Rob & Smith's

Operative Surgery

General Editors
Hugh Dudley and David Carter

Thoracic Surgery

Consultant Editors: John W. Jackson and D.K.C. Cooper

Fourth Edition

Butterworths

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Operative Surgery

Thoracic Surgery

Fourth Edition

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Tribute to John Jackson

Sadly, John Jackson, the senior editor of this volume, did not live to see it published. He had accomplished the preparation of this edition despite the increasing ill-health and pain which required him to undergo numerous operative and therapeutic procedures; his cheerful fortitude during this time was remarkable. The third-edition volume, covering both cardiac and thoracic surgery and this present volume remain as tributes to his editorial capabilities.

To those who knew him personally, however, he will not be remembered solely for his undoubted expertise as a thoracic surgeon. Rather, he will be remembered for the human qualities he possessed and demonstrated to the full – his concern for both patients and junior colleagues, his kindness, sensitivity and generosity, his delightful sense of humour. John Jackson will be sadly missed by all who were fortunate enough to know him – patients, colleagues, and friends.

D. K. C. Cooper

Preface

Those readers familiar with earlier editions of the series 'Operative Surgery' will note a major change in this current (fourth) edition, namely, the division of cardiac and thoracic surgery into two separate volumes. Hitherto, cardiothoracic operations have been described in a single volume – the third edition being edited by my late colleague John Jackson. There has been a tendency for surgeons to concentrate their practices increasingly in either cardiac of thoracic work, and it was felt that the preparation of separate volumes in these two fields would be timely. Though there will be those who deplore this further small step in the division of cardiothoracic surgery into two subspecialties, there will equally be many others who will applaud. Both the general editors and those involved with the preparation of the two volumes hope that the resulting texts will be easier to consult, and will even more adequately satisfy the needs of the reader.

In this particular volume on thoracic surgery, the requirements of the surgeon in training have been to the fore in the minds of the editors and authors, and it is hoped that the text and figures provide clear guidance for those inexperienced in the performance of certain operations.

The arrangement of the chapters, though now confined largely to mediastinal, pulmonary, and oesophageal operative topics, has largely followed that of the previous edition. The more complicated and less common operations follow minor and investigatory procedures in a more or less logical manner so that it should be possible for the reader to locate any one chapter without continual reference to the index. Where possible, each chapter follows the same pattern – an outline of investigations and indications followed by the operation, and finally aspects of postoperative care. All of the operations are well-tried standard procedures, and each surgeon has been encouraged to describe his own method, to include pitfalls and complications, and to mention or describe alternative procedures where appropriate.

Greater attention has been paid to investigatory procedures, and the chapters on rigid and flexible bronchoscopy, bronchography, aspiration of the chest, pleural biopsy and needle biopsy of the lung, mediastinoscopy, and oesophagoscopy, have been considerably expanded. Blunt and penetrating chest trauma has also been given greater attention, as have certain conditions not seen commonly in the United Kingdom or North America, such as pulmonary hydatid cysts.

The international flavour of the contributions has been increased further, and chapters are included from surgeons in the UK, the USA, Canada, South Africa, Yugoslavia and Germany. The text therefore reflects operative techniques practised and accepted worldwide.

D. K. C. Cooper

Contents

General

Pulmonary

Illustrations by Kevin Marks

Congenital diaphragmatic hernia and eventration

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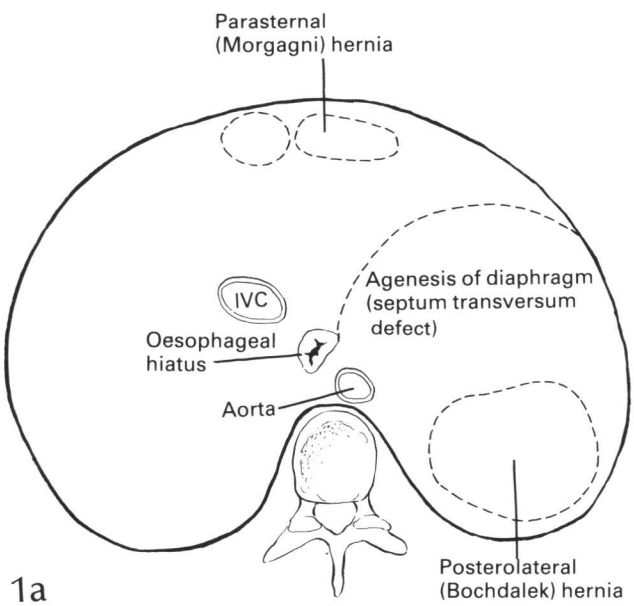
DIAPHRAGMATIC HERNIA

