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Correlation Between Angiotensin Converting Enzyme and Thoracic Trauma: An Institutional Study

Arvind Kumar Suman[1], Suresh Kumar[2], Sanjeev Kumar[3], Pradakhshana Vijay[4*], Priyanka Singh[5]

[1]Department of Neurosurgery, AIIMS Raebarelli

[2]Department of General Surgery, KGMU, Lucknow

[3]Department of General Surgery, KGMU, Lucknow

[4]Department of Oral Pathology, Indira Gandhi Govt. Dental College, Jammu

[5]Department of Oral Pathology, FODS, KGMU, Lucknow

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***Corresponding author:** Pradakhshana Vijay, Department of Oral Pathology, Indira Gandhi Govt. Dental College, Jammu.

ABSTRACT

Introduction: Chest injuries are the main cause of death in young adults and comprise 25% of all trauma-related deaths. The role of various biomarkers like Clara cell protein 16, von Willebrand factor and interleukin-6 has been previously studied in trauma-related acute respiratory distress syndrome (ARDS) while as Serum angiotensin-converting enzyme (ACE) levels have been evaluated in non-trauma-related ARDS cases. Not much data is available on correlation of ACE and thoracic trauma as no research has been done previously on this. Aim and objective: Assess role of ACE with trauma severity and outcome.

Material and method: 48 patients were selected for study and ACE levels, its correlation with TTSS, type of injury and outcome were evaluated.

Result and Discussion: Student t test was performed for statistical analysis. Levels of ACE were consistently raised with the severity of lung injury measured by TTSS. Conclusion: Serum ACE levels are increased in thoracic trauma cases, which indicate the severe nature of trauma in congruence with increased TTSS scores.

Key words: Chest injury, ACE, TTSS, Severity, Trauma

INTRODUCTION

The term 'Injury' is any lesion due caused due to an external source (intentional or unintentional) occurring due to exposure to any form of energy (electrical, mechanical, thermal, chemical) produced by interaction between host and agent. This leads to tissue damage when it exceeds the physiological tolerance limit of an individual. [1]

Trauma is the oldest of human afflictions, and the history of trauma is as old as medicine itself. [2] One of the earliest writings on thoracic injury was found in an Egyptian medical text "Edwin Smith Papyrus" which describes cases of penetrating thoracic trauma. [1]

Around 25% of the deaths of thoracic injuries could be motor vehicle collisions or penetrating mechanisms like stabbing. [2] Blunt trauma commonly results in chest wall injuries. The pain associated with these injuries can make breathing difficult compromising ventilation. [2]

The major pathophysiology involves derangements in the flow of air, blood or combination. Shunting and dead space ventilation produced by these injuries can also impair oxygenation. [3]

At the molecular level, a mediator-driven inflammatory process leads to respiratory insult after chest trauma occurs. Several blood-borne mediators are released, including Interleukin (IL)-6, tumor necrosis factor (TNF), and clara cells, von Wilibrand factor and Angiotensin Converting Enzyme (ACE). [4] These mediators are thought to induce secondary cardiopulmonary changes.

Renin-Angiotensin (RAS) has been involved in the pathogenesis of few common chronic lung diseases like pulmonary fibrosis and pulmonary hypertension. [4, 5] RAS plays a significant role in acute lung disease as well, so an increase in ACE activity might be a new approach for the treatment of acute lung failure in several diseases. [3]

Injury Severity Scoring is a process by which complex and variable patient data is reduced to a single number. [5] This value is intended to accurately represent the patient's degree of critical illness. In our study the scoring system which we are using is Thoracic Trauma Severity Score (TTSS).

But very few studies have been conducted to predict prognosis in traumatic chest injury patients, and association between TTSS and any serum marker was not done previously. So in present study we intend to see if any association between TTSS and a Serum biomarker (ACE) exists.

Also not many studies have been done in past on the role of RAS with traumatic lung injuries. So this seems to be first study to predict the association and role of Angiotension converting enzyme in lung trauma.

AIM AND OBJECTIVE

1. To assess the level of biomarker (ACE) in traumatic lung injury patients.
2. To correlate the levels of biomarker (ACE) with existing severity score of traumatic lung injury.
3. To correlate the level of biomarker (ACE) with outcome.

MATERIAL AND METHODS

After obtaining the ethical approval from the institutional Ethical Committee, prospective pilot study of one year duration was conducted in the surgical emergency unit of the institution. Following these 48 patients were selected for study done based on inclusion and exclusion criteria and written consent.

Inclusion criteria:

- Patient with isolated chest injury
- Blunt chest injury

- Penetrating chest injury

Exclusion criteria:

- Infective traumatic lung injury.
- Patients having infected parenchymal pathology of lung.
- Patients having polytrauma.

