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Study of incidence of occult pneumomediastinum due to blunt chest trauma

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ABSTRACT

Background: Pneumomediastinum refers to the presence of extraluminal gas within the mediastinum. If signs of pneumomediastinum are not present on chest X-ray and it is detected on contrast-enhanced computed tomography (CECT) thorax then it is known as occult pneumomediastinum. There is a dearth of literature regarding occult pneumomediastinum in patients with blunt chest trauma. **Aims and Objectives:** This study was done to see the incidence as well as outcome of occult pneumomediastinum in patients of blunt chest trauma. **Materials and Methods:** A prospective study was done in the department of general surgery at a tertiary care institute in which a total of 32 patients with blunt chest trauma were taken. The patients with occult pneumomediastinum were identified using CECT and appropriate management was done in all patients. Correlation of occult pneumomediastinum with subcutaneous emphysema, rib fracture, jugular venous pressure (JVP), pleural effusion, and outcome was seen. **Results:** It was evident from this study that 18.8% of patients of with chest trauma had occult pneumomediastinum. Incidence of blunt chest trauma is most common in the age group of 31–60 years as this age group is more vulnerable to roadside accidents and other accidents. There is a strong correlation between the presence of central subcutaneous emphysema, raised JVP, and worse outcomes with occult pneumomediastinum ($P<0.05$). **Conclusion:** This study showed a high incidence of occult pneumomediastinum in patients with chest trauma which is ultimately associated with high mortality. Hence, we should keep high index of suspicion regarding the presence of occult pneumomediastinum so that timely management of these patients can be done to prevent morbidity and mortality.

Key words: Pneumomediastinum; Blunt trauma; Computed tomography chest

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INTRODUCTION

Thoracic injuries are potentially responsible for 25% of all trauma deaths.[1-3] Chest X-ray is commonly used to screen patients with chest injury. However, the use of computed tomography (CT) scan for primary screening is increasing, particularly for blunt trauma. CT scans are more sensitive than chest X-ray in detecting intra-thoracic abnormalities such as pneumothorax and pneumomediastinum. Pneumomediastinum found on chest X-ray raises the possibility of associated aerodigestive tract injuries. In contrast, there is scarce information on the clinical significance of pneumomediastinum diagnosed by CT scan only.[4] Although rare, aerodigestive tract injuries are associated with significant morbidity and mortality, particularly in blunt trauma patients.[5,6] It has been already speculated that the widespread use of multi-detector thoracic CT scanning has increased the frequency of diagnosis of occult pneumomediastinum in blunt trauma.[7] Nonetheless, little has been written about the incidence or the natural history of occult pneumomediastinum in trauma patients.[8] The optimal management of occult pneumomediastinum in the blunt trauma setting remains controversial. Nearly 80% of the patients with

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tracheobronchial injuries die before arriving to a hospital, but only 0.5% of the patients admitted to trauma centers have such injuries.[9] Furthermore, the mortality rate of patients who undergo surgical repair for tracheobronchial injuries can be as high as 10–25%, with a considerably high rate of complications (19%). Blunt trauma composed of 86% of traumatic factors whereas penetrating traumas or iatrogenic injuries composed 14%.[10] Blunt injuries to the esophagus are an even rarer event, occurring in <0.1% of the patients who sustain blunt trauma. Mortality rate as high as 19% has been reported for esophageal injuries. Most patients with major aerodigestive tract injuries undergo primary repair, although good results using selective non-operative management have been reported.[10-13] As there is a scarcity of literature regarding the incidence and outcome of occult pneumomediastinum, hence, we have done this study to see the incidence and clinical consequences of occult pneumomediastinum in our blunt chest trauma patients.

Aims and objectives

This study was done to see incidence and outcome of occult pneumomediastinum due to blunt chest trauma.

MATERIALS AND METHODS

The present prospective study was conducted in the Department of Surgery at a Tertiary Care Teaching Institute. The study was conducted from February 2019 to May 2020 after approval from the hospital Ethics Committee (IEC/Th/19/SUR01 dated April 04, 2019). Patients in age group of 18–80 years with blunt chest trauma irrespective of sex were recruited from the trauma center in this study. Patients with a history of chronic obstructive pulmonary disease, patients with penetrating chest injuries, and patients with small amounts of air in the pleural space on chest X-ray were excluded from the study.

The patients who were admitted to emergency room after blunt chest trauma were reviewed prospectively. Biochemical investigation, arterial blood gas, and electrocardiogram of all patients were done. After those radiological investigations were done. The patients with occult pneumomediastinum were identified using contrast-enhanced computed tomography (CECT) and appropriate management was done. If tube thoracostomy was performed due to pneumothorax and/or hemothorax, it was followed up until the end of air leak or hemorrhagic drainage under 100 cc/day. Nasal oxygen inhalation (2–4 L/min) was given to all of the patients to accelerate the resorption of mediastinal emphysema. The patients were discharged after the complete resorption of pneumomediastinum as confirmed by CT chest.