History

Ambroise Paré reported the first diaphragmatic hernia, which was of traumatic origin, in 1597. In 1848, Vincent Alexander Bochdalek published his description of the congenital diaphragmatic hernia that now bears his name. The defect as described by Bochdalek was a triangular slit between the lumbar portion of the diaphragm and the apex of the twelfth rib. He attributed the herniation to rupture of a previously intact membrane in the lumbocostal triangle.

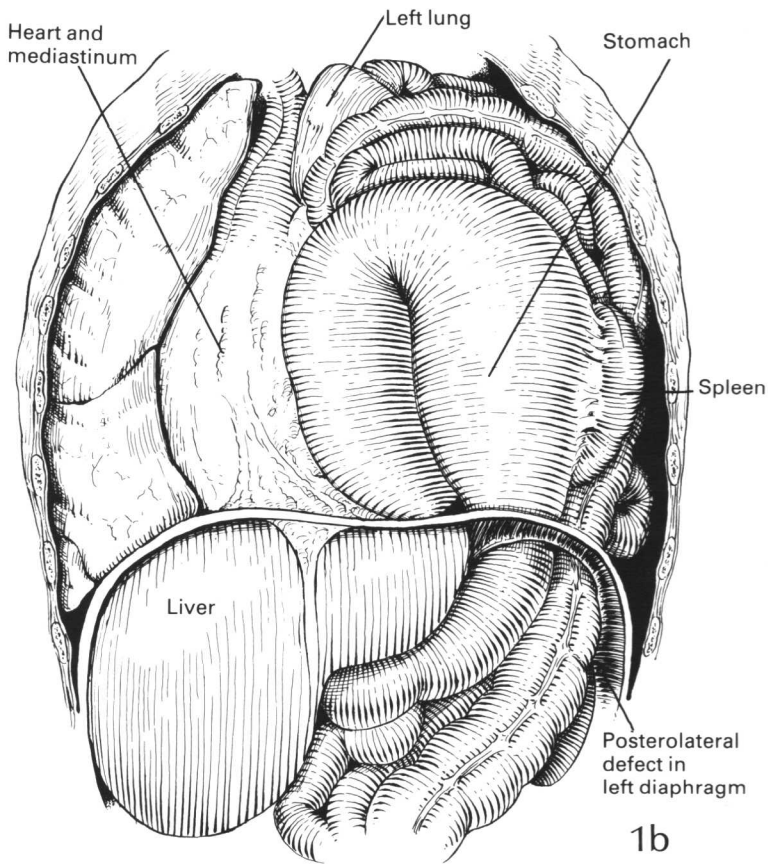


1a

1a & b

Types of hernia

The various areas in the diaphragm (excluding the oesophageal hiatus) through which hernias may occur are shown.



