ORIGINAL RESEARCH

Management of diaphragmatic eventration—A single centre experience

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ABSTRACT

Introduction: The diaphragm is a fibromuscular organ whose primary function is related to ventilation. It also serves as a barrier between pleural and abdominal cavities. This organ is rarely affected by pathologic entities, but eventration is among the primary diseases of this structure. **Methods:** This case series includes 10 patients diagnosed and managed as diaphragmatic eventration in Department of Surgical gastroenterology, Tirunelveli Medical College. All data were retrospectively collected. **Results:** There were a total of 6(60%) male patients and 4 (40%) female patients. (90%) patients had left sided diaphragmatic eventration Among the 10 patients, 8 (80%) were symptomatic and hence managed with surgery. Laparoscopic diaphragmatic repair was done in 5 (50%) patients. Laparotomy was done in 3(30%) patients. Remaining 2(20%) patients were asymptomatic and were managed conservatively. Postoperatively all patients were managed with Non invasive mode of ventilation, spirometery and respiratory exercises. None of the patients had a recurrence on regular follow-up. **Conclusion:** Diaphragmatic eventration is quite rare. All symptomatic patients have to be managed surgically. Surgical options include laparotomy and minimally invasive laparoscopy and thoracoscopy. Laparoscopy is better in terms of better intra-op exposure, postop recovery and postop pain relief. Diaphragmatic plication with barbed sutures seems to provide good results in terms of symptomatic relief and recurrence.

Keywords: Diaphragm, eventration

INTRODUCTION

Diaphragmatic eventration/hernia is a very rare disease with a reported incidence of 0.015%. It is more common in children. It has variable etiologies, congenital being the common one followed by acquired causes. Congenital diaphragmatic hernias have been reported in adults. Most patients are asymptomatic and the most common symptom being breathlessness.

Congenital diaphragmatic eventrations results from incomplete development of the central tendon or the muscular portion of the diaphragm. Acquired eventrations are caused by injury to the phrenic nerve due to trauma during birth, cervical or thoracic procedures, tumour invasion, or infection resulting in paralysis of the diaphragm.

CDE is considered to result from a congenital anomaly during the formation of the pleuroperitoneal membrane, as in Bochdalek diaphragmatic hernia, but that occurs in a later stage during embryonal growth [1]. CDE is a rare pathology that occurs in 0.02 to 0.07/1000 births, affecting mostly males in 60 to 80% of cases. It accounts for 5–7% of all diaphragm diseases [2]. Because the infant ribs are horizontal and the intercostal muscles are weak, breathing movement mainly depends on the abdominal breathing of the diaphragm muscles moving up and down. Infants and children with CDE have abnormally elevated diaphragm muscles, which often leads to collapse of the affected alveoli or atelectasis, thus affecting lung ventilation and lung development. Therefore, infants and children with CDE often have symptoms such as dyspnea, repeated respiratory infections, low weight, and stunting. Severe cases may manifest as respiratory distress syndrome, seriously affecting the quality of life of children. Traditionally, diaphragmatic plication has been performed by thoracotomy or laparotomy, particularly in symptomatic, smaller children [3]. However, advancements in endoscopic surgery have allowed diaphragmatic eventration to be treated quickly and safely.

Traditionally, diaphragmatic plication has been performed by thoracotomy or laparotomy. However, advancements in endoscopic surgery have allowed diaphragmatic eventration to be treated via laparoscopic and thoracoscopic approaches. Here, we present our experience with different surgical procedures to treat 10 patients with Diaphragmatic Eventration.

MATERIALS AND METHODS

This series includes all patients admitted, evaluated and diagnosed with diaphragmatic eventration based on pre-op imaging features from Jan 2021 to December 2023 in Department of Surgical Gastroenterology, Tirunelveli Medical College. All symptomatic patients were operated. We practice both open and minimally invasive laparoscopicaccess for diaphragmaticrepair. Open technique involves a Makucchi incision.Laparoscopic technique uses 10mm umbilical port, 5 mm right midclavicular line port, left midclavicular port and left lumbar port. Diaphragmatic eventration was repaired by plicatingthe lax diaphragm using 1-0 Prolene/ 2-0 barbed PDS.