METHOD:

5ml of venous blood was collected from the traumatic lung injury patient and centrifuged at 3000rpm for 10 min and serum was separated. The serum sample was then transferred to vial and stored at -80°C in deep freezer following which estimation of serum ACE was done using ELISA kit as per manufacturer's protocol.

Statistical analysis

Mean of 2 groups was tested using Student's t test and change of variable was tested using paired t test. 'p' <0.05 was considered statistically significant, where p is the probability.

RESULT

Gender and age

Of the 48 subjects enrolled in study, majority of the patients were males accounting for 91.67%. mean age of subjects was was 41.48 with standard deviation of 4.37. Bimodal age distribution was maximum between 21-30 years and 45-60 years. (Table 1)

Location of injury

Central position of trachea was injured in 91% cases compared to right/left side

Soft tissue injury and lung parenchyma condition

Contusion alone and minimal collection was the common finding (54.6% and 33.33%). Road traffic accidents were most common (54.16%) followed by fall from height and penetrating injuries (25% and 6.25%). (Table 2)

Thoracic Trauma Severity Score (TTSS)

Most of the patients had TTSS score of 6-10 followed by range of 11-15 and 0-5. Very few patients had a range more than 16; 3 of them needed Ventilator support onwards and 3 expired. (Table 3)

ACE levels and its correlation with TTSS, type of injury and outcome

The range of level in which most of the patients were between 60-70 (n=20, %=41) followed by level between 70-80 (n 15, %=31). It was seen that levels were significantly higher than normal range (8-50µg/L) in the patients of chest injury. Very few of them were having levels higher then 80 (n=3, %=6) and those were the patients who were having a higher score of TTSS and have poorer prognosis. (Table 4)

Levels of ACE were consistently higher in patients having Lung contusions, subcutaneous emphysema and Pneumothorax. So there was a significant association of values of ACE and these pathologies. (Table 5)

Of the 42 patients who were discharged it was found mean duration of stay was 9.4 days and mean level of ACE was 64.9. 3 patients with ventilator support had mean duration of stay as 19.3 days and mean ACE level as 75.01. 3

patients who died had mean duration of stay as 2.8 days and mean level of ACE was 80.2. So it was concluded that with increase in duration of stay and poor outcome levels of ACE were significantly raised. (Table 6)

34 patients with no complications had mean values of TTSS and ACE as 7.2 & 63.1. In 2 patients who developed pneumonitis as a complication levels were 9 & 66.4 respectively. 2 patients in which empyema thoracis developed as a complication, levels were 11.5 & 75.3. 9 Patients in which Acute Respiratory Distress Syndrome (ARDS) developed as a complication levels were 13 & 76.1 respectively and in 1 patient who died of Shock mean levels was 17 & 87.5.

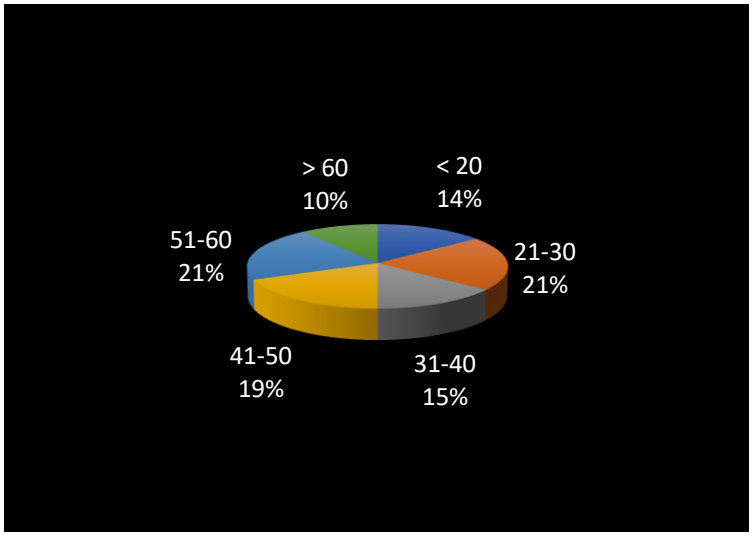

Table 1: showing bimodal distribution of age. Maximum (n=10; %=21) were aged between 21 to 30 years and 51 to 60 years followed by those aged between 41-50 years (n=9; %=19).