1b

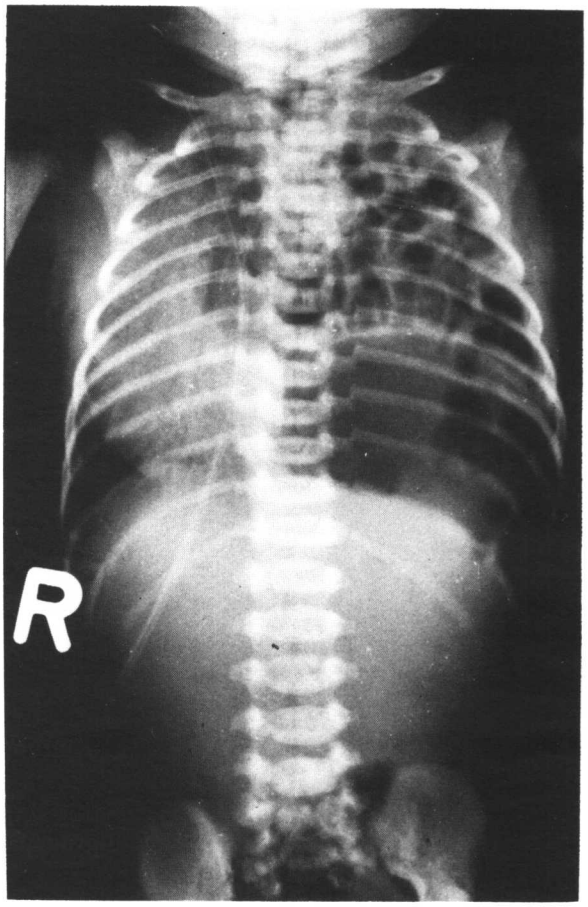
Diagnosis

Diaphragmatic hernia through the patent pleuroperitoneal canal, generally referred to as the foramen of Bochdalek, usually presents as an acute emergency in the neonatal period. The classical diagnostic triad consists of respiratory distress, apparent dextrocardia and a flat 'scaphoid' abdomen. Breath sounds are diminished on the affected side and borborygmi may be auscultated in the chest. The presenting symptoms in cases manifesting at a later stage include recurrent respiratory infections, dyspnoea, especially after meals, and vomiting. The left side is affected in 85–90 per cent of cases. This has been attributed to the later closure of the left pleuroperitoneal canal during the eighth week of intrauterine development. Bilateral hernias are rare.

2

A chest radiograph, which should always include the abdomen, is usually diagnostic. The affected hemithorax is filled with gas-containing loops of intestine, the mediastinum is displaced to the opposite side, and there is a decrease in the amount of intraperitoneal intestinal gas shadows.

The presence of a normal intestinal gas configuration with an apparently intact diaphragm is suspicious of congenital lobar emphysema or adenoid cystic malformation of the lung. Contrast studies of the gastrointestinal tract may be required to differentiate these two primary pulmonary conditions from a true diaphragmatic hernia.



2

Resuscitative measures

As soon as the diagnosis is suspected, a large calibre (No. 10 gauge) nasogastric tube should be introduced into the stomach and all swallowed contents evacuated. The infant is nursed in 100 per cent oxygen and if this fails to improve the respiratory embarrassment, ventilatory assistance is administered via an endotracheal tube. Ventilation with a face mask is strictly contraindicated as this forces air into the stomach and intestines, further embarrassing the respiration. Sudden deterioration during resuscitation may be due to a tension pneumothorax. This is relieved by inserting a hypodermic needle (No. 21 gauge) into the affected pleural space. An intercostal drain with underwater seal can then be formally introduced in a relatively stable patient. Correction of acidosis should be attempted with extreme caution.

Transportation

Where possible, transfer of the infant to a paediatric surgical centre should be carried out promptly while all resuscitative measures continue. This implies attendance by experienced medical and nursing personnel ensuring as far as possible that the infant remains normothermic and adequately oxygenated and that the intestines remain decompressed.

Anaesthesia

This consists of standard neonatal anaesthesia with preoxygenation and awake endotracheal intubation (if this was not required during resuscitation) followed by hand ventilation with an Ayre's T-piece. Gentle ventilation, using inspiratory pressures of up to 25 cm H_2O with 5 cm H_2O end-respiratory pressure to maintain the functional residual capacity, is maintained throughout the operative period. Monitoring of electrocardiogram, core temperature (rectal probe), central venous and arterial pressures, blood gases and blood loss is carried out intraoperatively.

