

Diaphragmatic Surgeries: A Single Center Experience in 10 years

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ABSTRACT

Background: Diaphragmatic surgeries include plication, direct suture repair and mesh repair in cases of traumatic diaphragmatic rupture, eventration and hernias. The aim of the current study is to review the experience of our center in diaphragmatic surgeries over the last 10 years. **Patients and methods:** A retrospective study of 40 patients who had thoracotomy repair in Mansoura University over the last 10 years. **Results:** The included patients were 29 (72.5%) males and 11 (27.5%) females. Left sided was affected in 32 (80%) patients. The indication of surgery in this case series was traumatic rupture in 19 (47.5%) patients, hernias in 15 (37.5%) patients and eventration in 6 (15%) patients.

Conclusion: Thoracic repair of the diaphragm is a safe effective procedure especially in trauma, hernias and eventrations.

Keywords: Diaphragm, Hernia, Eventration, Mesh, Case series, Mansoura University.

INTRODUCTION

The diaphragm is the strongest respiratory muscular structure that separates the thorax from the abdomen. Diaphragmatic injuries are relatively rare and constitute about 1% of traumatic injuries. They are a sign of severe momentum of trauma. Penetrating diaphragmatic injury is more commonly reported than blunt trauma ^(1,2).

Diaphragmatic injuries are often occult, and need a high index of suspicion to prevent missing them with subsequent herniation and strangulation of abdominal organs into the chest. About one-third of the diaphragmatic hernias present late ^(1,2). Diaphragmatic non neoplastic pathologies include hernia, traumatic injuries and or paralysis due to phrenic nerve injuries or invasion by tumors. Diaphragmatic surgeries include plication, direct suture repair or mesh repair ^(3,4).

The aim of the current study is to review the experience of our center in diaphragmatic surgeries over the last 10 years.

PATIENTS AND METHODS

This is a retrospective study of 40 patients which needed diaphragmatic thoracic surgery in our department in Mansoura University over the last 10 years.

This case series included patients who needed diaphragmatic repair whether plication, direct suturing or mesh repair of the diaphragm over the last 10 years in Mansoura University Hospitals; Main hospital, Emergency Hospital and Mansoura University Children Hospital. The available collected data included history, available investigations, operative notes and follow up visits. History included the personal history especially the age and sex, present history especially the trauma history and main complaint and associated injuries if any, past history especially surgical past history. Also, general and relevant local examinations especially the site of rupture were recorded in our data collection sheet. The available

investigations included routine preoperative labs, chest X ray, CT and or barium studies.

The operative notes included the approach, the pathology whether hernia or eventration, if viscera are in the chest, side and site of the injury and method of repair.

The follow up visits included general and local examinations, reporting and managing any complications. The follow up varied between 3 months and 10 years.

Ethical considerations:

An informed written consent was obtained from the patients and/or their legal guardians preoperatively as routinely done in our center. This is a retrospective study that needed no consent before publication from the patients.

Statistical Analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Qualitative data were described using number and percent. Quantitative data were described using mean and standard deviation (SD).

RESULTS

Study's case series included 40 patients; 29 males and 11 females. Left sided was affected in 32 patients (Table 1).

Table 1. Gender and side of thoracotomy repair.

Variable	No.	%
Gender		
Male	29	72.5
Female	11	27.5
Side of thoracotomy repair		
Left	32	80
Right	8	20

The indication of surgery in our series was traumatic rupture in 19 patients, hernias in 15 cases and eventration in 6 cases.

Table 2. Indications of thoracotomy in Mansoura University Hospitals over the last 10 years.

Indication	No.	%
Traumatic Rupture	19	47.5
Adult Hernia	4	10
Congenital hernia	5	12.5
Eventration:	12	30
Idiopathic	8	20
Post CABG	2	5
Post ASD repair	1	2.5
Advanced malignancy	1	2.5

Hernias were adult in 4 (10%) patients and 4 (12.5%) patients had congenital hernia. Three CDH were Bochdaleck and 2 were Morgagni. The principal symptom was shortness of breathing in 28 patients. History of trauma was clear in 25 patients. History of previous surgeries was reported in 5 patients including CABG in 3, ASD repair in one patient and thymoma excision in one patient (Table 2).

Chest x ray and CT chest was performed for all patients. Barium meal and barium studies were needed in only 12 patients. Three patients needed intraoperative general surgery assessment and assistance due to huge hernia. Thirty-nine patients needed thoracotomy and only one was performed thoracoscopically.

Nineteen patients required plication, 14 required direct prolene suturing and 7 needed prolene mesh repair (Table 3).

Table3. Techniques of diaphragmatic repair in Mansoura University Hospitals over the last 10 years.

Techniques of diaphragmatic repair	No.	%
Plication	19	47.5
Direct	14	35
Mesh	7	17.5

Five cases had postoperative pneumonia and lung collapse. Only 3 cases had wound infections and frequent dressings for more than 2 weeks. Two cases required short term postoperative ventilation. No recurrence was reported in the case series. The follow up varied between 3 months and 10 years. Fourteen cases had lost follow up.