We used barbed sutures to plicate the diaphragm from the outside to the inside in a continuous imbricated fashion to strengthen the diaphragm. Combined with the literature and our experience, compared with ordinary absorbable sutures, continuous suturing of the diaphragm with barbed wire has the following advantages.

Starting from the second stitch, slippage is not easy after tightening the suture. One stitch is sewn to tighten one stitch, and no knot is needed during the suture process, which greatly shortens the operation time. The diaphragm were sutured continuously by barbed wire to make the diaphragms stretch evenly from the centre in all directions. The tension distribution was uniform so that the movement of the diaphragms was more coherent. The diaphragm did not turn ischemic due to overtight suturing, and the suture did not relax to cause recurrence. Diaphragmatic herniation was repaired by primary suturing followed by non-absorbablemesh placement. Mesh is usually covered by peritoneum.

RESULTS

The seriescompromises a total of 10 patients.6 (60%) patients diagnosed with Diaphragmatic Eventration and 4 (40%) patients diagnosed with diaphragmatic hernia. There were 7 males (70%) and 3 females (30%), aged 21-67years. 9 patients had pathology in the left side hemi diaphragm (FIGURE 2). Only 1 patient a right sided diaphragm eventration. 8(80%) patients were symptomatic and diagnosed thereafter,whereas 2 patients were asymptomatic and incidentally diagnosed on routine physical examination. 3 (30%) patients has associated malformations (1 patient had atrial septal defect, 1 patient had vaginal agenesis and 1 patient had scoliosis with poliomyelitits). 1 patient had a history of trauma (`fall from height). The main symptom being exertional dyspnoea, breathlessness, chest pain, abdominal pain with recurrent respiratory tract infections.

All patients were evaluated with Xray chest, CT chest, CECT abdomen and pelvis all confirming the diagnosis. After proper preoperative optimisation, all symptomatic patients were taken up for surgery. Laparatomy and diagphramatic repair was done for 3 patients. Minimally invasive laparoscopic diaphragmatic repair was done in 5 patients.(FIGURE 3)The stomach, spleen, distal pancreas and part of the liver were found to be herniated into the thoracic cavity during the operation. Among these 5 patients, 2 were converted to laparotomy owing to the dense adhesions.

Preoperative diagnosis of Diaphragmatic eventration was changed to Diaphragmatic hernia for 3 patients based on the intra-op findings. All these patients underwent primary repair if the defect with mesh in two patients. Post op events were uneventful. 2 patients required elective postop ventilation. All patients were treated with intermittent NIV, aggressive chest physiotherapy, incentive spirometry in the postop period. Chest drain tube was removed on POD 4 after patient showed signs of improvement. The patients were followed at one month post-surgery. Radiologically to demonstrate the position of the diaphragm, and symptoms, if any, were also evaluated. All the symptoms disappeared after one monthnoneof them showed signs of recurrence.

Table 1: Case series details.

S.No	Age	Sex	Etiology	Side	Pathology	Surgery	Technique
1	48	M	Idiopathic	Left	Eventration	L To O	Plication
2	62	F	Idiopathic	Left	Eventration	L	Plication
3	74	M	Idiopathic	Left	Hernia	O	Mesh Repair
4	65	M	Idiopathic	Left	Eventration	L To O	Plication
5	27	M	Trauma	Left	Hernia	O	Primary Repair
6	21	F	Congenital	Left	Hernia	O	Mesh Repair
7	28	M	Congenital	Left	Eventration	L	Plication
8	55	F	Idiopathic	Right	Eventration	L	Plication
9	20	M	Idiopathic	Left	Eventration	Conservative	
10	49	M	Congential	Left	Eventration	Conservative	