The operation

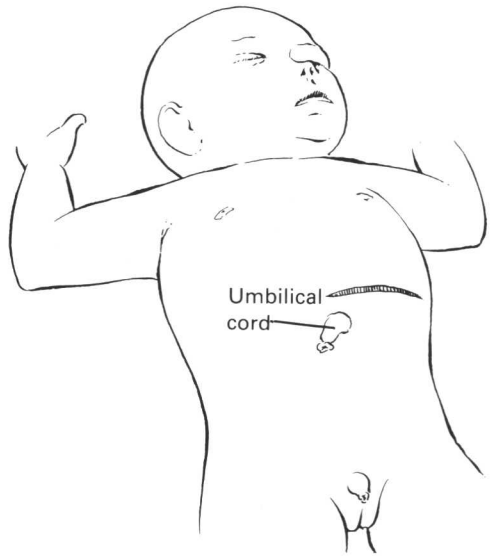
The incision

The abdominal approach is preferred for all left-sided congenital posterolateral diaphragmatic hernias. Correction of the associated intestinal malrotation and enlargement of the peritoneal cavity to accommodate the displaced viscera are more easily achieved through an abdominal incision.

A transthoracic approach may be used for the right-sided hernia where liver may be the only contents, or for recurrent hernias where adhesions prevent simple reduction of the herniated contents.

3

The abdominal approach is via a left upper abdominal transverse muscle-cutting (or alternatively a left oblique subcostal) incision placed 2 cm above the umbilical cord and extending from the midline to the tip of ninth costal cartilage.



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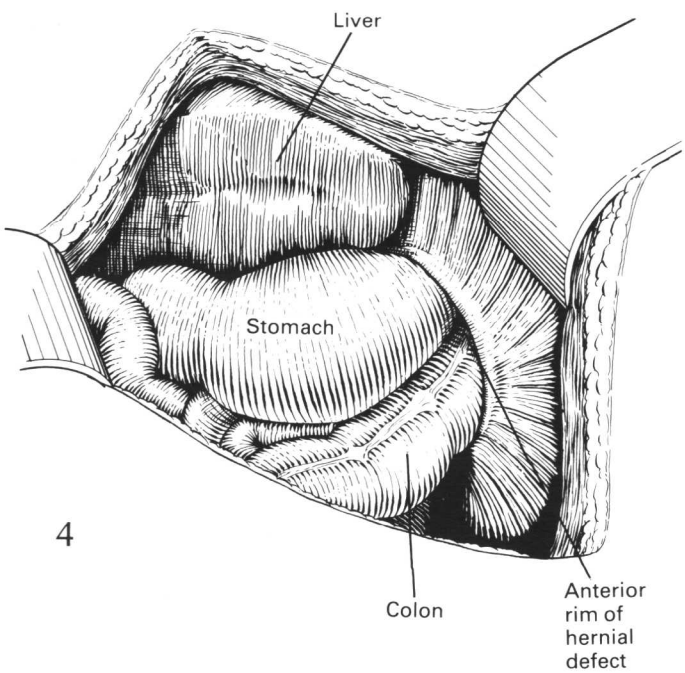


4

4

Exposure of the diaphragmatic defect

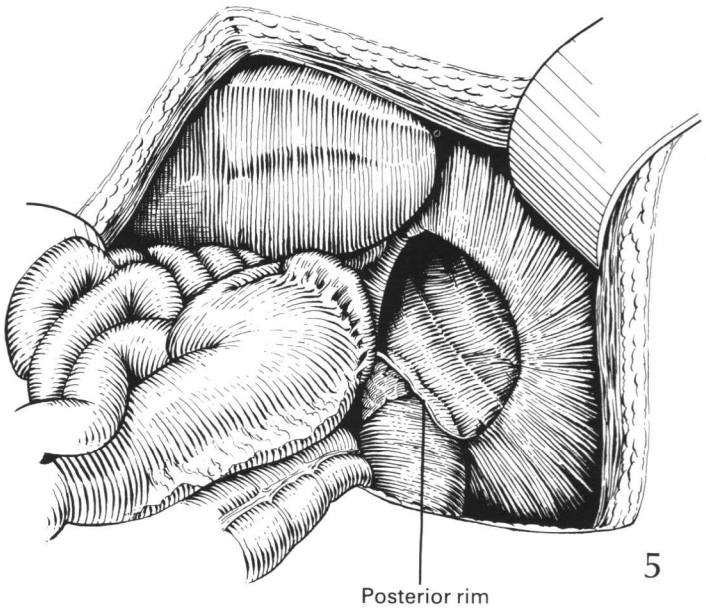
The cranial part of the wound is retracted upwards to reveal the anterior well-muscularized diaphragm and the posteriorly located defect through which most of the abdominal viscera have herniated into the pleural cavity. The peritoneal cavity is relatively empty.

