Eventration of the diaphragm

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Summary

Diaphragmatic eventration is a large or small area of the diaphragm consisting of fibrous tissue only. If small it is termed partial; if large, complete. The condition is infrequently recognised since it is seldom suggested on referral. A high index of suspicion in the interpretation of chest radiographs is often all that is needed, but occasionally more complex investigative procedures may be necessary. The records of patients seen in this unit are reviewed and discussed. Induction of a pneumoperitoneum was a safe procedure and diagnostic in 8 of 9 patients. All patients with complete eventration were advised to have surgery; in those in whom partial eventration was confidently diagnosed surgery was not recommended, but it was undertaken in 4 patients in whom a confident diagnosis was not made.

Diaphragmatic eventration is characterised by a large or small area devoid of muscle and consisting of fibrous tissue only in a diaphragmatic dome. The fibrous area, when small, constitutes a partial eventration; when large enough to include all or all but a narrow peripheral rim of diaphragmatic muscle, it constitutes a complete eventration. Complete eventration is more common on the right side; partial eventration is more usually on the right side and anterior. Complete left-sided eventration modifies the lie of the stomach which may be so to that part of the diaphragm. The induction of a pneumoperitoneum is one good way of identifying right-sided, partial eventration, which case that area of the dome was never muscularised or necessary contrast and fluoroscopy will confirm that there is usually on the right side and anterior. Complete left-sided paradoxical movement when the patient sniffs.

Diaphragmatic eventration may be present from birth, in which case that area of diaphragm with fibrous tissue and it was properly positioned, then this could with justification be termed 'acquired eventration'. An elevated attenuated diaphragm which follows phrenic paresis in which muscle is recognisable is not strictly an eventration, but the clinical effect — alimentary and respiratory symptoms — may be the same if the lesion is of long standing and the diaphragm does not recover. Now that phrenic avulsion is no longer practised and phrenic crush is a rare operation, most phrenic nerve palsies are evanescent and unequivocally acquired eventration is rarely seen. Most eventrations seen in practice today are presumed to have been present from birth because the sequence of a low, normal diaphragmatic dome developing with phrenic paresis into an established fibrous dome is unrecorded.

Patients and methods

That many do not recognise the condition is clear from a scrutiny of the records in the Department of Cardiothoracic Surgery at Wentworth Hospital in Durban. In 20 years, of 34 patients in whom the diagnosis of eventration of the diaphragm was established, this diagnosis was suggested in the referral letter of only 1. These 34 patients were referred specifically because of the radiographic abnormality. During that time many other examples of partial eventration were seen which were incidental in those patients. The age range of the 34 patients was 2 weeks - 80 years, with a mean of 34.3 ± 25 years; 11 were younger than 10 years and 5 were over 60 years. Males were more frequently affected (24 males, 10 females). In half of the 34 patients the original radiographic investigation had been undertaken as part of the investigation of unrelated symptoms, and in the other half because of respiratory or alimentary symptoms. Of 12 left-sided eventrations, 8 were complete; of 22 right-sided eventrations, only 2 were complete. Symptoms in those with complete eventration were of a respiratory and alimentary nature and were of almost equal frequency.

All patients with complete eventration were advised to undergo surgery and 7 complied. In none in whom partial eventration was confidently diagnosed was surgery action advised; in 4, in whom the diagnosis of eventration was either not suspected or not confirmed, exploratory right thoracotomy was undertaken to establish a diagnosis. In none of these 4 was recourse made to computed tomography, isotope scanning or ultrasonography because these investigations were not then available.

Those complete eventrations which were managed surgically, all left-sided, were similarly dealt with: the redundant fibrous tissue was folded on itself (plicated) and stitched laterally to the chest wall so that the dome became almost flat, and in 3 adults, this flat sheet of fibrous tissue was reinforced on its rostral aspect with a sheet of Marlex mesh. Reinforcement of this sort was not used in 3 adults, this flat sheet of Marlex mesh in a child is unknown. Now that animal pericardium preserved and sterilised with gluteraldehyde is readily available, this may well be a suitable reinforcement in children. Gastric decompression assists postoperative care. In those patients with hypoplasia of the lung, longstanding pulmonary compression, pulmonary re-expansion may be delayed. In children an immediate improvement in oxygenation occurs after repair; in adults there is frequently no significant improvement in lung function but gastrointestinal symptoms attributed to the eventration are relieved.