DISCUSSION

The commonest cause of diaphragmatic hernia of the abdominal viscera in adults is trauma, whereas in babies or newborns, it is due to congenitally absent or defective fusion of the septum transversum and or the pleuroperitoneal membrane (3-5). This copes with our series where trauma was responsible for almost half of our series; 47.5%. Adult hernia was present in 10% and congenital hernia in 12.5%. Adult hernias in our series are mostly due to trauma neglected few months or years back. The adult hernias incidence of 10% is mainly due to missed diagnosis at the time of initial presentation

confirming the difficulty of hernia diagnosis. These are some sort of delayed or missed diagnosis of hernia. *Papas et al. (2007)* reported an incidence of late diaphragmatic hernia of 30%. This high incidence may have been due to wrong radiology interpretation and or only intermittent respiratory and gastrointestinal symptoms (6,7). Left sided affection was noted in our series (80%). Three cases were diagnosed intraoperatively during exploratory laparotomy. Confusion in the diagnosis is not uncommon. It may be easily missed to present later. As per *Ball et al. (1982)* the correct diagnosis is readily made if the diaphragmatic injury was recent, left sided and large with herniated viscera in the chest and if the proper diagnostic tools were carried out; Chest x ray PA and lateral views, upper gastrointestinal examination, barium meal and or enema, nuclear scan of the liver and or CT chest and abdomen. It needs a high index of suspicion. The missed diagnosis was more if the trauma history is old or not sure, if the hernia was right sided with herniation of the liver or other solid (water density) organs, or if the diagnostic tests were not properly performed (8).

Mirvis et al. (2007) reported a left sided injury in 70% in their series. This may be due to the fact that the right diaphragm is well-protected by the liver (5-8).

Male/female ratio in our series was 2.6/1. *Shah et al. (1995)* reported M/F ratio of 4/1 as they included the traumatic cases only while we included traumatic and non-traumatic cases. M/F ratio in our trauma cases was about 5/1 (7).

We diagnosed our cases based on the history, Chest x rays, CT axial view in all cases. We needed coronal and sagittal views in difficult cases as they were not routinely performed. Passing a nasogastric Ryle tube into the stomach followed by chest X-ray may be helpful especially in infants and emergency departments (8-16).

We included 5 cases of congenital diaphragmatic hernias; 3 Bochdaleck and 2 morgagni hernias. Both were diagnosed more than 1 month after delivery. They did not need ECMO or pulmonary hypertension treatments. They did very well. We were lucky.

Offringa et al. (2018) think that these hernias should be repaired by a patch that should be oversized and tension free. This was not the case in our series of these hernias were primarily repaired and did well postoperatively. We did thoracotomies for these cases. This copes with *Offringa et al. (2018)* who believe that a minimally invasive surgical approach must not be used in neonatal CDH for fear of recurrence. Fortunately, we had no recurrence at least in our short follow up period in these cases which was 15 months.

Offringa et al. (2018) think that those patients if diagnosed very early in life may need ECMO support and repair should be avoided until after decannulation. In case the patient could not be weaned off ECMO,

consideration should be given for either surgery or palliation, as appropriate. Actually, there is no evidence which is better early or late repair^(16,17).

We recorded 12 cases of diaphragmatic eventrations of different etiologies. Eight were of idiopathic etiology, 5 post CABG may be due to injury during LIMA harvesting or systemic cooling or both; one post ASD repair and one during advanced thymic tumors excision. All of them did well. None of them was younger than 18 years.

As we know that eventration in children is an emergency condition in contrast to adult eventration which is an elective condition. *Zhao et al. (2020)* reported 125 cases of eventrations with excellent results after both open and thoracoscopic repair. Plication was the commonest method used as it has an advantage over direct repair regarding being stronger especially if there is a good edge. Mesh was used in 7 cases. We used Prolene mesh double layers (Dual mesh). We do not have the biological mesh. *Frantzides (2010)* think that the ideal mesh is the one which generates adhesions to the diaphragmatic surface but not the visceral surface. Expanded polytetrafluoroethylene (ePTFE) prostheses is the dual-sided composite mesh that promotes tissue ingrowth causing fibrosis and a better uniform mesh-tissue complex and may avoid the possible major complications⁽¹⁷⁻¹⁹⁾. During our follow up, there were no major complications. Five cases had postoperative pneumonia and lung collapse that necessitated IV antibiotics, respiratory physiotherapy and long hospital stay. Three cases had wound infections and frequent dressings for more than 2 weeks. One of them had to be reclosed in OR. Two cases required short term postoperative ventilation for 1 week and 21 days. They were very weak preoperatively, severely malnourished with bad chest infections. Fortunately, they were successfully weaned. We never encountered recurrence in our series. The follow up varied between 3 months and 10 years. Fourteen cases missed their follow up. The mean hospital stay was 16 days which is relatively long. This was because we admit the patient one week preoperatively to prepare him and optimize the general condition of the patient. Postoperatively, the patient had to be in ICU for at least 3 days and then shift to the normal ward. Some patients spent a longer time in ICU either on ventilator or on some inotropes and IV antibiotics to control their sepsis and or pneumonia.

In conclusion, diaphragmatic injuries and hernias are still diagnostic challenge. Repair of such lesions is feasible and safe.

LIMITATIONS

This is a retrospective study with all the inherent defects of retrospective studies. Our study included

heterogeneous cohort of different ages and types of pathologies. The number is small with a relatively short follow up period. Some data are missing. Fourteen cases were missed in the follow up.

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