5

Definition of the diaphragmatic defect

The herniated contents, which may include the entire small intestine together with a variable amount of the right colon, stomach, spleen and left lobe of liver, are gently withdrawn. The anterior rim of the defect is usually well defined and easily identifiable. The posterior rim is frequently adherent to the posterior abdominal wall in close proximity to the left adrenal and kidney. Occasionally the posterior rim is completely deficient but more commonly it gradually fades out laterally, where the margin of the defect merges with the chest wall.

Exposure of the margins of the defect may be facilitated by retracting the left lobe of the liver medially after dividing the left triangular ligament. A careful search is now made for a sac which is present in 10–15 per cent of cases. The sac may be extremely thin and closely applied to the pleura. The sac should be excised up to the margins of the diaphragmatic defect. A plastic drainage tube is inserted into the pleural cavity via the ninth intercostal space in the mid-axillary line. Some surgeons prefer not to drain the pleural space; others prophylactically insert catheters into both sides of the chest.



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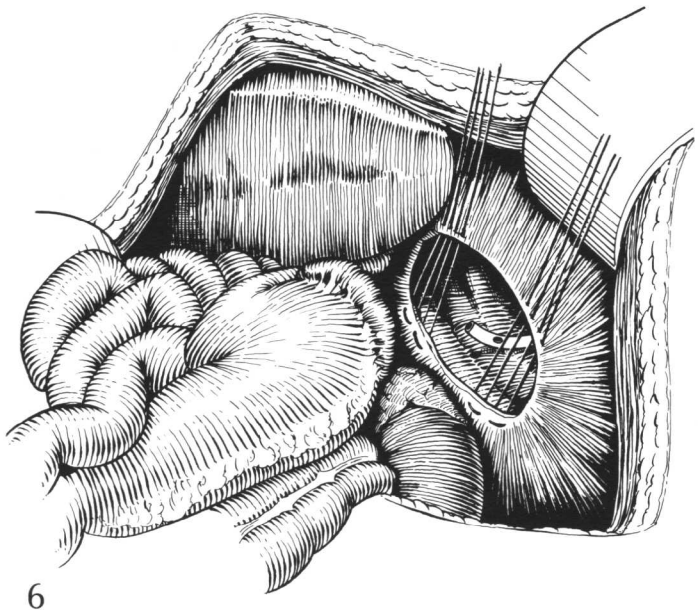


6

Repair of the defect

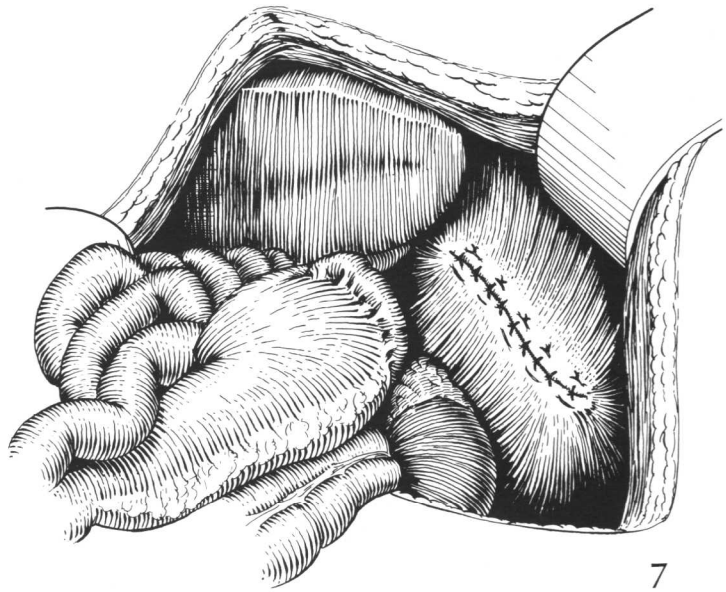
The hernial orifice is closed in two layers by approximating the margins of the defect with interrupted non-absorbable suture material (2/0 or 3/0 silk or braided polyamine).

6

The first row consists of horizontal mattress sutures inserted 5 mm from the edge of the defect.