Fig. 1 shows a typical complete left-sided eventration in a child with alimentary symptoms. A typical right partial eventration of the diaphragm, anteriorly situated which was demonstrated radiographically after the induction of a pneumoperitoneum is depicted in Fig. 2 and Fig. 3 shows a right-sided eventration unsuspected on preliminary investigation in a young girl thought on radiographic evidence to have a hydatid cyst.

Discussion

Eventration was first recognised and described by Petit in the 18th century. The lesion was given its name by Beclard.
left-sided lesions, and patients with the more obscure right-sided lesions, often unrecongnised by referring physicians, are referred to thoracic surgical units.\textsuperscript{11}

In infants, acute respiratory distress and difficulty in feeding are the prominent symptoms. At this age tolerance to eventration is low because infants are predominantly diaphragmatic breathers, have labile mediastinums, are usually recumbent, and hyperventilation and retained secretions more readily lead to airway obstruction. One of the causes of neonatal respiratory distress is eventration.

Elevation or rotation of the stomach caused by left-sided lesions may be the cause of dysphagia, epigastric pain, flatulence and other symptoms, any of which may be relieved by a change of position. Patients known to have a high left dome may in later life, as a result of age-related decrease in cardiorespiratory reserve and increased abdominal pressure consequent upon obesity, develop digestive or respiratory symptoms.

Techniques used to reach a diagnosis need to be evaluated in relation to their danger to the patient, their invasiveness, simplicity, cost and diagnostic yield. In the context of eventration, a high index of suspicion in the interpretation of plain chest radiographs in the postero-anterior and lateral position followed by fluoroscopy, is often all that is needed. Provided that they are on general grounds suitable for an operation, all patients with total left-sided eventration should be advised to undergo an operation for its repair. Distinction between eventration and diaphragmatic hernia in these circumstances is irrelevant because both need surgical management.

Although a plain chest radiograph may strongly suggest the diagnosis of partial eventration on the right, in some instances further investigation may be needed to confirm the diagnosis. Fluoroscopy is open to misinterpretation. The membranous segment usually initially moves upwards (paradoxically) with inspiration, but as the slack is taken up it may move downwards towards the end of normal inspiration. With sniffing, the membranous segment usually moves paradoxically.

The induction of a pneumoperitoneum, first reported by Zeitlin\textsuperscript{12} in 1930, using carbon dioxide or nitrous oxide at 7 -10 mm/kg body weight, is one way of diagnosing partial right-sided eventration if the liver is not adherent to the undersurface of the diaphragm. The investigation is contraindicated in patients with a history of peritoneal sepsis or inflammatory bowel disease. In this series a pneumoperitoneum was diagnostic in 1 but not in the other 3 because the liver was adherent to the undersurface of the diaphragm. The induction of a pneumoperitoneum, first reported by Zeitlin\textsuperscript{12} in 1930, using carbon dioxide or nitrous oxide at 7 -10 mm/kg body weight, is one way of diagnosing partial right-sided eventration if the liver is not adherent to the undersurface of the diaphragm. The investigation is contraindicated in patients with a history of peritoneal sepsis or inflammatory bowel disease. In this series a pneumoperitoneum was diagnostic in 1 but not in the other 3 because the liver was adherent to the undersurface of the diaphragm.

Most reported series have been small;\textsuperscript{4-8} Richard et al. reported a series of 80 patients.\textsuperscript{9}

Most eventrations reported in the literature have been left-sided, with a male predominance. It is not clear from these reports whether they refer to partial or complete eventration. Complete eventration is unequivocally commoner in males and on the left; partial eventration is also unequivocally commoner on the right, with an equal distribution between the sexes.\textsuperscript{10}

Discrepancies in the literature may relate to the fact that paediatric surgical units deal more often with more obvious

Fig. 1. Postero-anterior and lateral chest radiographs demonstrating complete left-sided eventration.

Fig. 2. Partial right-sided eventration well demonstrated by the induction of a pneumoperitoneum.

Fig. 3. Partial right-sided eventration in a patient who had a thoracotomy in the belief that the opacity was an hydatid cyst.