	140
Percentage of arterial oxygen saturation	89.1	10.6	Unmeasurable	99
Respiratory rate	17.1	6.2	5	66
Body temperature	36.8	0.7	30	37
Systolic blood pressure	113.8	22.2	50	175
Diastolic blood pressure	70.6	12.2	25	90
Injury severity score (ISS)	27.6	11.9	11	96

Table 2. Frequency and percentage of traumatic and Non-traumatic damage to the chest

Traumatic damage to the chest	frequency	percentage
Pneumothorax	85	17.6
Contusion	76	15.8
Hemothorax	58	12
Gear fracture	51	10.6
Scapular fracture	8	1.7
Sternum fracture	6	1.2
Flail chest	4	0.8
Subcutaneous emphysema	2	0.4
Traumatic damage to organs other than the chest	**frequency**	**percentage**
Brain	122	25.3
Lower limb	119	24.7
Abdomen	60	12.4
Spinal cord	55	11.5
Upper limb	42	8.7
Face	40	8.3
Pelvis	30	6.2

In evaluating the final fate of the patients, of the 482 investigated patients, in 135 patients (2%) blood transfusion was performed, with the administration being less than 5 to 6 units in 92 patients (74.2%) and more than 6 units in 32 patients (25.8%).

It should be noted that only 15 patients (3.1%) were discharge from the emergency room. 308 patients (63.9%) were admitted to the hospitalization section, 83 patients (17.2%) to the ICU, and 149 patients (30.9%) were directly sent to the operation room before hospitalization.

Intubation was performed on 157 patients (32.6%). The intubation location was before transferring the patient for 32 patients (20.4%), in the emergency room for 95 patients (60.5%), in the hospitalization sections for 16 patients (10.2%), and in the intensive care unit for 14 patients (8.9%). It should be noted that 10 patients (2.1%) died in the emergency room.

A follow-up of the patients showed that 83 patients (17.2%) were hospitalized in the ICU (directly from the emergency room or after being hospitalized in the sections). The duration of hospitalization was less than 3 days for 23 patients (5.3%), between 3 to 7 days for 262 patients (60.0%), and more than 7 days for 152 patients (34.8%). It should be noted that 34 patients (4.05%) finally died during the course of the study (10 patients in the emergency room and 24 patients during the hospitalization period).

The mean SOFA score for these patients was 7.6±2.8% (a minimum of 4 and a maximum of 15).

Finally, the incidence of pulmonary complications in all the investigated patients was 232 cases (48.1%), with pneumonia being the most common complication (161 cases; 33.4%). Pneumothorax (41 cases; 8.5%), ARDS (39 cases; 8.1%), hemothorax (37 cases; 7.7%), contusion (34 cases; 7%), thromboembolism (5 cases; 1%), and other complications (8 cases; 1.7%) were respectively the next common complications.

In investigating the factors causing pulmonary complications in patients, the patients were divided into two general groups of with and without pulmonary complications, and the relationship between demographic and clinical factors and these complications was investigated. In investigating the relationship between demographic factors and pulmonary complications in the patients, it was revealed that the age of the patients in the group with complications was significantly higher ($p < 0.001$) than the group without complications. The mean age was 38.8±13.7 for the group without complications and 44.8±16.5 for the group with pulmonary complications. However, there was not a significant relationship between the patients sex and the presence or not of pulmonary complications ($p = 0.38$). It should also be noted that there was not a significant relationship between pulmonary complications and education level ($p = 0.08$), residence address ($p = 0.13$), and the mechanism of trauma ($p = 0.84$) in the patients (Table 3).

In investigating the relationship between the vital signs and the clinical findings for the patients with pulmonary complications, the consciousness level of the patients in the group with pulmonary complications was significantly lower than the group without these complications ($p < 0.001$). Furthermore, the level of arterial oxygen saturation and systolic and diastolic blood pressure in the group with pulmonary complications was significantly lower. Pulse rate and ISS were also significantly related to the incidence of pulmonary complications (Table 4).