7

The second row approximates the everted rim.



7

Where the posterior rim is partially or totally absent, the sutures should be placed around the adjacent rib to achieve a secure repair. Direct apposition of the hernial margins is occasionally impossible. In these cases the defect is best closed with a prosthetic patch (Dacron, Teflon). Alternatively a flap of anterior abdominal wall may be rotated into the opening and sutured in position.

Additional manoeuvres

The intestinal malrotation is corrected by dividing abnormal bands and splaying the root of the mesentery. The duodenal loop is straightened, and the small intestine placed in the right side of the abdomen with the caecum in the left upper quadrant. The peritoneal cavity is enlarged by forcibly stretching the muscles of the anterior abdominal wall.

Closure of the abdomen

The abdominal incision is closed *en masse* or in layers with 3/0 polyglycolic acid sutures. A subcuticular 4/0 polyglycolic acid suture approximates the skin edges. In the very rare case closure of the abdominal wall cannot be achieved without profound tension which will further embarrass respiration. In these cases the establishment of a ventral hernia or accommodation of the intestine temporarily in a pouch fashioned with Silastic sheeting may be required.

The intercostal drain is connected to an underwater seal with 2–3 cm H_2O of negative pressure. We prefer to clamp the drainage tube, releasing it for a short period only every 6 hours. This manoeuvre allows gentle expansion of the ipsilateral lung while extreme to-and-fro shifting of the mediastinum is prevented. The intercostal drain is removed when full expansion of the lung has occurred or when a stable state has been achieved. No attempt at rapid re-expansion of the lung should be made.

Postoperative care

All neonates presenting within 12 hours of birth are electively ventilated postoperatively. Monitoring consists of electrocardiogram, temperature, central venous pressure (via internal jugular vein catheter) and arterial pressure (via the right radial artery). Transcutaneous arterial P_{O_2} is measured in the upper part of the abdomen to give an early indication of ductal shunting of blood arising from increased pulmonary vascular resistance.

Fifteen per cent of infants are at risk of developing a transitional circulation (right-to-left shunting at ductal and atrial level) due to the pulmonary vascular resistance rising above systemic pressures. Such patients may respond dramatically to pulmonary vasodilators (e.g. tolazoline 1–2 mg/kg bodyweight per hour as an intravenous infusion). Dopamine (5–15 μg/kg/min) may be required in addition to improve the systemic circulation by its direct inotropic effect. Owing to the vasodilatory effects of both these drugs, large volumes of plasma expanders may be required. These requirements are best assessed by monitoring the central venous pressure.

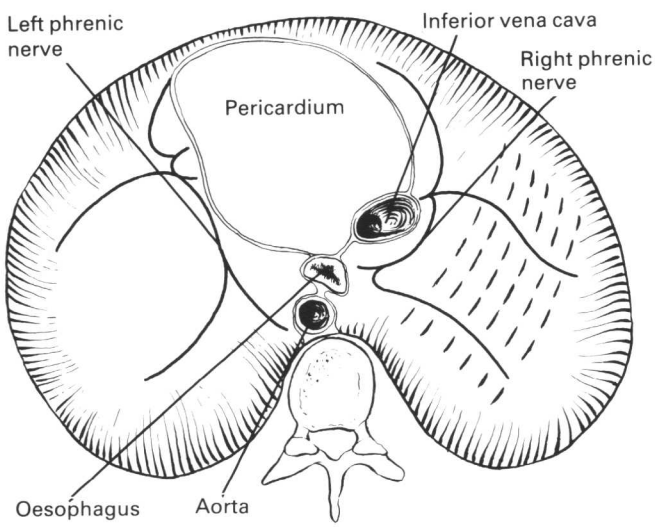
Weaning of the infant from ventilatory assistance is accomplished slowly using intermittent mandatory ventilation once cardiopulmonary stability has been achieved. Prolonged ileus, particularly in the infant requiring ventilatory support, may indicate the need for parenteral nutrition for a variable period during the postoperative course.