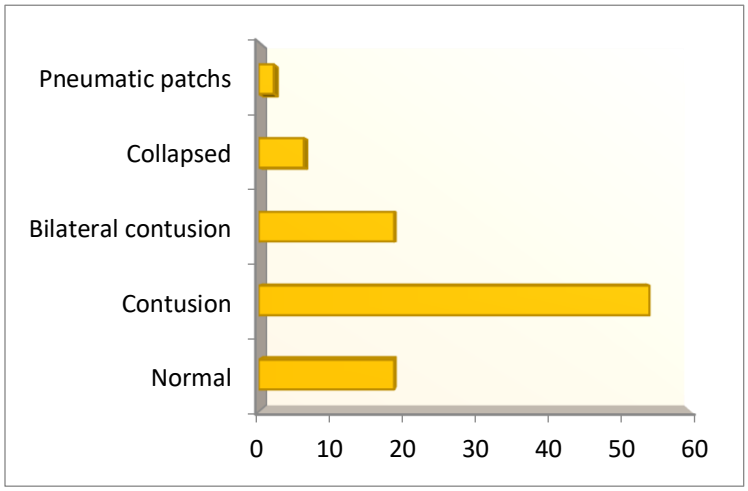

Table 2: shows Unilateral Lung contusion was the most consistent finding (N=26, %=54), followed by Bilateral Contusion (n=9, %=18). In few patients collapsed lung (n=3, %6) and pneumatic patches (n=1,%=2) were found and in rest Lung Parenchyma was normal.

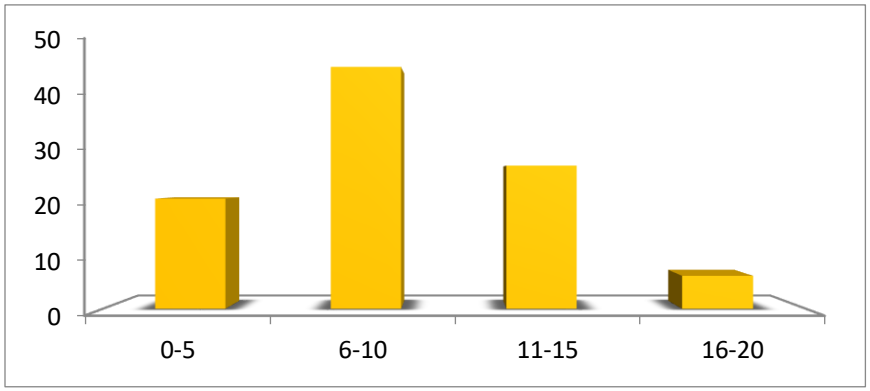

Table 3: showing range of TTSS of 6-10 (n=22, %=45), followed by range of 11-15 (n=13, %=27) and 0-5(n=10,%=20).

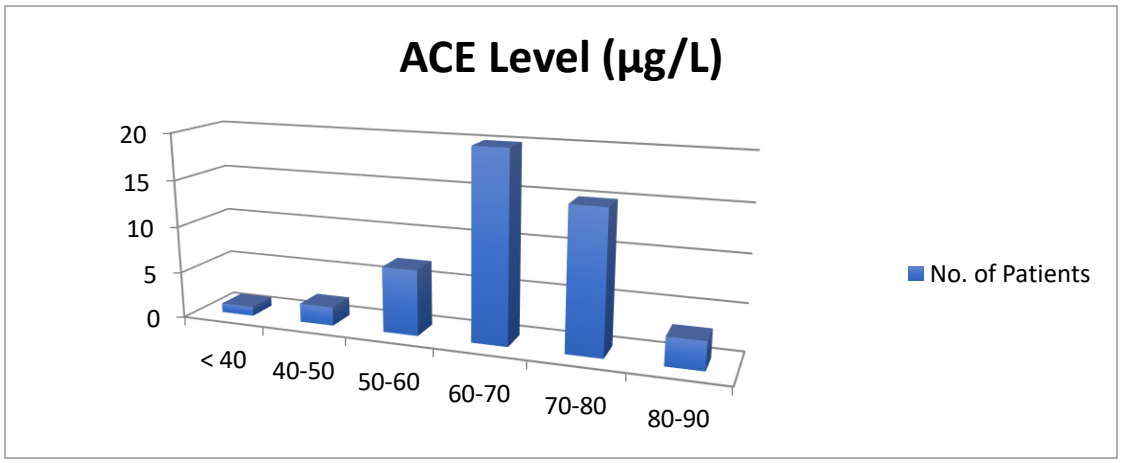

Table 4: showing serum level of ACE in different patient's serum by using ELISA Kit

