



MANAGEMENT OF TRAUMATIC DIAPHRAGMATIC HERNIA – 13 YEAR EXPERIENCE OF A TERTIARY CARE CENTER

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ABSTRACT

Introduction- Blunt or penetrating trauma to the lower chest and abdomen can result into rupture of diaphragm and herniation. Sometimes, it is life threatening if herniation is massive causing cardio-respiratory compromise or strangulation of herniated contents. Early diagnosis and intervention is must to save the life. The purpose of this retrospective study was to find out etiology, management, and outcome of traumatic diaphragmatic hernia at our center. **Methods-** we have retrospectively analyzed 49 patients of traumatic diaphragmatic hernia admitted in SMS Hospital Jaipur, Rajasthan, from June 2009 to June 2022. Analysis was done regarding age, gender, mode of injury, side of diaphragmatic injury, time to diagnosis, associated injuries, treatment and outcome. **Results-** The most common age group affected was 3rd decade (36%) and males (86%) outnumbered females (14%) with male to female ratio was 6:1. 88% patients suffered from blunt trauma while penetrating trauma was seen in 12% cases. Bullhorn injury, an unusual cause of injury, was noted in this study in 2 cases (4%). Left leaf of diaphragm (84%) was commonly injured than right leaf (16%). Thoracotomy was the preferred approach (69%) and laparotomy was done in 31% cases. Mortality rate was 6% in this series. **Conclusion-** Trauma to the lower chest and upper abdomen should raise the suspicion of diaphragm injury. Careful evaluation, routine radiography, and intraoperative examination of diaphragm during any exploratory laparotomy or thoracotomy of trauma patients help in managing these cases timely with better results if not associated with severe cerebral and thoracoabdominal injuries.

KEYWORDS : trauma, diaphragm, hernia, cardio-respiratory, laparotomy, thoracotomy, bullhorn.

INTRODUCTION

Traumatic diaphragmatic hernia is important sequelae of an thoracoabdominal trauma and presents a diagnostic and therapeutic challenge to the trauma team. It came into picture when Sennertus⁽¹⁾ in 1541 reported a delayed diaphragmatic hernia case resulting from trauma but successful repair took almost 45 years when Riolfi repaired a case in 1886⁽²⁾. It commonly results from blunt or penetrating trauma. The frequency that which mechanism will predominate depends on the social and geographical circumstances. It may be caused by iatrogenic injuries during thoracic or abdominal procedures or secondary to thoracocentesis and radio frequency ablation. Spontaneous rupture during pregnancy has also been reported^(3,4). The most common cause of blunt diaphragmatic hernia is road traffic accidents. Other causes include fall from height or crushing blow. Sudden deceleration in motor vehicle accidents or fall from height is an important mechanism for diaphragmatic injury from blunt trauma while stab injury and gunshot injury are common mode of penetrating trauma. The overall incidence of diaphragmatic hernia is 0.8%-5% in all trauma patients⁽⁵⁾.

Left leaf of diaphragm is more prone to rupture in blunt trauma because of weakness along the fusion of costal and lumbar parts during embryonic development. Right leaf is protected by liver and its attachments however, both leaves are equally susceptible in penetrating injuries. Although most of the cases are diagnosed early yet delayed presentation is not uncommon especially in penetrating injuries where hernia may be small. In acute cases, massive herniation of

intraabdominal contents into thoracic cavity may result into cardio-respiratory compromise, compression and collapse of the lung, mediastinal shift, and compression of heart with decreased venous return. Concomitant severe injuries to other organs and state of shock may lead to missing of the diagnosis of subtle diaphragmatic hernia. Clinical features of delayed presentation include dyspnoea especially during exertion, upper gastrointestinal symptoms, chest pain or pain abdomen. Review of literature by Shah R et al showed that diagnosis is missed in 66% cases⁽³⁾ while according to Stark P et al diagnosis is missed initially in upto 70% cases⁽⁶⁾ and Sliker showed that 7.2% injuries that are missed in acute stage, end up with complications⁽⁷⁾.