Sample size calculation: $n=(\sigma 1\ 2+\sigma 2\ 2).\{Z1-\alpha/2+Z\ 1-\beta\}\ 2\ (M1-M2)\ 2=(12+12)\{1.96+1.96\}2\ (1\times1)=(1+1)\times15.36\ 1=30.73$ where $Z\alpha/2$ was the critical value of the normal distribution at $\alpha/2$ (e.g., for a confidence level of 95%, α is 0.05 and the critical value was 1.96), $Z\beta$ was the critical value of the normal distribution at β (e.g., for a power of 90%, β was 0.1 0) and M1, M2 were the expected sample mean of the two groups. $\sigma 1$ and $\sigma 2$ were the expected sample Sd of the two groups.

Statistical testing was conducted with the statistical package for the social science systems version SPSS 17.0. Continuous variables were presented as mean±SD or median if the data was unevenly distributed. Categorical variables were expressed as frequencies and percentages. The comparison of continuous variables between the groups was performed using Student's t-test. Nominal categorical data between the groups was compared using the Chi-square test or Fisher's exact test as appropriate. Non-normal distribution continuous variables were compared using Mann–Whitney U-test. For all statistical tests, a $P<0.05$ was taken to indicate a significance difference.

RESULTS

A total of 32 patients with blunt chest trauma were included in the study who underwent CECT-thorax to look for occult pneumomediastinum. In this study, patients included were in the age group of 18–80 years and the mean age of the patients was 51.17 years with standard deviation of 24.48 years. Most of the patients were in the age group of 31–60 years. In this study out of 32 patients, 30 (93.75%) patients were males and the remaining 2 (6.25%) were females. The most common mode of injury in this study was roadside accident (RSA) occurring in 43.75% of patients, physical assault in 21.8%, and fall from height in 18.75% of patients. All the baseline parameters were comparable in both groups (Table 1).

In this study, occult pneumomediastinum was present in 18.8% of patients which was significant. The presence of subcutaneous emphysema is an important clinical indicator of pneumomediastinum. If subcutaneous emphysema is present centrally then there are high chances of presence of pneumomediastinum. This study also shows a strong correlation between central subcutaneous emphysema and pneumomediastinum ($P=0.002$). Raised jugular venous pressure (JVP) is another important parameter which indicates the presence of pneumomediastinum ($P=0.030$). Blunt chest trauma accounts for high mortality; hence, these patients should be properly managed. Mortality associated with blunt chest trauma patients having occult

pneumomediastinum is significant, that is, 33.3% which indicates that these patients should be managed in the intensive care unit (ICU) (Table 2).

DISCUSSION

The principle aim of this study was to study the incidence of occult pneumomediastinum in blunt chest trauma patients. The thoracic injury which can be caused either by blunt or penetrating trauma is associated with considerable morbidity and mortality due to the relation with the injuries of the tracheobronchial tree, esophagus, or vascular structures. In patients with pneumomediastinum, blunt trauma is the most commonly faced injury mechanism and may co-occur with severe blunt thoracic and cervical trauma up to 10% of patients. High-speed motor vehicle accidents account for the major reason for blunt trauma in those patients. The Macklin effect is the most common cause of pneumomediastinum in the setting of blunt trauma. It is the outcome of rupture of terminal alveoli afflicted by increased intrathoracic pressure and consequent dissection of air through peri bronchial and perivascular fascial sheaths, finally into the mediastinum. Traumatic pneumomediastinum is sourced by tracheobronchial or esophageal tears in up to 10% of patients. Although oesophageal injuries are rare manifesting in <0.1%–1.5% of patients, mortality rate as 19% has been reported in those cases.

It is of importance to exclude aerodigestive tract injuries to avoid unnecessary endoscopic or surgical procedures. Multi-detector CT is the first-line non-invasive imaging method which is readily available for the diagnosis and exclusion of possible aerodigestive tract injuries. In our study, incidence of occult pneumomediastinum was 18.8%.