In investigating the relationship between the location of the injury and pulmonary complications, it was found

out that there was a significant relationship between the location of trauma and the incidence of pulmonary complications. As shown in Table 5, the incidence of pulmonary complications in patients with simultaneous damage to the chest and other organs was significantly higher than in patients with damage only to other organs ($p < 0.001$). It should be noted that single injury to the chest also caused more pulmonary complications than injury to other organs ($p < 0.001$).

Furthermore, hemothorax, pneumothorax, contusion and other traumatic chest injuries and traumatic head injury increase the incidence of pulmonary complications. However, pulmonary complications are less common in trauma to the spine, and injuries to the lower limb and the upper limb than other patients (Table 6).

In investigating the relationship between therapeutic measures and the incidence of pulmonary complications, blood transfusion was not significantly related to pulmonary complications ($p = 0.1$). However, injecting more than 5 to 6 units of blood causes an increase in the incidence of pulmonary complications in the patients to some extent (68.8 versus 48.9; $p = 0.05$).

Table 3. The relationship between basic and demographic factors of the patients and the incidence of pulmonary complication

Demographic factor	Without complication	With complication	p-value
Age (Mean and standard deviation)	38.8±13.7	44.8±16.5	< 0.001
Sex			
Man	153 (50.2)	152 (40.8)	0.38
woman	95 (54.3)	80 (45.7)	
Education level			
Under diploma	68 (46.3)	79 (53.7)	0.08*
Diploma	117 (53.2)	103 (46.8)	
Bachelor's	57 (55.9)	45 (44.1)	
Higher than bachelor's	6 (66.7)	3 (33.3)	
Residence place			
Native	201 (52.8)	180 (47.2)	0.13
Nonnative	39 (43.8)	50 (56.2)	
Pedestrian	44 (54.3)	37 (45.7)	
Falling	71 (51.1)	68 (48.9)	
Trauma mechanism			
Motorcycle	41 (51.2)	39 (48.8)	
Car	72 (49.3)	74 (50.7)	
Other	18 (60.0)	12 (40.0)	

Table 4. The relationship between vital signs, consciousness level, and the severity of the injury in the patients and the incidence of pulmonary complications

Factor	Without complications	With complications	p
GCS level	14.2±2.2	11.5±3.9	< 0.001
Arterial oxygen saturation level	90.2±13.3	87.8±6.1	0.0098
Pulse rate	96.0±17.0	100.6±16.2	0.003
Respiratory rate	17.1±2.9	17.0±8.5	0.98
Body temperature	36.8±0.8	36.8±0.6	0.71
Systolic blood pressure	118.5±21.4	108.9±21.8	< 0.001
Diastolic blood pressure	72.3±12.1	68.7±12.1	0.002
Severity of the injury (ISS)	23.9±10.0	31.7±12.6	< 0.001

Table 5. The relationship between the location of the injury and the incidence of pulmonary complications

Location of the injury	Without complications	With complications	p-value
Chest	36 (43.4)	47 (56.6)	< 0.001
Other organs	196 (63.4)	113 (36.6)	
Simultaneous injury to the chest and other organs	18 (20.0)	72 (80.0)	

Performing intubation, the location of the intubation, the hospitalization of the patient in hospital sections or sending the patients to the operation room, admission to the ICU, and the SOFA score were all accompanied by an increase in the incidence of pulmonary complications in traumatic patients (Table 7).

In order to evaluate the independent factors affecting the incidence of pulmonary complications and to eliminate contaminating factors and the accompanying factors, a multivariate logistic regression model was explained in which all the significant factors in univariate analyses mentioned in the previous section and the status of the incidence of pulmonary complications in patients were entered into the model. The results of this analysis are shown I Table 8. As can be seen, an age of above 45 years old, a level of consciousness lower than 15 based on the GCS criterion, single trauma to the chest, simultaneous trauma to the chest and other organs, hospitalizations of longer than one week, intubation, and finally sending the patient to the operation room are the main factors that increase the likelihood of the incidence of pulmonary complications. However, a heartbeat rate of higher than 100 per minute decreases the likelihood of the incidence of pulmonary complications ($p = 0.01$).