Diagnosis requires a high index of suspicion in all trauma cases especially involving lower chest and upper half of the abdomen. Knowledge of mode of injury is also very crucial to avoid misdiagnosis of traumatic diaphragmatic hernia. Apart from clinical examination, chest x ray is the initial tool which helps in the diagnosis with sensitivities upto 94% if diaphragmatic hernia is present⁽⁸⁾. Features suggestive of diaphragmatic hernia on chest x ray include blunting of costophrenic angle, irregularity of diaphragmatic outline, elevated diaphragm on the affected side, collapse of lower lobe of lung, mediastinal shift, and air fluid levels. Taking a chest x ray in Trendelenburg position after passing a radio opaque Ryel's tube can be confirmatory if stomach is herniated. CT Scan of thorax and abdomen is the investigation of choice to confirm the diagnosis along with information about other abdominal and thoracic injuries. Specificity of multidetector CT is 100% in diagnosing left

diaphragmatic hernia and 83% for right diaphragmatic hernia⁽⁹⁾.

Early diagnosis and repair is the pre-eminent requisite to save the life especially hernia resulting from penetrating injury because although the rent may be small but these are more prone to strangulation and gangrene of herniated contents adding to the morbidity and mortality.

Primary repair of involved leaf is the gold standard treatment of traumatic diaphragmatic hernia. Prosthetic mesh may be required in larger defects with tissue loss or where repair seems to be under tension.

The purpose of this retrospective study was to evaluate the etiology, demography, management, and outcome of traumatic diaphragmatic hernia at a single tertiary center.

MATERIAL AND METHODS

SMS Hospital Jaipur, Rajasthan, is a tertiary care hospital and its trauma unit is the largest trauma center of the state. It drains almost 90 – 95% of trauma patients including those from the neighboring states.

Cases were studied retrospectively using trauma emergency, operation theater, ICU, and ward registry. Patients sustaining traumatic diaphragmatic hernia between June 2009 and June 2022 were selected. Data was collected regarding time of admission, type of injury, mechanism of injury, time of surgery, mode of injury, demographics, associated injuries, surgical management, and outcome. Informed consent was not taken in view of retrospective nature of the study.

Inclusion criteria:

- All trauma patients with confirmed diaphragmatic hernia who underwent surgical repair from June 2009 to June 2022 at SMS Hospital Jaipur.

Exclusion criteria:

- Patients who had been surgically treated before admission to our institution and had not received a secondary operation.

Mechanism of injury was classified into two types – blunt trauma and penetrating trauma. Blunt trauma was further categorized into trauma caused by road traffic accidents, fall from height and falling of heavy object on the patient. Penetrating trauma was divided into three- stab injury, gunshot injury, and bull horn injury.

As soon as patients arrived in emergency department they were initially managed for hemodynamic instability. After that they were examined thoroughly for signs and site, type, and mechanism of injury and organs involved. X ray chest and USG whole abdomen are routinely performed at our set up for every patient of thoracoabdominal trauma. Suspected patients had undergone CT scan of chest and abdomen to confirm the diagnosis and other underlying organ injury.

Confirmed patients for traumatic diaphragmatic hernia were taken for surgery. Laparotomy was performed if abdominal organ injury requiring surgical repair was also present otherwise ipsilateral thoracotomy was the preferred approach. Primary repair in interrupted manner with non absorbable monofilament suture was the standard treatment. Prosthetic mesh was used in two patients because of poor tissue quality.

RESULTS

A total of 49 patients with diaphragmatic injury from June 2009 to June 2022 (13 years) were enrolled for the study. All patients were diagnosed preoperatively. Out of 49, 42 (86%) were male and 7 (14%) were female (table 2). 3rd decade (18 patients,

36%) was more prone to trauma followed by 4th decade (12 patients, 24%) (table 1). Blunt trauma (43 cases, 88%) outnumbered the penetrating trauma (6 cases, 12%) (table 3). Road traffic accident was the most common mode of Blunt trauma seen in 39 patients (79%) and 3 (6%) patients suffered fall from height. 3 (6%) had stab injury. Gunshot injury and trauma from fall of heavy object were seen in 1 (2%) patient each. One interesting mode of penetrating injury common in our region was bullhorn injury seen in 2 patients (4%) (table 4). 47 (96%) patients were diagnosed within 24 hrs of admission and only 2 (4%) patients had delayed presentation at 3 month and 5 month after trauma (table 8).