Table 1: Baseline parameters of the study subjects

Parameters	No pneumomediastinum (%)	Pneumomediastinum (%)	P-value
Age groups			
18–30 years	5 (83.3)	1 (16.7)	0.793
31–45 years	7 (77.8)	2 (22.2)	
46–60 years	9 (90)	1 (10)	
61–80 years	5 (71.4)	2 (28.6)	
Sex			
Male	24 (80)	6 (20)	1.00
Female	2 (100	0 (0	
Mode of trauma			
Road side accident	14 (93.3	1 (6.6)	0.307
Physical assault	6 (85.7)	1 (14.2)	
Fall from height	3 (50)	3 (50)	
Misc.	3 (75)	1 (25)	

Table 2: Correlation of occult pneumomediastinum with various clinical and radiological parameters

Parameters	No pneumomediastinum (%)	Pneumomediastinum (%)	Total	P-value
S/C emphysema location				
Absent	15 (100)	0 (0)	15	0.002
Present peripherally	11 (73.3)	4 (26.7)	15	
Present centrally	0 (0)	2 (100)	2	
Rib fracture				
Absent	1 (50)	1 (50)	2	0.345
Present	25 (83.3)	5 (16.7)	30	
Jugular venous pressure				
Not raised	26 (86.7)	4 (13.3)	30	0.030
Raised	0 (0)	2 (100)	2	
Ultrasound–pleural effusion				
Present	14 (77.8)	4 (22.2)	18	0.260
Absent	12 (85.7)	2 (14.3)	14	
Post-trauma contrast-enhanced computed tomography thorax				
Day 1	25 (86.2)	4 (13.8)	29	0.083
Day 3	1 (33.3)	2 (66.7)	3	
Outcome				
Discharged	26 (86.7)	4 (13.3)	30	0.030
Expired	0 (0)	2 (100)	2	
Total	26 (81.3)	6 (18.8)	32	

In another study conducted by Muckart et al., incidence was 5.9%.[14] Similarly, study conducted by Rezende-Neto et al., incidence of occult pneumomediastinum was 5.9%.[4]

In the present study, we can conclude that blunt chest trauma was most common in the age group of 30–60 years as this age group is most vulnerable to RSA, physical assault, and other accidents. In another study conducted by Kavurmaci et al., it also shows that the most vulnerable age group was 30–64 years for blunt chest trauma.[15] In males incidence of blunt chest trauma was far more as compared to females. In study conducted by Chouliaras et al., it shows that incidence in males was more about 76%.[16] In another study conducted by Muckart et al., it also shows males accounted for the majority of patients (70.9%).[14]

From this study, we can conclude that the relation between rib fracture and pneumomediastinum was not significant (P>0.05). It shows that it is not necessary that in every patient sustaining rib fracture pneumomediastinum will occur. This study also concludes that the relation between subcutaneous emphysema and pneumomediastinum was significant (P<0.05). Location of subcutaneous emphysema is important in the presence or absence of pneumomediastinum. In this study, we can see that those patients having subcutaneous emphysema centrally than peripherally were having pneumomediastinum. In a study conducted by Kavurmaci et al., results show that subcutaneous emphysema was present in 82.6% of cases of blunt chest trauma with pneumomediastinum.[15]

This study concludes that the relation between raised JVP and pneumomediastinum was significant (P>0.05) pneumomediastinum was present in all those patients having raised JVP. Patients in whom JVP was not raised pneumomediastinum may or may not be present. Hence, the presence of raised JVP is an important clinical parameter for the presence of pneumomediastinum. This study concludes that the most common mode of trauma in blunt chest trauma patients was RSA which accounts for 43.75% of patients. In another study conducted by Chouliaras et al., it shows motor vehicle accidents as predominant mechanism of blunt chest trauma accounting for 49% of cases.[16] Similarly, other study conducted by Muckart et al., shows motor vehicle accidents as a major cause accounting for 94% of cases.[14] Study conducted by Kavurmaci et al. also shows similar results with 55.07% of patients of blunt chest trauma having RSA. In this study, out of a total of 32 patients 30 patients were discharged and two patients were expired. Mortality was 6.25% in blunt chest trauma patients. Both the expired patients had occult pneumomediastinum.[15] In the study, a total of six patients had occult pneumomediastinum and out of them, four were discharged while two patients expired, indicating mortality was 33.3% in blunt chest trauma patients having occult pneumomediastinum which was significant. P=0.030 in this study. Hence, these patients should be managed in ICU.

Occult pneumomediastinum is not an uncommon finding in blunt chest trauma. Routinely, we advise chest X-ray in blunt chest trauma patients to look for rib fractures, pneumothorax, or haemothorax. However, it is not necessary that signs of pneumomediastinum will be seen on chest X-ray. While managing chest trauma patients, we should rule out the possibility of pneumomediastinum by CECT thorax as it can be a life-threatening condition.

Limitations of the study

The limitations of our study were that it was a single centre study with small sample size.

CONCLUSION

In our study, the incidence of occult pneumomediastinum was found to be high with significant mortality in patients with blunt chest trauma. Early detection and timely management of pneumomediastinum can improve outcomes in these patients. More studies with larger sample size are required in blunt chest trauma patients to make a definitive conclusion.

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Authors Contribution:
SV, VS- Implemented the study, collected data; **SV, AV, GK**- Data analysis, wrote the manuscript; **PG**- Developed study protocol, supervised implementation of study; **AK, HK, SSLL**- Implemented the study, contributed in writing of the manuscript

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