Table 6. The relationship between the location of the injury by organ and the incidence of pulmonary complications

Injury location	Without complications (%)	With complications (%)	p-value
Chest			
Hemothorax	12 (20.7)	46 (79.3)	< 0.001
Pneumothorax	28 (32.9)	57 (67.1)	< 0.001
Pulmonary contusion	21 (27.6)	55 (72.4)	< 0.001
Gear fracture	20 (39.2)	31 (60.8)	0.06
Other organs in the chest	20 (31.8)	43 (68.2)	0.001
Other organs			
Damage to the head	40 (34.2)	77 (65.8)	< 0.001
Damage to the face	22 (55.0)	18 (45.0)	0.68
Damage to the abdomen	27 (45.0)	33 (55.0)	0.25
Damage to the spinal cord	40 (72.7)	15 (27.3)	0.001
Damage to the upper limb	39 (92.9)	3 (7.6)	< 0.001
Damage to the lower limb	74 (62.2)	45 (37.8)	0.009
Damage to the pelvis	12 (40.0)	18 (60.0)	0.18

Table 7. The treatments administered in the emergency room and its relationship with the fate the patients

Therapeutic measures	Without complications (%)	With complications (%)	p-value
Blood transfusion	62 (45.9)	73 (54.1)	0.1
Blood volume			
Less than 5-6 unit	47 (51.1)	45 (48.9)	0.05
More than 5-6 units	10 (31.2)	22 (68.8)	
Intubation	26 (16.6)	131 (83.4)	< 0.001
Intubation place			
Before transferring	6 (18.8)	26 (81.2)	
Emergency room	20 (21.0)	75 (79.0)	0.046
Hospitalization sections	0 (0.0)	16 (100.0)	
ICU	0 (0.0)	14 (100.0)	
Decision made about the patient			
Discharge from the emergency room	14 (93.3)	1 (6.7)	0.001
Hospitalization	168 (54.6)	140 (45.4)	
Operation room	66 (44.3)	83 (55.7)	
Admission to the ICU			1
Yes	228 (57.1)	171 (42.9)	< 0.00
No	22 (26.5)	61 (73.5)	
SOFA score	6.0±0.1	7±2.6	0.004

Table 8. Independent factors affecting the incidence of pulmonary complications in traumatic patients

Factor	The ratio of the chance	Confidence interval 95%	p-value
Age of above 45 years	3.2	1.7-5.9	< 0.001
Reduced consciousness (GCS <15)	2.7	1.2-6.0	0.01
Diastolic blood pressure lower than 60 mm Hg	1.03	1.002-1.07	0.03
Single trauma to the chest	12.4	5.4-28.5	< 0.001
Simultaneous trauma to the chest and other organs	39.8	13.9-114.0	< 0.001
Intubation	14.5	4.9-43.4	< 0.001
Hospitalizations longer than one week	5.0	2.4-10.3	< 0.001
Sending the patient to the operation room	9.2	3.9-21.6	< 0.001

DISCUSSION

The present study was an attempt to determine the incidence of pulmonary complications and the main causes of them in traumatic patients visiting the emergency room. Incidents, as one of the main factors threatening life, cause the death of more than 5 million people in a year or 16,000 people in a day. Previous studies have shown that among the 15 main factors causing death in people aged 15-29, 5 factors are related to unintentional incidents including road accidents, drowning, burning, poisoning, and falling from high places (23,24). In the present study, the age group 15-29 years old comprised the highest number of patients in the investigated population, too. Trauma usually affects young age groups of society and can disable the active and productive population of society (25). Furthermore, trauma incurs enormous financial costs to the patients and their families and also to health centers and insuring organizations, and leaves destructive psychological and social effects on the individual and the society (26-28).