Results

The mortality rate is directly proportional to the degree of pulmonary hypoplasia. Infants presenting within 6–12 hours of birth usually have advanced pulmonary hypoplasia, whereas those infants in whom the diagnosis is not evident before 12–24 hours have little impairment of pulmonary development. The survival rate for infants presenting within 12 hours of birth is between 45–60 per cent, while few deaths should occur in infants older than 12 hours at the time of diagnosis. At the Hospital for Sick Children, London, 92 infants with diaphragmatic hernia were treated between 1979 and 1981. The overall survival rate was 74 per cent (68 infants). All the deaths, 24 cases, occurred in those infants presenting within 6 hours of birth (overall survival rate in this group 61 per cent, i.e. 37 of 61 patients).

EVENTRATION OF THE DIAPHRAGM

This refers to an abnormally high position of one or both leaflets of the intact diaphragm as a result of paralysis, hypoplasia or atrophy of the muscle fibres. It is poorly tolerated by the young infant especially if bilateral. If there is a possibility that the damage to the phrenic nerve is reversible, the condition can be successfully managed with continuous positive airway pressure ventilation for a period of 4–6 weeks. Where the phrenic nerve injury is thought to be permanent or where there is a relapse following a trial of conservative management, surgery is recommended. The aim of surgery in eventration is to fix the paralysed diaphragm in the inspiratory position, thereby minimizing paradoxical movement and preventing shift of the mediastinum with respiration.



The operation

The incision

A thoracic or abdominal approach may be used. In bilateral eventration, an upper abdominal transverse muscle-cutting incision is performed, while in unilateral cases, especially when the right hemidiaphragm is involved, a thoracic approach affords easier access and allows identification of the branches of the phrenic nerve. The lateral thoracotomy is via the unresected bed of the eighth rib.

8

Exposure of the diaphragm

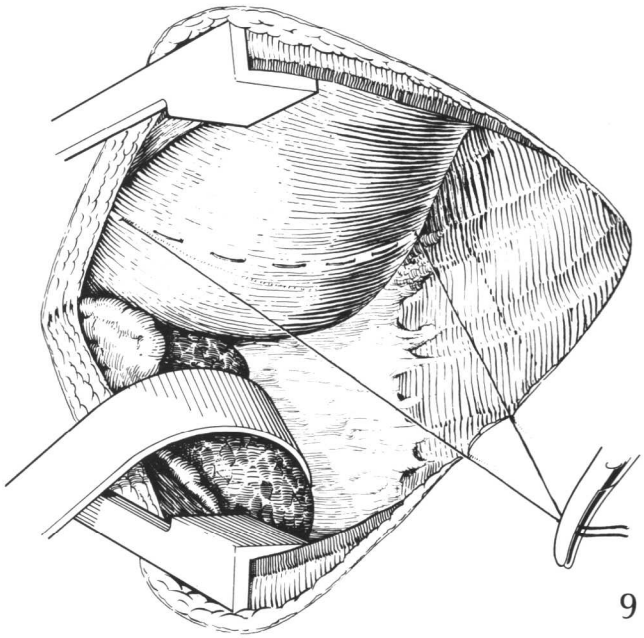
The inferior pulmonary ligament is divided and the distribution of the branches of the phrenic nerve defined.

9–11

Technique of plication

Four to six rows of 2/0 or 3/0 non-absorbable sutures (silk or braided polyamine) are inserted into the diaphragm from anterolateral to posteromedial. Each row comprises five to six pleats, avoiding the branches of the phrenic nerve. The suture should not pass through the full thickness of the diaphragm as underlying adjacent viscera may be traumatized. The sutures are left untied until all the rows are in position.

An intercostal drain with underwater seal may be inserted and removed when full expansion of the lung has been shown to have occurred. No special postoperative measures are necessary. Recovery is rapid and uneventful and complications rarely occur.



