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RESEARCH ARTICLE

VATS VERSUS LAPAROSCOPY TRAUMATIC DIAPHRAGMATIC INJURY REPAIR

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Abstract

Introduction: Diaphragmatic injury is usually missed in case of trauma patient, clinical picture is usually masked by other abdominal or thoracic injuries. CXR (chest X ray), abdominal ultrasound have a high rate of missing. High index of suspicion is required to diagnose diaphragmatic injury.

Discussion: Comparison between 20 cases of traumatic diaphragmatic injury. Surgery is the only treatment. Different approaches are used, taking advantage of the wide spread practice of minimal invasive surgeryVATS (Video assisted thoracoscopic surgey) and laparoscopy. Overlooked injuries are usually on the right side and after blunt trauma in these cases open surgery is favoured.Prolene stitch repair (primary repair) was the main modality of repair, mesh repair was used in larger tears with poor quality tissues .Quality of life improves remarkably after repair with most patients discharged from hospital within few days.

Conclusion:VATS and Laparoscopy show efficiency in both diagnosis and treatment of diaphragmatic injuries. Conversion to open surgery may be needed in case of severe visceral injuries.Combined approach needs good communication between thoracic and general surgeonsOutcome is usually favourable with competent long term repair. Uunfavourable outcome is associated with multiple visceral organ injury and critical pre operative status.

Introduction:-

Traumatic diaphragmatic injury (DI) is sometimes difficult to diagnose and depends on a high index of suspicion. Injury is more commonly seen in males with penetrating injuries, but females have delayed presentation usually with herniation. Injury to the diaphragm is reported to be present in (0.8-8%) of cases of blunt Thoraco-Abdominal Trauma (TAT). Most common causes are Road traffic accident (RTA) and fall from height. Penetrating trauma has been reported to cause (12.3–20%) of cases. Discrepancies could be due to varying regional, social, and economic factors in the areas studied**. (1)**

Between 50% and 80% of injuries occur on the left hemidiaphragm. It is possible that the liver situated in the right hypochondrium cushions the diaphragm.(2)

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Penetrating injuries as high as the 3rd rib and as low as the 12th have been found to injure the diaphragm, it should be suspected from the site of wound entry ,size of haemo-thorax or haemo-pneumo-thorax**.(3)**

Iatrogenic cause of DI (eg. Insertion of chest tube) has been reported, thus raising the importance of follow up clinically and radiologically after this simple procedure.(4)

Computed tomography has an increased accuracy of diagnosis over X-ray. Another diagnostic method is laparoscopy or Thoracoscopy with the advantage of therapeutic intervention.(5)

Video Assisted ThoracoscopicSurgery (VATS) has been foundto be the most accurate method (accuracy rate 98%) in diagnosingDI and unlike laparoscopy.

Surgery is mandatory in diaphragmatic tear repair. Either VATS or Laparoscopic.(6)

Patient and Methods:-

This study included 20 cases of diaphragmatic they were 15 males and 5 females. Their age ranged between 9-45 years (mean=29.55).

Total cases	Male	Female	Range of age	Mean age
20	15	5	9-45 years	29.55

Table 1:-Shows demographic data of the study.

Penetrating injuries and blunt injuries were equally distributed as a mode of injury in this study (9 cases each, 45%) , while iatrogenic injury was mode of injury in (2 cases, 10%).

Mode of injury	No. of cases	Percentage
Penetrating	9	45%
Blunt	9	45%
Iatrogenic	2	10%
Total	20	100%

Table 2:- Shows type of mode of injury.

Left diaphragmatic copula was involved in (17 cases, 85%),right diaphragmatic copula was involved in (3cases, 15%).Regarding the investigations accuracy,plain X-ray chest and upper abdomen showed herniated bowel in chest in (3 cases, 15 %) , suggestive criteria of diaphragmatic injury and associated injuries (elevated hemidiaphragm copula , hemithorax , fractured rib ..Etc) in (14 cases, 70%) , and false negative results in (3 cases, 15 %) .Abdominal ultrasound was diagnostic of diaphragmatic injury and herniation in (4 cases, 20%), it showed associated injuries in (10 cases, 50%), and false negative results in (6 cases, 30%). In (6 cases, 30%) abdominal U.S. was free (false negative results).Abdominal and chest C.T. was done in 17 cases in this study, C.T. was conclusive of diaphragmatic injury and herniation in (12 cases, (12/17)=70.5) . It showed associated injuries required exploration in (3cases, (3/17)=17.6%) , while false negative in (2 cases, (2/17)=11.7).Diagnostic laparoscopy was done for (6 cases), it showed diaphragmatic injury in all cases (6/6) with accuracy (100%). Diagnostic thoracoscopy was done for two patients and it showed diaphragmatic injury in both of them (2/2) with accuracy (100%)

Minimal invasive approach was used (Laparoscopic/ VATS) provided that proper trained surgeon is available. Good communication between thoracic and general surgeons is needed.