In a cross-sectional study by Geiger on patients with severe trauma, pulmonary failure was reported to be the main pulmonary complications. It was also shown that age, base excess, the number of injected units of FFP, and the injury severity score (ISS) are predictors of respiratory failure in traumatic patients (18). In a general review, Bakowitz et al. also mentioned factors like aspiration, the presence of lung cantiguide, pneumonia, inhalation injuries, lung injuries associated with the ventilator, lung injuries associated with blood transfusion, pancreatitis, sepsis, and traumatic brain injury as the main factors causing the incidence of pulmonary complications (19). In the study by Miller et al. on 4397 injured patients, 4.5% of the patients had respiratory distress syndrome. This study showed that an age of above 65 years old, an ISS of above 25, The presence of hypotension at the time of admission to the hospital, administering more than 10 units of blood during the first 24 hours, and the presence of pulmonary canine are the main risk factors for causing respiratory failure (29). In a study investigating the risk factors causing acute respiratory distress syndrome in 693 patients with severe traumatic injuries, femoral fracture, traumatic injury to the chest and blood administration are the factors that increase the chances of the incidence of respiratory failure (30). The incidence of ARDS was reported to be 14% in another study. The severity of the injury based on ISS, the administration of plasma in the operation room, and the volume of the fluids taken during the first 23 hours are factors that play a role in the creation of ARDS (17). In a prospective cohort study, 35% of the patients got ARDS. The main factors predicting this respiratory complication are PACHE II, the severity of the injury, the presence of the blunt damage, pulmonary cantigium, injecting high volumes of fluids, and the presence of flail chest (16).

The incidence of pulmonary complications in the present study was 43.1%, which is a very high rate. However, the incidence of pulmonary complications in patients with multiple trauma was 60% in the study by Saltzher et al. (15). Hoyt et al. also showed that pulmonary complications make up one third of the complications caused by trauma (14). In a cohort study on 217 patients with ARDS, Estenssoro et al showed that 11% of acute respiratory distress syndrome cases happen in traumatic patients, being the third main factors causing the syndrome after sepsis and shock (31). 6.5% of traumatic patients who remain under mechanical ventilation for more than 48 hours acquire acute respiratory distress syndrome, of whom 50% acquire pneumonia and 19% die as a result of these complications (32). In an investigation of the relationship between brain traumatic injury and traumatic pulmonary complications, it was shown that pulmonary complications happen as an independent damage in addition to brain injuries and also can threaten the life the patient as a secondary complication to the brain injuries due to defective airway protection (33).

Pulmonary problems are among the most important complications in patients injured in accidents, and it seems that they are more common in traumatic injuries to the chest. However, the present study showed that delayed traumatic complications that follow the trauma are more common than the acute complications caused as a results of the trauma itself. For example, delayed pneumonia was the most common pulmonary complication in the present study with an incidence of 28.8%, while acute pneumonia caused by the direct damage to the chest was reported in 5.8% of the cases. These findings can indicate that hospitalization and taking measures like intubation and mechanical ventilation can cause the incidence of pulmonary complications. Several studies have emphasized the need for paying more attention to the pneumonia following intubation and mechanical ventilation, and they have also emphasized that the incidence of these complications need to be decreased by taking such preventive measures as prophylaxis antibiotics (34-37). In the present study,

too, intubation and long periods of hospitalization were two important and independent factors that caused the incidence of pulmonary complications following trauma.

In the present study, an age of above 45 years old, a consciousness level of lower than 15 based on the GCS criterion at the time of admission to the hospital, single trauma to the chest, simultaneous trauma to the chest and other organs, hospitalizations of longer than one week, intubation, and finally sending the patient to the operation room were the most important factors that increased the chances of the incidence of pulmonary complications. In fact, there are some contradictions in the results reported by different studies on the factors causing pulmonary complications. For example, in one study it was shown that factors such as age, base excess, the number of injected units of FFP, and injury severity score (ISS) are predictors of respiratory failure in traumatic patients (18). In a review study on the causes and common treatments of ARDS, Bakowitz et al. explained a list risk factors for this syndrome in traumatic patients that included aspiration, lung cantiguide, pneumonia, inhalation damages, lung damages associated with the ventilators, lung damages associated with blood transfusion, pancreatitis, sepsis, and traumatic brain injuries (19). Direct trauma to the lung, previous history of the disease, sex, ttransfusions more than 10 units of blood, decreased level of consciousness, and increased severity of the injury were the most important factors that increase the chances of the incidence of pulmonary complications following severe trauma (18). These contradictions in results may be due to the investigated populations of traumatic patients. For example, in the study by Geiger et al. only patients with severe traumatic injuries entered the study, while in the present study all traumatic patients entered the study.