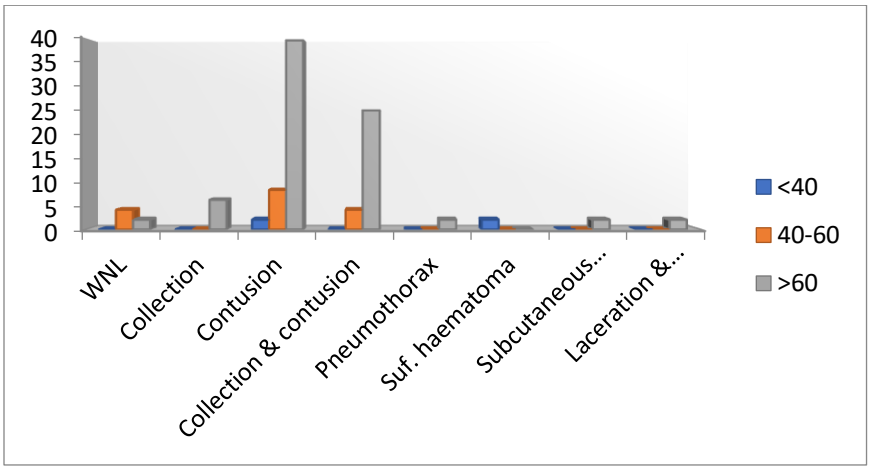

Table 5: showing the levels of ACE were consistently higher in patients having Lung contusions, Collections subcutaneous emphysema and Pneumothorax.

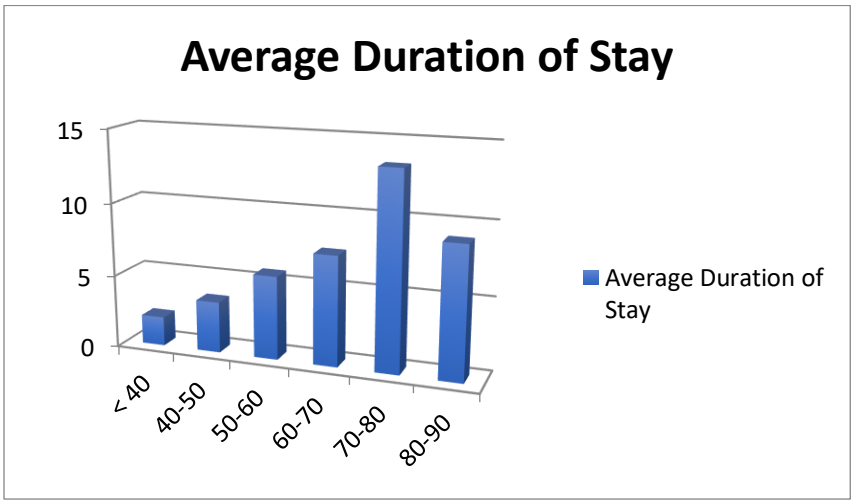

Table 6: showing ACE level range of 70-80 with mean duration of hospital stay being 13.4 days and with decreasing levels of ACE, duration of stay in days was also decreasing and minimum duration of stay of 2 days was in patients having ACE levels below 40.

DISCUSSION

The true incidence of pulmonary injuries is unknown and difficult to estimate from the literature. Thoracic injury is a common cause of mortality and major disability, and account for 20%-25% of deaths due to trauma. [6] Penetrating thoracic trauma accounts for almost 33% of total chest trauma. Early recognition and timely treatment of life-threatening injuries, better resuscitative techniques, preoperative care, and effective surgical procedures can significantly affect outcomes in these patients.

A study done by Verma S.K. & Garg Vishal revealed the most common age group affected was 21-30 years, included 265 (33.8%) cases and almost half of the victims were between 11-30 years, 396 (50.5%) cases. This is consistent with present study. [7]

One study by Bulent Kocer et al. showed males were common victims of accidents and trauma which were confluent with our study also. [8] The male predominance is explained by the fact that men involve more in outdoor tasks, travelling, construction works & fights.

Tirupathi and Iyer in their study concluded rib fracture as most common diagnosis of chest injury which was similar to present study. [9]

Alastair G Proudfoot & Mathew Hindand in their study showed lower the values of PaO_2/FiO_2 poorer the prognosis which was same as that of our study. [10]

As given by Pepe at al, a severity score was calculated and formulated in range between 0-25. Most of patients were under a range of 6-10 (n=22, %=45), followed by 11-15(27%) and 0-5(20%). [11, 12] Also, patients with high level of TTSS had higher serum ACE level compared to patients who were having a lower score.

Levels of ACE were statistically significant (0.0045) in the patient having contusion, collection, pneumothorax and subcutaneous emphysema in which levels of ACE were raised much more than normal lung. [4, 5] And it was found that levels of ACE were consistently raised with the severity of lung injury measured by TTSS. It was also found that there were no significant association of the level of ACE with respect to age and sex of the patients.

CONCLUSION

ACE emerges as multifaceted player in complex scenario of thoracic trauma. From modulating vascular reactivity to influencing lung injury and inflammation, ACE's contributions are far reaching. Serum ACE levels may act as a prognostic marker in thoracic trauma. Recognizing its importance holds promise for tailoring therapeutic interventions in thoracic trauma, potentially improving patient outcome and quality of life. As our understanding of ACE's role continues to deepen, the future of trauma care may rest upon its molecular shoulders, unlocking new avenues for research and innovation in critical field..

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