Laparoscopy provides betterinitial orientation and surgical exposure of the abdominal cavity in order to exclude visceral organ injury. VATS was done in few cases simultaneously with patient in supine position with the operated upon chest side is slightly elevated using saline bags and towels. Thoracoscopy has been successful for repair of DI and offer excellent exposure to thoracic cavity and has decreased the difficulty in reduction of herniated contents.

Only small diaphragmatic laceration (1 to 3cm) resulting from penetrating injury were repaired using video assisted endoscopic techniques. Larger defects required conversion to a mini thoracotomy for optimal exposure and repair.

Table 3:- Shows accuracy of investigations.

Investigation	Conclusive	suggestive	False negative	Total
Plain x-ray	3	14	3	20
Abdominal U/S	4	10	6	20
C.T. chest and abdomen	12	3	2	17
Laparoscopy	0	0	0	6
Thoracoscopy	0	0	0	2
mean	3.8	5.4	2.2	13
median	3	3	2	17
mode	0	0	0	20
standard deviation	4.91935	6.308724	2.48998	8.42615

Diaphragmatic ruptures resulting from blunt trauma needed open surgery for formal inspection especially with high risk of missed organ injury

VATS repair of DI was successful with (one conversion due to bleeding in one case) which concluded that VATS is a safe, accurate, and less invasive procedure than laparotomy and laparoscopy in diagnosis and management of DI. Recurrence of diaphragmatic hernia was reported in two cases (10%). One after laparoscopy and the other after Laparotomy .This may be attributed to much tension on sutures. The two cases were repaired successfully after 2 month by use of non absorbable mesh through laparotomy.

In this study, DI was repaired by single layer prolene sutures whatever the type of exposure (laparotomy, laparoscopy, thoracotomy or VATS) in 19 cases (95%). Two patients of them had recurrence 2 month later where non absorbable mesh repair was used. Mesh repair was performed in 3 patients (15%),one primarily through thoracotomy and two recurrent cases through laparotomy .

A for mean post operative hospital stay, it was as following: (4) days for VATS and laparoscopy patients, (8) days for laparotomy patients and (12) days for thoracotomy patients, much similar to Mattew **et al, 2008**reporteddata

Isolated diaphragmatic injuries was present in (5 patients, 25%, while visceral injuries was recorded in (15 patients, 75%). The injuries mainly affected the spleen (12 cases, 60%), stomach (5 cases, 25%) , liver (3 cases, 15%) and bowel (2 cases, 10%). Hemothorax was associated in (12 cases, 60%) in this study.

Discussion:-

Surgical approach to managing diaphragmatic rupture includes laparotomy, thoracotomy, laparoscopy or VATS. This decision is dependent on the associated injuries, stability of patient, surgeons' preference and experience. Laparotomy is more appropriate in unstable patients when associated intra-abdominal injuries are present or suspected. A thorough examination of both hemidiaphragms is usually done. Furthermore, this incision can be extended to a thoraco-laparotomy if there are significant intrathoracic injuries or when safe reduction of the herniated viscera is not possible**.**

Converting from laparoscopy to laparotomy was due to multiple visceral injury or extensive adhesions, while converting from VATS to thoracotomy was due to intrathoracic bleeding.

Laparoscopic and VATS repair of Diaphragmatic injury had a very low of recurrence and offered similar or even better outcomes, especially with lower post-operative pain, quicker discharge and better cosmetic wounds