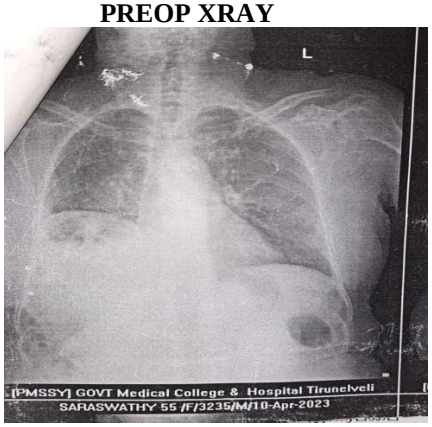
CASE 1

A 48 year male, presented with breathlessness, abdominal pain and chest pain. He also gave a history of fall from height. CT chest showed diaphragmatic hernia with herniation of intestinal contents into the left hemithorax. He was taken up for immediate surgery. Laparotomy done. Diaphragmatic hernia repair done using 1-0 prolene. Postop event was uneventful and he was discharged on POD 10.

CASE 2

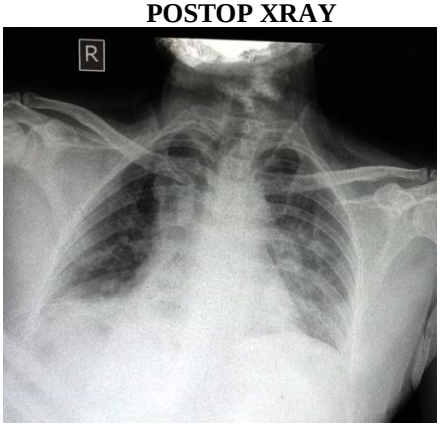
A 55 year Female, with no comorbidities, presented with complaints of breathlessness, abdominal pain, and chest pain. On evaluation she was diagnosed with right side diaphragmatic eventration. Laparoscopic plication of right hemidiaphragm was performed. Laparoscopic ports used are the same as mentioned above. She recovered well postoperatively and discharged on POD 6. She showed no signs of recurrence on 3 months follow-up.

PREOP XRAY



a

POSTOP XRAY

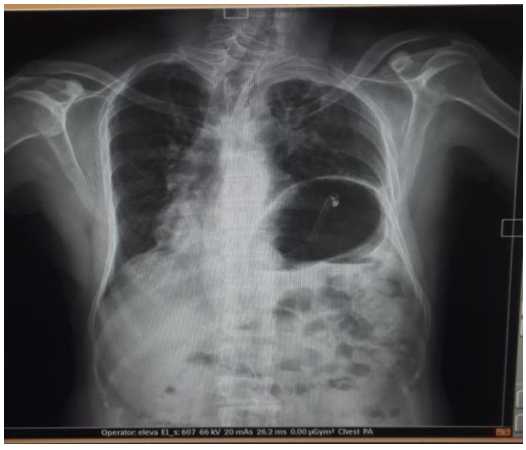


b

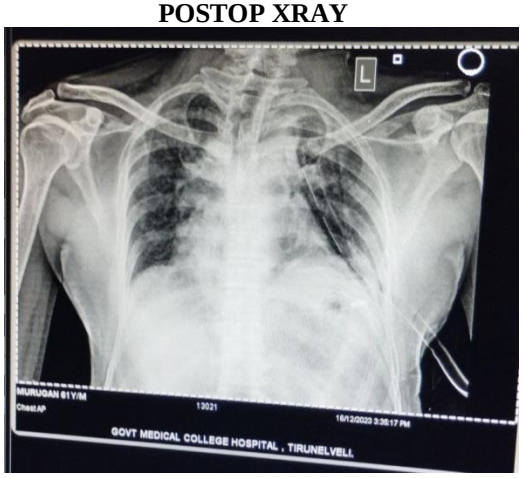
CASE 3

A 65 year old male, with no comorbidities, presented with complaints of breathlessness and chest pain. On evaluation he was diagnosed with Left side diaphragmatic eventration. He was preoperatively optimised and prepared for laparoscopic diaphragmatic plication. Laparoscopic ports were created as mentioned above. Due to dense perisplenic and periphrenic adhesions, it was converted to open. Open plication of the diaphragm done using barbed PDS sutures. Postop recovery was smooth. Patient was discharged on POD 10.

