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Case Series

Single institutional experience of management of penetrating trauma chest

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ABSTRACT

Chest trauma is now the second most common non-intentional traumatic injury. Chest trauma is associated with high mortality. Control of blood loss and stabilization of vital organs is of vital importance over diagnostic and therapeutic measures. Bleeding may arise from chest wall, intercostal or internal mammary arteries, great vessels, mediastinum, myocardium, lung parenchyma, diaphragm or abdomen. Modified early warning signs (MEWS) score of >9 on presentation have shown higher rate of mortality. Diagnostic modalities such as extended-focused assessment with sonography in trauma (eFAST) have been effective. The type of surgical approach alters according to the site of injury. We here presented our experience with six such patients. All the six patients involved in this study had penetrating trauma chest with various sharp weapons including dagger, ice pick, flag post. Time of presentation of all these patients were delayed due to ours being a tertiary centre. The patients were explored on the basis of eFAST findings, intercostal drainage, hemodynamics. Out of the six patients two patients succumbed and the patients who died also had high MEWS score. All the patients were approached surgically with respect to the type of injury sustained. Penetrating chest trauma present a challenging clinical situation which warrants early evaluation and intervention. The cases of chest trauma then be it blunt or penetrating should always be treated within the advanced trauma life support (ATLS) guidelines followed by the definitive management. Regardless of any penetrating object, the foreign body should be left *in situ* and only to be removed under vision. If in case the penetrating object has already been removed the operative intervention is decided on the amount of drainage. With blunt chest trauma, approximately 15% of the deaths result directly from intrathoracic injury, but with penetrating chest trauma, nearly 100% of the deaths result from intrathoracic injury. Hence, the operative exploration of the chest in penetrating chest trauma and should be done on emergent basis as the mechanism of injury, vital organ damage and hemodynamic status all equate to higher rate of mortality.

Keywords: Penetrating trauma chest, Hemothorax, eFAST, MEWS score, Thoracotomy, ATLS

INTRODUCTION

Chest trauma is now the second most common non-intentional traumatic injury.[1] Chest trauma is associated with high mortality.[2,3] Penetrating injury to the chest is although less common than the blunt trauma but is more deadly. The direction of penetrating trauma also dictates the investigation and intervention. Control of blood loss and stabilization of vital organs is of vital importance over diagnostic and therapeutic measures. Hemothorax is a frequent consequence of traumatic thoracic injuries. Bleeding may arise from chest wall, intercostal or internal mammary arteries, great vessels, mediastinum, myocardium, lung parenchyma, diaphragm or abdomen.[4] MEWS score of >9 on presentation have shown higher rate of mortality and is one of the important prognostic

markers.[5] Various diagnostic modalities available are computed tomography (CT), point of care ultrasound (POCUS), eFAST have all been effective but the clinical evaluation and physical findings also holds a upper hand in management of penetrating chest trauma.[4,5] The goals of surgical intervention were primary bleeding control and hemostasis, further stabilization of vital functions as well as operative repair of organs and concomitant injuries as required.[6] The type of surgical approach altered according to the site of injury. We herein presented our experience with six such patients.

CASE SERIES

Case 1

A 35 year old male patient presented to emergency with stable hemodynamics and with alleged history of penetrating trauma with a dagger to right anterior chest wall in the left 3rd intercostal space 10 cm below the clavicle and 8 cm away from midline with weapon *in situ*, the weapon was directed inferomedially from the point of entry. On examination there was evidence of absent breath sounds on right side with normal heart sounds. Chest radiograph preoperatively showed no rib fracture, massive hemothorax with weapon in sight and intercostals drain (ICD) in situ. eFAST was suggestive of right hemothorax with no pericardial effusion. CT thorax was suggestive of lung laceration of size 2-3 cm, multiple lung contusions, no major vessel injury with gross hemothorax, pericardial integrity maintained. Cardiac enzymes were not raised. MEWS score in this patient was 6. Patient was taken for emergency right anterolateral thoracotomy via 4th intercostal space. Intra-operative findings confirmed that the tip of the dagger was seen abutting the pericardium, which was removed carefully under vision and finger guidance, intramuscular hematoma was present, blood clots were evacuated, laceration of size 2 cm over the left middle lobe, which were then repaired with polypropylene 5-0 pledgeted sutures. Chest was closed with chest tube in situ in the 5th intercostal space. Post-operative period was uneventful and patient was discharged on 11th post operative day.