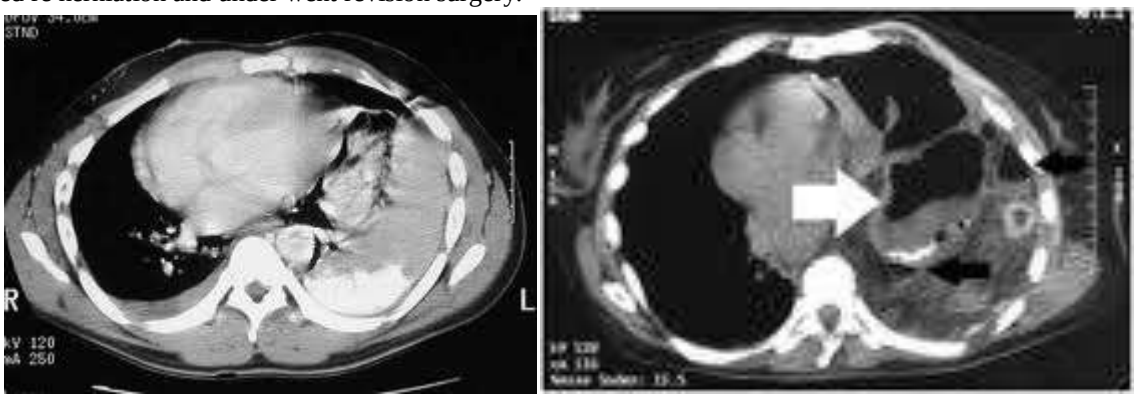
The conversion from laparoscopy to laparotomy and from VATS to thoracotomy was done putting in mind patient's safety first, and to control bleeding or repair visceral injury. Sometimes conversion was done to offer good repairstitches.

Most cases were chronic cases of DI with transverse diaphragmatic lacerations longer than 10 cm close to oesophageal hiatus or adjacent to the pericardium**.**

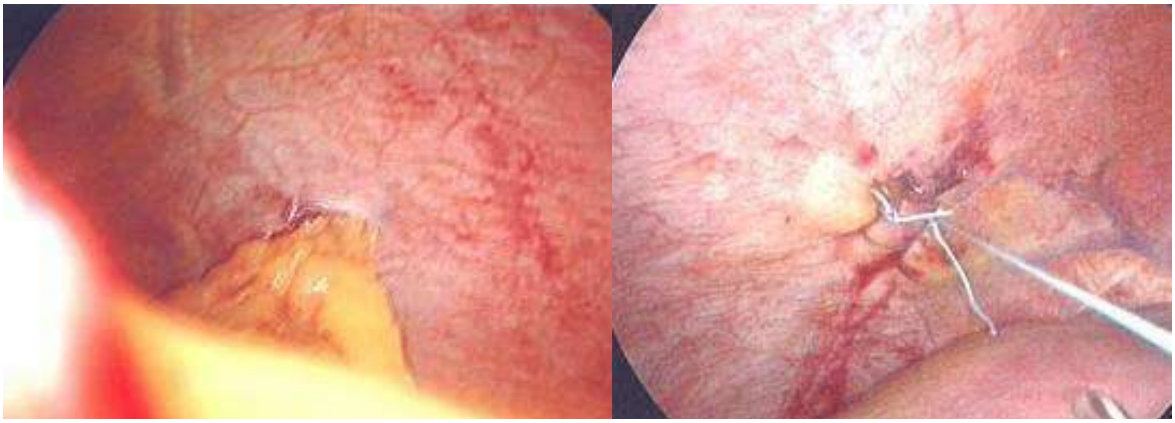
Video assisted thoracoscope (VATS) was tried in 2 cases, in one of them thoracoscopic repair of DI was successful. The other case was converted to thoracotomy for repair of large defect.

Thoracotomy was done for 2 cases (10%). In one of them it was a conversion after VATS .Repair of DI was done by prolene sutures in 19 cases (95%) and by mesh in 3 cases (15%)* to close the defect .

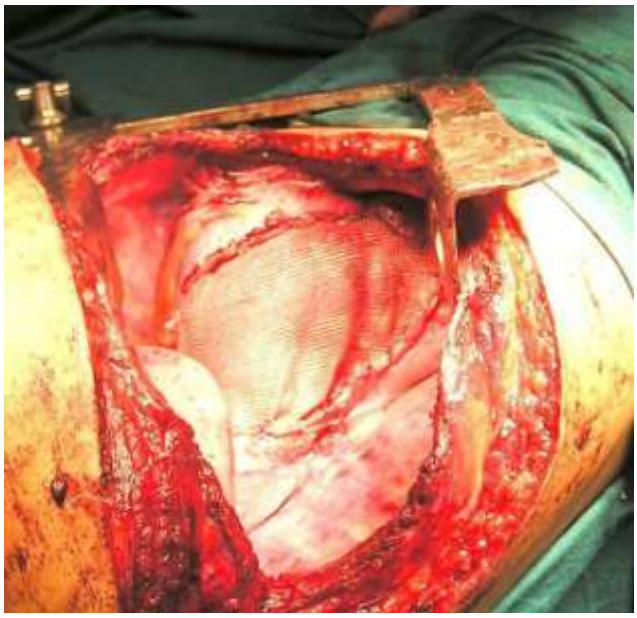
An intercostal tube was inserted in all patients (100%)
In this study, the early post operative period was favourable in 16 cases (80%), 2 patients had troublesome outcome (10%) eg. (Long ICU stay, post operative chest and wound infection), 2 patients died (10%) (Onefrom peritonitis the other from hypovolemic shock). During 3 month follow up all patients under went CXR and chest-abdomen C.T. to detect competence of repair which revealed 16 case with competent repair (no gaping or herniation) (80%), 2 cases showed re herniation and under went revision surgery.