PREOP XRAY



POSTOP XRAY



DISCUSSION

Diaphragmatic eventration is the partial or total replacement of the diaphragm muscle by fibroblastic tissue, displacing theaffected hemidiaphragm. The diaphragm becomes lax but still, the diaphragm maintains its continuity and continuity of its annexes to the costal margin [4]. This substitution will result in a very thin compliant membrane which will lead to a decrease of the movements and even paradoxical movement, causing a poor lung expansion and decreased blood flow. This elevation of the diaphragmatic dome to the chest also allows the protrusion of abdominal contents to the thoracic cavity. [5].

DE affects less than 0.05% of the population, both children and adults, and is more common in males. This abnormal elevation of the diaphragm can affect one or both hemidiaphragms, the left hemidiaphragm being affected more commonly [6]. Aetiology includes congenital defects or acquired. When congenital, it can be isolated or be associated with other congenital anomalies, it can have partial or

diffuse involvement of the hemidiaphragm, and be a consequence of a defect in the diaphragm or muscle defect due to the absence of the phrenic nerve [7]. However, the most common etiology is acquired.

The main symptom of diaphragmatic eventration is compression of the lower lobe of the lungs due to the intra-abdominal organs, manifesting in the form of breathlessness on exertion, chest pain and sometimes abdominal pain. Compression can also cause the mediastinum to move on the healthy side, and the lung function of the healthy side can be reduced accordingly. It has been noted that in unilateral diaphragmatic eventration/hernia, the lung capacity and total lung capacity are reduced by 20–30% [8]. Bilateral diaphragmatic eventration reduces lung function even more seriously, especially in the supine position [9].

The main differential diagnosis is the unilateral phrenic nerve paralysis that causes progressive atrophy of the muscle. Eventration of diaphragm is usually asymptomatic but may be the cause of a progressive dyspnoea and frequent respiratory infections. The main feature of these complaints is that they often intensify with posture changes.

Surgery is indicated in patients who are symptomatic [10]. Indications for surgery are as follows: relative to the normal diaphragm position, the diaphragm is displaced upwards by 3 or more intercostals; diaphragm eventration causes obvious compression on the affected side of the lung and obvious shortness of breath, asthma and other respiratory distress symptoms; frequent lung infections, hypoxemia, and even abnormal breathing exercises; during follow-up, the diaphragm continues to rise, and the eventration is aggravated.

The traditional treatment method of CDE is diaphragmatic plication performed either by laparotomy or thoracotomy. However, with the development of minimally invasive technology, laparoscopy and thoracoscopy has gradually been applied in the treatment of Diaphragmatic eventration

The principle of treating Diaphragmatic eventrationis to restore the normal anatomical position and tension of the diaphragm. Whether Role of treatment in asymptomatic patients is still controversial.Postop period is critical as the patients are more prone for respiratory complications which are prevented by respiratory exercises, non-invasive / invasive mode of ventilation if required. Patients should be followed up o a regular basis to look for recurrent symptoms.

CONCLUSION

Diaphragmatic eventration is quite rare. All symptomatic patients have to be managed surgically. Surgical options include laparotomy and minimally invasive laparoscopy and thoracoscopy. Laparoscopy is better in terms of better intra-op exposure, postop recovery and postop pain relief. Diaphragmatic plication with barbed sutures seems to provide good results in terms of symptomatic relief and recurrence.

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