This study showed that most of traumatic patients in accidents are men and young people, and accidents with vehicles are the main cause of these accidents. In confirmation of these findings, yousefzadeh et al. showed that around 50% of traumatic patients were in the age group 20 to 44 years of old and the number of men was 3.6 times the number of women. The highest number of patients were motorcycle riders and finally 5.2% died as a result of the traumatic injuries (38). The incidence of accidents in men is reported three time more than women (39), and in one study 89.9% of the patients were men, of whom 56.8% were aged 16 to 25 years old (40). In another cross-sectional descriptive study, too, most of the victims of the accidents were aged 21 to 30 years old (41). Saaki et al, pointing to the fact that most of the victims who die in accidents are men, also showed that most of the victims are illiterate and in the age range 21-40 years (42). Barzegar et al. showed that 80.2% of traffic accidents were men and their mean age was 39.8 years old (43).

CONCLUSION

The incidence of pulmonary complications in the investigated traumatic patients was 48.1%. In the end, it should be noted that delayed pulmonary complications are much more common in traumatic patients, because delayed pneumonia was the most important complication in the present study. This preventable complication can be decreased by adopting appropriate action. Therefore, given the significance of such a high incidence, further studies and taking effective preventive and medical measures are strongly suggested.

Suggestions

It is suggested that the probability of the incidence of pulmonary complications be taken into account in patients with the risk factors an age of above 45 years old, a reduced GCS criterion lower than 15 at the time of admission to the hospital, single trauma to the chest, simultaneous trauma to the chest and other organs, hospitalizations of longer than one week, and airway intubation. Triple prevention levels like reducing the incidence of accidents, especially road accidents, by training, safety training to prevent falling from high places, improving protective measure in the workplace, initial and immediate care at the accident site, using prophylaxis, and rehabilitation services are useful measures that can be very effective in preventing the incidence of pulmonary complications.

REFERENCES

1. Onyemaechi N, Ofoma UR. The Public Health Threat of Road Traffic Accidents in Nigeria: A Call to Action. Ann Med Health Sci Res. 2016;6(4):199-204.
2. Steinmetz J, Svendsen LB. The initial treatment of multitrauma patients. Ugeskr Laeger. 2014 7;176(28):V02130143.
3. John E. Campbell, Roy L. Alson. International Trauma Life Support for Emergency Care Providers. 8th ed. *International Trauma Life Support.* 2015 ISBN: 978-0134130798.
4. Dyer O.(2004) One million people die on world's roads every year. *BMJ*;328(7444):851.
5. Saadat S, Soori H. (2011) Epidemiology of traffic injuries and motor vehicles utilization in the Capital of Iran: A population based study. *BMC public health*.11(1):488.
6. Shams Vahdati S, Ghaffarzad A, Rahmani F, Panahi F, Omrani Rad A. Patterns of Road Traffic Accidents in North West of Iran during 2013 New Year Holidays: Complications and Casualties. Bull Emerg Trauma. 2014;2(2):82-85.
7. White TO, Jenkins PJ, Smith RD, Cartlidge CW, Robinson CM. (2004) The epidemiology of posttraumatic adult respiratory distress syndrome. *J Bone Joint Surg Am*. 86(11):2366-76.
8. Goldstein JN, Fazen LE, Wendell L, Chang Y, Rost NS, Snider R, et al. (2009) Risk of thromboembolism following acute intracerebral hemorrhage. *Neurocritical care*.10(1):28-34.
9. Maramattom BV, Weigand S, Reinalda M, Wijdicks EF, Manno EM. Pulmonary complications after intracerebral hemorrhage. *Neurocritical care*.2006 5(2):115-9.
10. Kahn JM, Caldwell EC, Deem S, Newell DW, Heckbert SR, Rubenfeld GD. (2006) Acute lung injury in patients with subarachnoid hemorrhage: incidence, risk factors, and outcome. *Critical Care Medicine-Baltimore*.34(1):196.
11. Wartenberg KE, Schmidt JM, Claassen J, Temes RE, Frontera JA, Ostapkovich N, et al. (2006) Impact of