Figure 1: Dagger *in situ.*

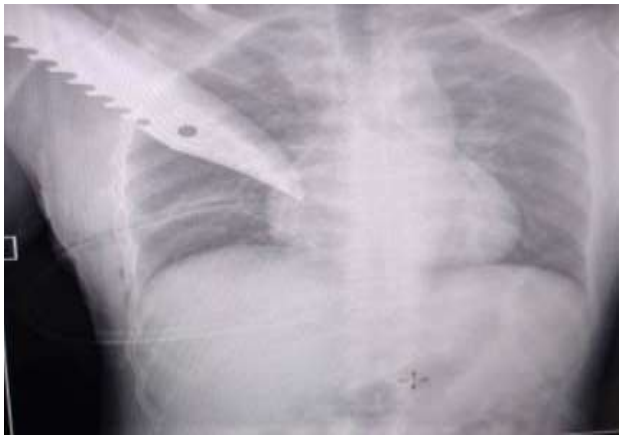

Figure 2: Chest radiograph (post ICD insertion) picture showing dagger and intercostals drain *in situ.*

Figure 3: CT thorax confirming findings.

Case 2

An 18 year old male patient presented in emergency with unstable hemodynamics and alleged history of stab injury to right anterior chest wall, the weapon ice pick was already removed and was directed posteriorly from the point of entry, there was a small injury in the left 4th intercostal space just adjacent to the sternum 1 cm away with ICD *in situ* (done in emergency room) with 1.5 litre sanguineous fluid collected within 30 min for which patient was admitted and planned for exploration. On examination, right sided air entry was absent with normal heart sounds, chest radiograph on arrival suggestive of ICD *in situ* with hemothorax. eFAST was suggestive of right hemothorax, with no pericardial effusion. CT chest was not done in view of unstable hemodynamics. Patient when brought was hemodynamically unstable with cold extremities, hypotension. Cardiac enzymes were normal. MEWS score in this patient was 8.

Hence, patient was taken for emergency median sternotomy as the site was just lateral to the sternum in the 4th intercostals space. Evidence of injury of right internal mammary artery. The artery was ligated with suture and clips. Lung laceration of size 2 cm was present which was closed with a pericardial patch. Pericardium was found to be breached with no cardiac or great vessel injury. Post-operatively patient was discharged on post-operative day 10 with bilaterally clear chest.

Figure 4: Black spot at the right 4th ICS showing.

Figure 5: Ice pick (weapon used) the site of injury.

Case 3

A 20 year old male patient presented with stable hemodynamics and alleged history of penetrating trauma with a dagger to left posterolateral aspect over the left renal angle and directed superomedially. On examination patient had absent breath sounds on left with normal heart sounds. Chest radiograph showed massive left hemothorax. eFAST was suggestive of left hemothorax with no pericardial effusion. CT thorax was suggestive of multiple lung contusions and laceration of size 3 cm over the left lung lower lobe with hemothorax. MEWS score in this patient was 5. Patient was taken for emergency left posterolateral thoracotomy via 5th intercoastal space. Intra operative findings confirmed presence of blood clots which were evacuated, intramuscular hematoma was present, diaphragm was breached which was repaired with polypropylene 3-0 suture, laceration of size 3 cm on the left lower lobe of lung, which was then repaired with prolene 5-0 with horizontal mattress sutures. Chest was closed with chest tube in 6th intercostal space. Post-operatively patient was discharged on post-operative day 9 with bilaterally clear chest.

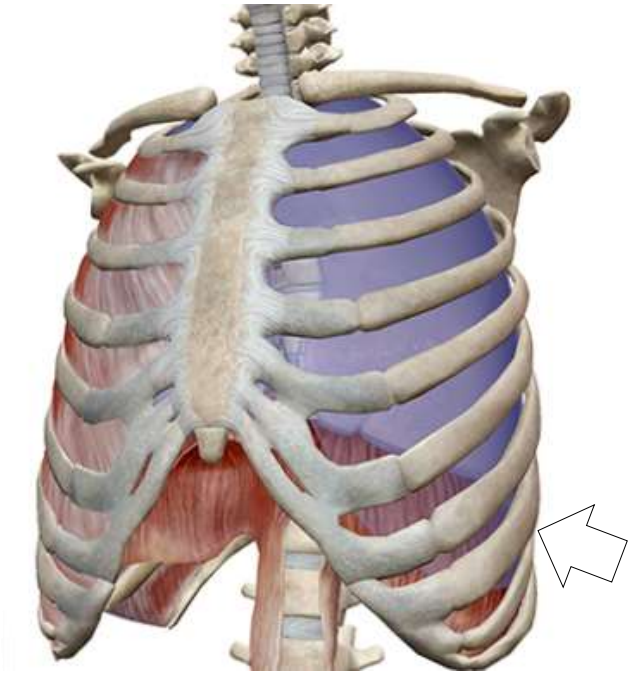

Figure 6: Arrow showing the site and direction of penetration.