Left leaf of diaphragm was injured in 41 patients (84%) and in 8 cases (16%) right dome was involved (table 5). In 28 (57%) patients multiple organs were herniated while in 21 (43%) cases only single organ herniation was found (table 9). Among the single organ herniation stomach was the most frequent, 16 (33%) (table 10). Overall, the Stomach was the most common herniated organ (34, 69%) followed by small intestine (16, 33%) and colon (14, 28%), omentum (9, 18%), spleen (5, 10%) and liver (3, 6%) (table 12). Multiple organ herniation consisted of combination of stomach, small intestine, colon, spleen, omentum and liver. The frequency of multiple organ combination herniation is shown in table number 11. Associated organ injury included chest injury in the form of rib fractures in 43 (88%) and pulmonary contusion in 21 (43%) cases, head injury in 4 (8%), and abdominal injury in 19 (38%) patients (table 7). Gastric perforation was seen in 5 (10%), jejunal perforation in 2 (4%), transverse colon injury in 1 (2%), liver injury in 3 (6%), mesenteric tear in 4 (8%), pelvic and urinary bladder injury in 2 (4%), pancreatic injury in 1 (2%), and splenic injury in 1 (2%) patient (table 6).

Thoracotomy on the affected side was preferred in 34 (69%) patients and midline laparotomy was done in 15 (31%) cases (table 13). Laparotomy was done where intraabdominal injuries required surgical management. Primary repair (96%) was the main method for surgical repair of traumatic diaphragmatic hernia and prosthetic mesh was used in 2 (4%) cases because of poor tissue quality and tissue loss (table 14). Out of 49 cases, 3 (6%) patients died and 46 (94%) survived (table 15). One mortality was due to multi-organ failure, one due to pancreatic trauma, and one due to respiratory failure in delayed presented case. 4 (8%) patients of 49, suffered complications in form of wound infection in 2, and pneumonia in 2. All patients recovered from complications with suitable treatment.

DISCUSSION

Blunt trauma is the major cause of TDH and Approximately 65% - 75% cases are seen in blunt trauma and penetrating trauma accounts for 25% - 32%, less commonly it is caused by iatrogenic injuries or spontaneous rupture^(8,10). But one study showed that penetrating trauma (63%) was more common than blunt trauma (37%) in their region⁽¹¹⁾. In this study too blunt trauma appeared as major cause (88%) while penetrating trauma showed 12% incidence. Results similar to our study were seen in studies done by few other authors^(12,13,14). A little higher frequency of blunt trauma diaphragmatic hernia is seen in our study which may be because motor vehicle accidents seems to be more common in our region and young males are travelling on road more than females that is why more prone to injury. Male to female ratio in this study was 6:1 (86% versus 14%) and victims were mostly in 3rd and 4th decade of age (60%). Bergin D et al and Van Hise ML et al suggested that upto 90% of diaphragmatic ruptures from blunt trauma occur in young males after motor vehicle accidents^(9,15). Road traffic accident is the major reason of blunt trauma (80%) and stab injury (6%) is common mode for penetrating trauma in this study. Another interesting mode of penetrating injury found in our study was bullhorn injury (4%) which is not

reported from elsewhere. Lim BL et al found that 80% cases had injury on left side while 20% on right side⁽¹⁶⁾. Nearly similar results are found in our study (84%, left dome versus 16% right dome). Although in living cases left leaf of diaphragm is frequently involved than right leaf yet autopsy studies⁽¹⁷⁾ and few authors⁽¹⁸⁾ stated that both leaves are equally affected but right sided injuries are associated with severe life threatening hepatic and vascular injuries causing mortality before reaching the hospital. Bilateral involvement is seen in 3% cases⁽¹⁹⁾ but in this series bilateral involvement is not seen.

Literatures suggest that stomach is the most frequent that migrated into the thorax^(18,20). Our results do not differ from the literature showing Stomach (69%) as the most frequent organ to be herniated followed by small intestine (33%) and colon (28%). Most of the cases were diagnosed on chest x ray in our setup but CT Scans added more consistency as it provided more detailed information as well as confirming the diagnosis.

The surgical approach was selected on the basis of intraabdominal organ injuries requiring repair. In 70% cases thoracotomy was utilized. Lung contusions and rib fractures were managed conservatively. Associated intraabdominal injuries were tackled simultaneously along with primary repair of diaphragmatic defect. For the delayed cases thoracotomy is the suitable approach.