medical complications on outcome after subarachnoid hemorrhage. *Critical care medicine*.34(3):617-23.
12. Pelosi P, Ferguson ND, Frutos-Vivar F, Anzueto A, Putensen C, Raymondos K, et al. (2011) Management and outcome of mechanically ventilated neurologic patients. *Critical care medicine*.39(6):1482-92.
13. Lee K, Rincon F. (2012) Pulmonary complications in patients with severe brain injury. *Critical care research and practice*.
14. Hoyt DB, Simons RK, Winchell RJ, Cushman J, Hollingsworth-Fridlund P, Holbrook T, et al. (1993) A risk analysis of pulmonary complications following major trauma. *The Journal of trauma*.35(4):524-31.
15. Saltzherr TP, Visser A, Ponsen KJ, Luitse JS, Goslings JC. (2010) Complications in multitrauma patients in a Dutch level 1 trauma center. *The Journal of trauma.* 69(5):1143-6.
16. Watkins TR, Nathens AB, Cooke CR, Psaty BM, Maier RV, Cuschieri J, et al. (2012) Acute respiratory distress syndrome after trauma: development and validation of a predictive model. *Crit Care Med*. 40(8):2295-303.
17. Zielinski MD, Jenkins D, Cotton BA, Inaba K, Vercruysse G, Coimbra R, et al. (2014) Adult respiratory distress syndrome risk factors for injured patients undergoing damage-control laparotomy: AAST multicenter post hoc analysis. *Journal of Trauma and Acute Care Surgery*. 77(6):886-91.
18. Geiger EV, Lustenberger T, Wutzler S, Lefering R, Lehnert M, Walcher F, et al. (2013) Predictors of pulmonary failure following severe trauma: a trauma registry-based analysis. *Scandinavian journal of trauma, resuscitation and emergency medicine.* 21(1):1.
19. Bakowitz M, Bruns B, McCunn M. (2012) Acute lung injury and the acute respiratory distress syndrome in the injured patient. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 20(1):1.
20. Butcher NE, Enninghorst N, Sisak K, Balogh ZJ. (2013) The definition of polytrauma: Variable interrater versus intrarater agreement—A prospective international study among trauma surgeons. *The journal of trauma and acute care surgery*. 74(3):884-9.
21. Breslau N, Kessler RC, Chilcoat HD, Schultz LR, Davis GC, Andreski P. (1998) Trauma and posttraumatic stress disorder in the community: the 1996 Detroit Area Survey of Trauma. *Archives of general psychiatry*. 55(7):626.
22. Blackburn S. The Oxford dictionary of philosophy: OUP Oxford; 2005.
23. Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, et al. (2013) Priority actions for the non-communicable disease crisis. *The Lancet*. 377(9775):1438-47.
24. Meheš M, Abdullah F. (2011) Global Surgery and Public Health: A New Paradigm. *Archives of Surgery.* 146(10):1218-9.
25. Frounfelker R, Klodnick VV, Mueser KT, Todd S. Trauma and Posttraumatic Stress Disorder Among Transition-Age Youth With Serious Mental Health Conditions. J Trauma Stress. 2013;26(3):409-12.
26. Naghavi M, Abolhassani F, Pourmalek F, Lakeh MM, Jafari N, Vaseghi S, et al. (2009) The burden of disease and injury in Iran 2003. *Population health metrics*.7(1):9.
27. Rehm J, Mathers C, Popova S, Thavorncharoensap M, Teerawattananon Y, Patra J. (2009) Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *The Lancet*. 373(9682):2223-33.
28. Manjavidze I. 1298 Trauma Prevention of Children. *Pediatric Research.2010* 68:642.