Case 4

A 44 year old male patient presented with unstable hemodynamics and alleged history of penetrating trauma with a dagger to left posterolateral aspect with point of insertion below the thoracic cage and directed upwards. On examination patient had decreased breath sounds on left side with normal heart sounds. Chest radiograph showed mild left hemothorax. eFAST was suggestive of massive hemoperitonium with splenic trauma and left hemothorax, no pericardial effusion. MEWS score in this patient was 11. Patient was taken for emergency left posterolateral thoracotomy with laparotomy with two separate incisions. Laparotomy was done first due to left posterolateral thoracotomy was done via 5th intercostal space. Intra-operative findings confirmed presence of blood clots which were evacuated, intramuscular hematoma was present, diaphragm was breached which

was repaired with polypropylene 3-0 suture, left lung was found to be normal. Chest was closed with chest tube in 6th intercostal space. The abdominal laparotomy performed by general surgeon gave evidence of massive blood clots, patient underwent splenectomy in view of splenic trauma. Post operatively patient was shifted to ICU with unstable hemodynamics. Patient died in this case 24 hours post procedure.

Case 5

An intra-operative referral was sent of a 40 year old male patient with alleged history of penetrating trauma with a dagger to superior aspect of abdomen with point of insertion below the sternum and directed upwards. On examination patient had decreased breath sounds on left side with normal heart sounds. Chest radiograph showed mild left hemothorax, with lung contusion. eFAST was suggestive of hemoperitonium with hemothorax of left side. MEWS score in this patient was 5.

Patient was taken for emergency laparotomy surgery. The abdominal laparotomy performed by general surgeon gave evidence of muscle hematoma with no major organ injury. Diaphragm was breached which was repaired with polypropylene 3-0 suture, left lung had a small contusion which was managed conservatively with chest tube in 5th intercostal space. Post-operatively patient was shifted to ICU with stable hemodynamics. Post-operatively patient was discharged on POD 9 with bilaterally clear chest.

Case 6

A 32 year old male patient presented to the emergency with alleged history of penetrating trauma with a flag post rod to the left anterosuperior aspect of thorax causing fracture of clavicle, 1st, 2nd, ribs and injury to sternum. Patient was hemodynamically unstable on arrival and was intubated. The time of presentation of the patient was 20 hours from the time of injury. On examination patient had a glassgow coma scale of E3VtM2, blood pressure maintained with ionotropic supports. Chest drain was *in situ* with massive collection of 1000 ml. The wound could not be assessed as it was packed. There were decreased breath sounds on left side with normal heart sounds. Chest radiograph showed mild left hemothorax. eFAST was suggestive of hemothorax of left side. Patient had a cardiac arrest preoperatively and was revived after cardiopulmonary resuscitation (CPR). MEWS score in this patient was 12. Patient was taken for emergency surgery. Intra-operative findings confirmed injury to subclavian artery and vein, with apical left lung laceration. Just on exploring the wound the patient had another episode of cardiac arrest, following which CPR was given on table. Subclavian vein and artery were clamped and repair was aborted looking at the unstable hemodynamics and patient was packed and shifted to ICU with unstable hemodynamics. Patient succumbed this case 2 hours post procedure.

Table 1: All patients parameters in relation to outcome.