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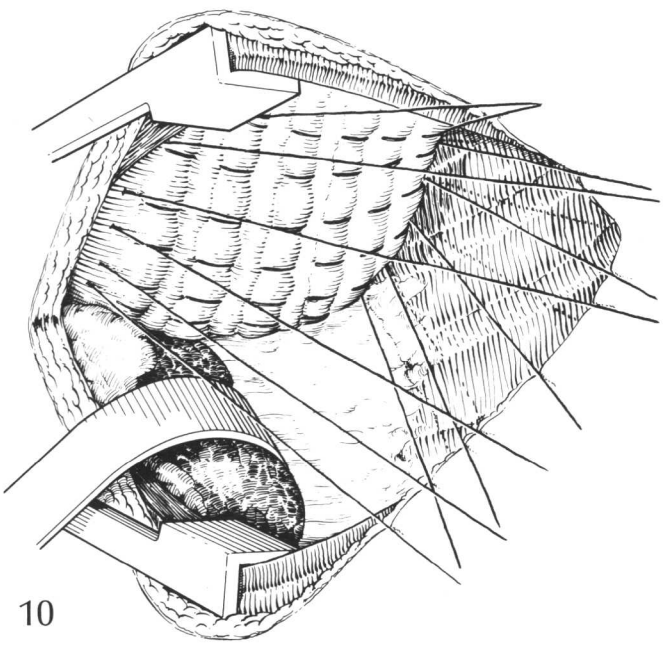

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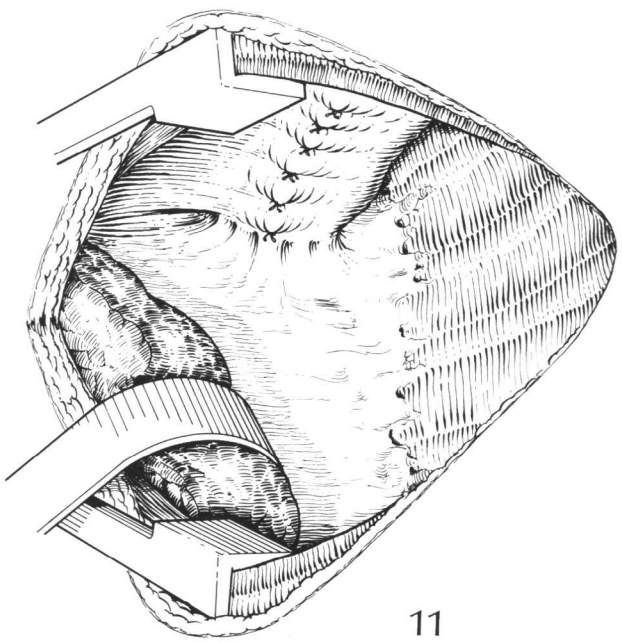

11

Further reading

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Illustrations by Peter Jack

Pectus excavatum

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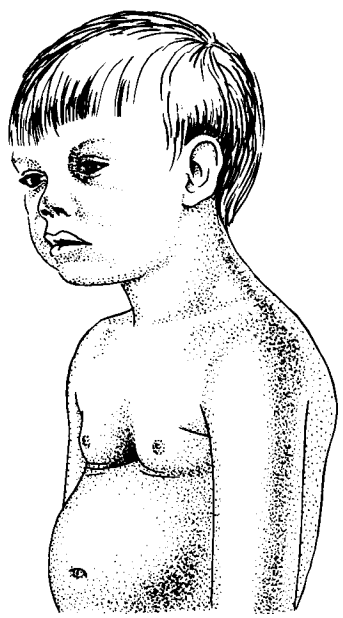
Preoperative

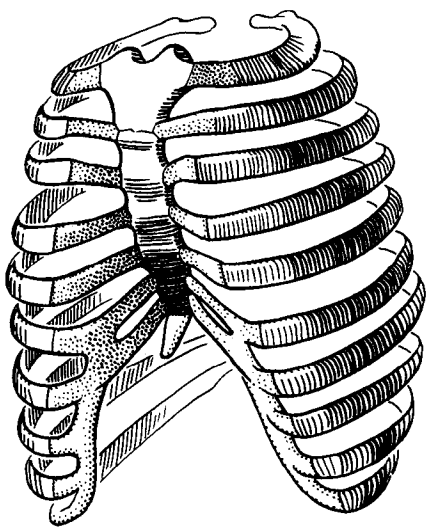
Indications

1a & b

Pectus excavatum (funnel chest) presents with a varying degree of depression of the sternum and costal cartilages in the front of the chest, and is usually associated with kyphotic posture and a protruberant abdomen.



1a



1b