29. Miller PR, Croce MA, Kilgo PD, Scott J, Fabian TC. (2002) Acute respiratory distress syndrome in blunt trauma: identification of independent risk factors. *The American surgeon.* 68(10):845-50; discussion 50-1.
30. Navarrete-Navarro P, Rivera-Fernández R, Rincón-Ferrari MD, García-Delgado M, Muñoz A, Jiménez JM, et al. (2006) Early markers of acute respiratory distress syndrome development in severe trauma patients. *Journal of critical care.* 21(3):253-8.
31. Estenssoro E, Dubin A, Laffaire E, Canales H, Saenz G, Moseinco M, et al. (2002) Incidence, clinical course, and outcome in 217 patients with acute respiratory distress syndrome. *Crit Care Med.* 30(11):2450-6.
32. Recinos G, DuBose JJ, Teixeira PG, Barmparas G, Inaba K, Plurad D, et al. (2009) ACS trauma centre designation and outcomes of post-traumatic ARDS: NTDB analysis and implications for trauma quality improvement. *Injury*. 40(8):856-9.
33. Lee K, Rincon F. (2012) Pulmonary complications in patients with severe brain injury. *Crit Care Res Pract*. 207247.
34. Reignier J, Mercier E, Le Gouge A, Boulain T, Desachy A, Bellec F, et al. (2013) Effect of not monitoring residual gastric volume on risk of ventilator-associated pneumonia in adults receiving mechanical ventilation and early enteral feeding: a randomized controlled trial. *Jama*. 309(3):249-56.
35. Kaneoka A, Pisegna JM, Miloro KV, Lo M, Saito H, Riquelme LF, et al. (2015) Prevention of healthcare-associated pneumonia with oral care in individuals without mechanical ventilation: A systematic review and meta-analysis of randomized controlled trials. *Infection Control & Hospital Epidemiology*. 36(08):899-906.
36. Banupriya B, Biswal N, Srinivasaraghavan R, Narayanan P, Mandal J. (2015) Probiotic prophylaxis to prevent ventilator associated pneumonia (VAP) in children on mechanical ventilation: an open-label randomized controlled trial. *Intensive care medicine.*41(4):677-85.
37. Biswal N, Narayanan P, Srinivasaraghavan R, Banupriya B. (2015) Probiotic prophylaxis to prevent ventilator-associated pneumonia (VAP) in children on mechanical ventilation: an open-label randomized controlled trial--response to comments by Saptharishi et al. Intensive care medicine. 41(6):1162.
38. Yousefzadeh S, Ahmadi Dafchahi M, Mohammadi Maleksari H, Dehnadi Moghadam A, Hemati H, Shabani S. (2007) Epidemiology of Injuries and their Causes

among Traumatic Patients Admitted into Poursina Hospital, Rasht. *Journal of Kermanshah University of Medical Sciences*.;11(3):1-7.

39. Rowe R, Maughan B, Goodman R. (2004) Childhood psychiatric disorder and unintentional injury: findings from a national cohort study. *Journal of pediatric psychology*.;29(2):119-30.
40. Torabi A, Tarahi M, Mahmoudi Ga. (2009) Epidemiology of motorcycle accident in Khoramabad, Iran. *Payesh*.
41. Mohammadfam A, Akbari Gh. (2004) Epidemiologic investigation of traffic accidents leading to death in Tehran Province in 1999. *The Scientific Journal of Kurdistan University of Medical Sciences*. 6(3): 35-40.
42. Saaki M, Ehsan Saleh A. Moshfeghi Gilani F. (2002) Epidemiologic investigation of traffic accidents leading to daeth in Lorestan Province from 1999 to 2001. *Legal Medicine*. 80(3): 8-24.
43. Barzegar A, Sadegh H, Chaboksavaran N. (2006) Epidemiologic investigation of mortality rates for traffic accidents in Kermanshah Province in 2004. *The journal of Kerman University fo Medical Sciences*. 1348 (2).