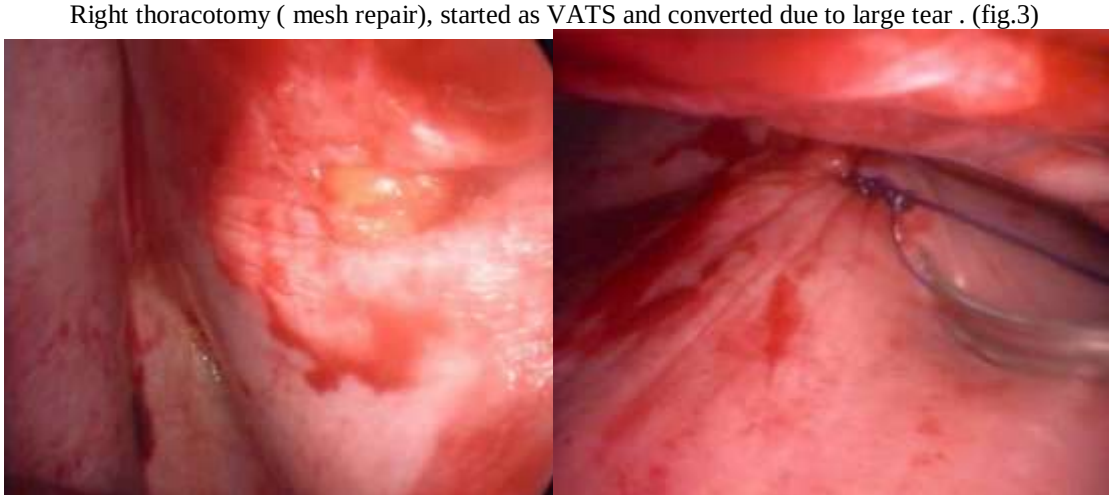
Left side diaphragmatic injury with stomach herniation (Fig.1)



Laparoscopic repair (direct repair) of left diaphragmatic copula injury (fig.2)



Right thoracotomy (mesh repair), started as VATS and converted due to large tear . (fig.3)



VATS left side (diaphragmatic tear identified), prolene stitch repair Fig.4

Total no . of cases	20 cases
Penetrating injuries	9 cases
Blunt injuries	8 cases
Iatrogenic injuries	2 cases
Left (hemidiaphragm)	17 cases
Right (hemidiaphragm)	3 cases
Isolated diaphragmatic injury	1 case
Associated injuries	19 cases
CXR	Elevated hemidiaphragm,hemothorax,fractured ribs or herniated viscus.(17 cases)
Abdominal ultrasound	Diaphragmatic herniation (3 cases)
C.T.	Diaphragmatic gaping or disruption ,dependent viscera sign , subphrenic collection(13 cases)
Laparotomy	10 cases. 3 cases with laparoscopy converted to laparotomy.
Laparaoscopy	4 cases
VATS	1 case
Thoracotomy	1 case and 1 case VATS converted to thoracotomy

Intercostal tube	20 cases
Mesh repair	3 cases
Mortality	2 cases

Table 4:- Breakdown of cases management.

Conclusion:-

Diaphragmatic injury is rarely an isolated injury, visceral injuries are usually accompanied.As diagnostic tools laparoscopy and thoracoscopy haveaccuracy approaching 100%. VATS is showing increased role in management of DI especially in long standing cases where dense adhesions are difficult to release from abdominal side and right side DI injuries where liver is blocking the access. Combined repair is feasible and offer excellent outcome. Postoperative results donot depend on surgical technique only as many other contributers are envolvedeg.(pre-op. status , other medical conditions and timing of intervention).Laparotomy /thoracotomy repair the bailout procedures in case of complex repair.

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