Case no.	1	2	3	4	5	6
Age (in years)/sex	35/M	18/M	20/M	44/M	40/M	32/M
Time from injury to presentation (in hours)	6	12	3	12	4	20
Weapons	Dagger	Ice pick	Dagger	Dagger	Dagger	Flag post
Findings	Lung laceration	RIMA transection	Lung laceration	Grade IV splenic laceration+diaphragm breach	Diaphragm injury	Subclavian artery+vein transected
Associated injury	None	None	None	Splenic trauma	Abdominal wall injury	Right lower limb laceration
Drain (in ml)	700	1500	800	500	300	1000
Approach	Right anterolateral thoracotomy	Median sternotomy	Left posterolateral thoracotomy	Left posterolateral thoracotomy	Laparotomy	Wound exploration
Repairs	Lung repair	RIMA ligation	Lung repair	Diaphragm repair	Diaphragm repair	Subclavian artery and vein ligated
MEWS	6	8	5	11	5	12
Outcomes	Discharged	Discharged	Discharged	Death	Discharged	Death

DISCUSSION

Penetrating chest trauma present a challenging clinical situation which warrants early evaluation and intervention.[7] The mechanism of chest trauma can be blunt or penetrating type was important to be known. The mechanism of chest trauma and direction of injury was instrumental in directing the management.[8] The imaging modalities such as eFAST can detect blood in pleural and pericardial space were critical in unstable patients, thus helped in directing the definitive management. CT inspite of having higher sensitivity and specificity was not regularly done because of the risk in mobilisation of unstable patients.[9]

MEWS score was one of the main prognostic marker for penetrating chest trauma. It included the assessment of heart rate, blood pressure, temperature, central nervous system evaluation, GCS, urine output. The scoring was given on each of these factors, ranging upto 14 depending on the severity on presentation. It had been seen that a score >9 had poor prognosis with uncertain outcome.[17] Most important factor in determining the survival rate in penetrating chest trauma was the distance or time to receive the definitive management.[10] The rate of mortality was equal in different geographical horizons inspite of having variable rate of chest trauma in urban and rural population.[11] Very young and old patients were seen to be on higher side of mortality in case of penetrating chest trauma.[12] Such traumas when associated with extra thoracic injuries, higher MEWS score and with delayed presentation accounted to poor prognosis and worsened the rate of mortality in chest trauma.[17]

The cases of chest trauma then be it blunt or penetrating should always be treated within the ATLS guidelines followed by the definitive management. After a primary survey immediately life threatening injuries should be treated such as airway obstruction, tension pneumothorax, open pneumothorax, massive haemothorax, flail chest, cardiac tamponade. Secondary survey will provide information on potentially life-threatening injuries pulmonary contusion, myocardial contusion, aortic disruption, traumatic diaphragmatic rupture, tracheobronchial disruption, oesophageal disruption.[13] Regardless of any penetrating object, the foreign body should be left *in situ* and only to be removed under vision.[14] If incase the penetrating object had already been removed before coming to the medical facility, the operative intervention was decided on the amount of drainage from the intercostal drain. The quatified amount of intercostal drain for which operative intervention was done was approximately 1000-1500 ml immediately, 200 ml per hour for 2-4 hours or persisting hypotension even on active resuscitation.[13]

In our institution a primary evaluation and hemodynamically unstable patients are admitted at designated facility in emergency. A team of critical care specialists were available for initial resuscitation and stabilization. The choice of incision and approach was according to the site of injury and the structures involved. In two of the three cases performed the weapon *in situ* was removed under vision. In one of the case the weapon was already removed, exploration was done on the basis of amount of ICD drainage. Two cases were the patients died were mainly due to late presentation, vital organ injury and excessive blood loss leading to shock. This again proved the importance of early interventions.[7] MEWS score in these two patients was also seen to be on the higher than which was an important prognostic marker.[15-17]

The study conducted by Seamon et al in 2015 had a higher mortality rate (75%) compared to our study in penetrating chest trauma, as the study mainly included pulseless patients.[18] Kucuk et al in a their 10 year old outcome of clinical outcome in intensive care unit of thoracic trauma showed 25.1% mortality which was marginally lower to that of our study as the sample size also included the patients with blunt trauma hence diluting the mortality.[12] Checchi et al in the year 2020 in their study had a mortality rate of 44.8% in level 1 and level 2 centres post penetrating trauma which mainly had late presentation and secondary sepsis in level 2 centers.[10] When compared with some above mentioned studies conducted, we had lower mortality rate (33%) as compared inspite of having intrathoracic penetrating trauma because of a less number of sample cases and early presentation by the survived patients from the time of trauma.

CONCLUSION

With blunt chest trauma, approximately 15% of the deaths result directly from intrathoracic injury, but with penetrating chest trauma, nearly 100% of the deaths result from intrathoracic injury. Hence, the operative exploration of the chest in penetrating chest trauma and should be done on emergent basis as the mechanism of injury, vital organ damage and hemodynamic status all equate to higher rate of mortality.[16]

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