In most cases, isolated diaphragmatic hernia is associated with good outcome if timely surgical intervention is done. Khan et al reported 15% - 40% mortality for blunt diaphragmatic rupture and 10% - 30% for penetrating diaphragmatic rupture⁽²¹⁾. As high as 80% mortality rates have been reported when strangulation and gangrene of herniated contents occur⁽²²⁾. Low mortality rate (6%) in this series is due to early transport facility, careful evaluation of trauma patients with early diagnosis and timely intervention. Within 24 to 48 hours of admission all patients were operated in our setup.

CONCLUSION

A thorough clinical examination of trauma patient with an eye of suspecting diaphragmatic injury if affected site of trauma and mechanism of injury suggest it then early diagnosis can be made with prompt surgical intervention. Recent advances in early transport of trauma victims to the health care facility and immediate multidisciplinary approach in their management have reduced the mortality and morbidity in our tertiary care center.

Table 1: Age distribution

AGE (Years)	NUMBER	PERCENTAGE (%)
0 – 10	2	4
11 – 20	5	10
21 – 30	18	36
31 – 40	12	24
41 – 50	6	12
51 – 60	4	8
61 – 70	3	6
>70	0	0
Total	49	100

Table 2: Gender distribution

GENDER	NUMBER	%
Male	42	86
Female	7	14
Total	49	100

Table 3: Type of trauma

Type of injury	Number	%
Blunt trauma	43	88
Penetrating trauma	6	12
Total	49	100

Table 4: Type of trauma

Mode of injury	Number	Percentage (%)
RTA	39	80
FFH	3	6
Stab injury	3	6
Gunshot injury	1	2
Fall of heavy object	1	2
Bullhorn injury	2	4
total	49	100

Table 5: Side of diaphragm involvement

Affected side	Number	Percentage (%)
Right leaf	8	16
Left leaf	41	84
Total	49	100

Table 6: Abdominal organ injury

Organ injured	Number	Percentage of total (49)(%)
Stomach	5	10
Small intestine	2	4
Colon	1	2
Liver	3	6
Spleen	1	2
Pancreas	1	2
Mesenteric tear	4	8
Urinary bladder	1	2
Pelvic injury	1	2
Total	19	38

Table 7: Distribution of systemic organ trauma

Other organ injury	Number (49)	Percentage of total (49) (%)
Head injury	4	8
Rib fracture	43	88
Pulmonary contusion	21	43
Abdominal organ injury	19	38

Table 8: Time of presentation

Presentation	Number	Percentage (%)
Acute	47	96
Delayed	2	4
Total	49	100

Table 9: Distribution of hernia content

Hernia content	Number	Percentage (%)
Multiple organ	28	57
Single organ	21	43
Total	49	100

Table 10: Distribution of single organ herniation

Distribution of single organ herniation	Number	Percentage of total 49 (%)
Stomach	16	33
Small intestine	2	4
Colon	2	4
Omentum	1	2
Total	21	43

Table 11: Distribution of multiple organ herniation

Distribution of multiple organ herniation	Number	Percentage of total 49 (%)
Stomach + omentum	5	10
Stomach + spleen	3	6
Stomach + small intestine	2	4
Stomach + colon	4	8
Stomach + colon + small intestine	2	4
Stomach + spleen + small intestine	1	2
Stomach + colon + omentum	1	2

Colon + small intestine	5	10
Spleen + small intestine	1	2
Omentum + small intestine	1	2
Liver + small intestine	2	4
Liver + omentum	1	2
Total	28	57

Table 12: Overall frequency of herniation

Organ	Number (49)	Percentage of total 49 (%)
Stomach	34	69
Small intestine	16	33
Colon	14	28
Omentum	9	18
Spleen	5	10
Liver	3	6

Table 13: Surgical approach

Surgical approach	Number	Percentage (%)
Thoracotomy	34	70
Laparotomy	15	30
Total	49	100

Table 14: Type of Repair

Type of repair	Number	Percentage (%)
Primary	47	96
Prosthetic mesh	2	4
Total	49	100

Table 15: Surgical Outcome

Outcome	Number	Percentage (%)
Complications	4	8
Mortality	3	6
Survived	46	94

Abbreviation

- SMS- Sawai Man Singh hospital
- CT Scan-Computerized tomography scan
- ICU-Intensive Care Unit
- USG-Ultrasonography

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