# Diaphragmatic Eventration

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## 19.1 Introduction

Diaphragmatic eventration (DE) constitutes an atypically elevated elevation of one or both hemidiaphragm secondary to both congenital and acquired issues. In particular, congenital diaphragmatic eventration refers to a developmental defect in the muscular portion of the diaphragm [1]. The reported incidence of congenital DE is 1 per 1,400 children who underwent chest radiographs. Congenital DE is reported more commonly among males and is more likely to affect the left hemidiaphragm [2, 3].

## 19.2 Classification

DE is due to both congenital and acquired factors. Congenital cases are characterized by a malformation of the diaphragmatic muscle, which occurs embryologically because of abnormal migration of myoblasts. Instead, in acquired cases, DE is caused by phrenic nerve palsy that can occur for several reasons (e.g., trauma or cardiac surgery), and therefore, the amount of diaphragmatic muscle fibers is normal [4–6]. Notably, acquired DE may also develop as a consequence of traction on the phrenic nerve during delivery [7].

## 19.3 Diagnosis

Clinical manifestations of congenital DE in children are various. The majority of patients are totally asymptomatic but sometimes may present with mild gastrointestinal conditions or life-threatening respiratory distress. The main symptom that patients with DE may experience is dyspnea [8, 9].

Diaphragmatic eventration may easily be missed or misdiagnosed. In general, diagnosis of DE can be achieved incidentally if an elevated hemidiaphragm is noted on a plain chest X-ray [10]. Fluoroscopic evaluation of the diaphragm ("sniff test") can be used to confirm the paradoxical movement of the diaphragm [11] (Fig.19.1).

## 19.4 Treatment

Surgical treatment for DE is mandatory exclusively for symptomatic children. Small eventrations with slight respiratory symptoms may be treated conservatively and can safely be observed. The gold standard operation for symptomatic patients is plication of the diaphragm via thoracotomy or laparotomy. Recently, both thoracoscopic and laparoscopic plication have been

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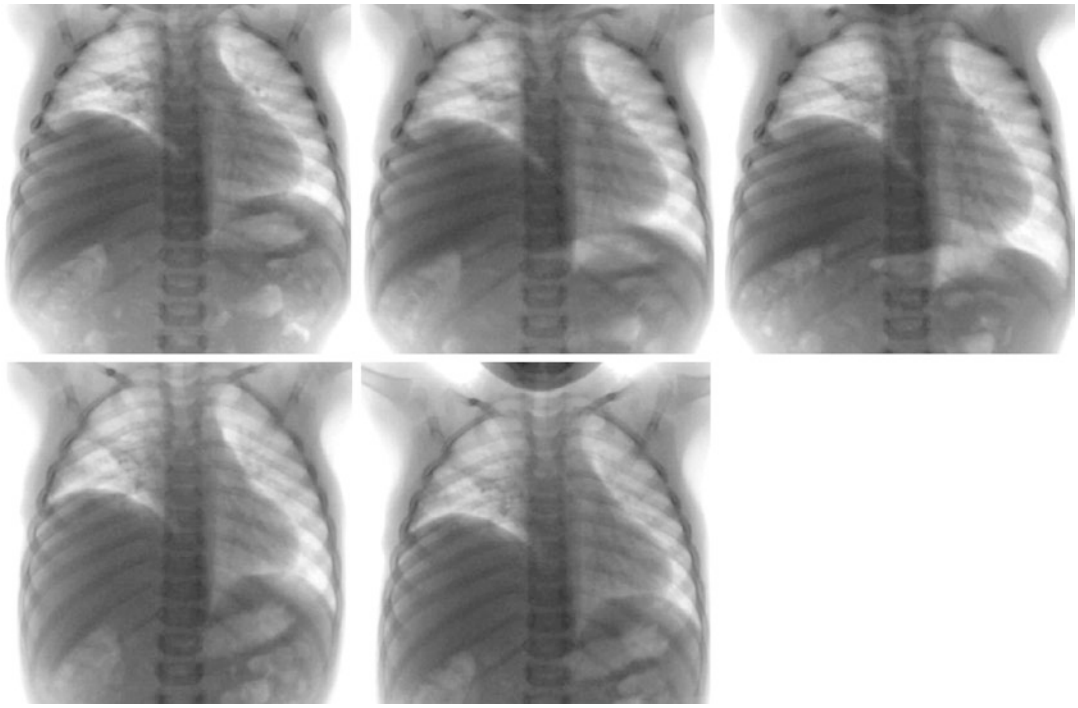

**Fig. 19.1** Dynamic radiological study of the chest: the right hemidiaphragm presents paradoxical movements, resulting in more relief than the contralateral

reported for DE in pediatric patients. The thoracoscopic approach is reported to be associated with a large working space and direct visualization of the phrenic nerve that must be preserved, on the other hand, laparoscopic plication is associated with less intercostal nerve pain and a larger working space [12–14].

Unilateral DE is most commonly approached via a seventh intercostal space thoracotomy, which allows for ideal visualization of the phrenic nerve and its branches that must be protected from injury during the operation. The concept of surgery for DE is to excise the thinned portion of the hemidiaphragm (usually centrally located) and approximate the edges with nonabsorbable, interrupted 2–0 sutures without excessive tension. The use of a stapler has also been described in the literature. In case of an acquired eventration, repair involves plication of redundant areas of the diaphragm to create a taut closure by grasping the central portion of the affected hemidiaphragm with a non-crushing clamp. Thus, the plication should be done in an anteromedial to posterolateral configuration with nonabsorbable sutures (Fig. 19.2). Intrapleural drainage is usually maintained for some days following the transthoracic and thoracoscopic approaches [11, 13, 14].

## 19.5 Conclusion

The most frequent complication reported in children after diaphragm plication is recurrence. Notably, recurrence was observed predominantly in cases treated laparoscopically [15]. In conclusion, if technically feasible, all pediatric patients with DE should undergo plication of the diaphragm using thoracoscopy. However, further studies are needed to make definitive conclusions.

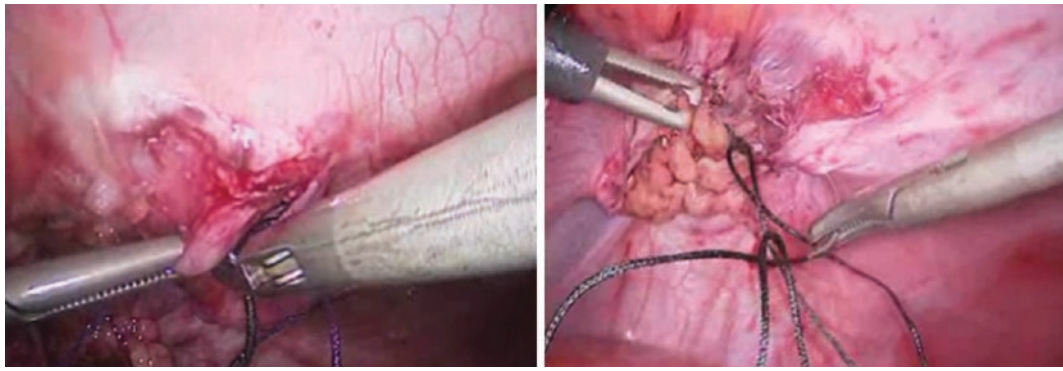

**Fig. 19.2** Intraoperative laparoscopic diaphragmatic plication

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