Chapter 60

Abdominal wall, hernia and umbilicus

Learning objectives

To know and understand:

- Basic anatomy of the abdominal wall and its weaknesses
- Causes of abdominal hernia
- Types of hernia and classifications
- Clinical history and examination findings in hernia
- Complications of abdominal hernia
- Non-surgical and surgical management of hernia – including mesh
- Complications of hernia surgery
- Other abdominal wall conditions

THE ABDOMINAL WALL

Basic anatomy and function related to pathology

The abdominal wall is a complex structure composed primarily of muscle, bone and fascia. Its major function is to protect the enclosed organs of the gastrointestinal and urogenital tracts but a secondary role is mobility, being able to flex, extend, rotate and vary its capacity. Flexibility requires elasticity and stretch, which compromise abdominal wall strength.

The roof of the abdomen is formed by the diaphragm separating the thoracic cavity above, with negative pressure, from the abdomen below, with positive pressure. Weakness of the diaphragm can lead to much of the bowel being drawn into the chest down this pressure gradient. The bony pelvis forms the floor of the cavity but a muscular central portion, the perineum, may also weaken and allow rectum, bladder and gynaecological organs to bulge downwards, a condition called prolapse.

The overall design of the abdominal muscles is best seen on a transverse computed tomography (CT) scan through the mid-abdomen. Posteriorly the muscles are strong, further supported by the vertebral column, ribs and pelvis. Two regions called the posterior triangles represent areas of weakness which can lead to rare lumbar hernias. Laterally there are three thin muscle layers the fibres of which criss-cross for strength and flexibility. Surgeons can make use of these layers, by making releasing incisions, separating the layers and then sliding one layer over another to increase girth and allow closure of defects in the centre of the abdomen, e.g. the 'Ramirez slide' used in large incisional hernia repair (Figure 60.1).

Anteriorly the two powerful rectus abdominis muscles extend vertically from ribs to pelvis. Herniation through these strong muscles does not occur naturally but their central join, the linea alba, is an area of weakness resulting in epigastric and paraumbilical herniation. Divarification of the recti is the condition where the linea alba stretches laterally as the two rectus muscles separate. It occurs in the upper abdomen in middle-aged, overweight men (Figure 60.2) but also as a result of birth trauma in women when it occurs below the umbilicus.

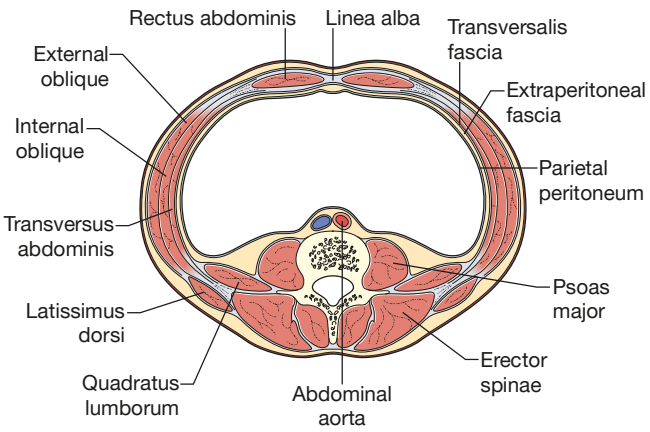

Figure 60.1 A cross-section of the midabdomen showing the muscular layout.

Abdominal pressure

The positive pressure within the abdomen is used by a surgeon when drains are placed to allow blood, pus, bile, bowel content and urine to flow outwards down the pressure gradient. However, this constant pressure from within can also lead to the condition of abdominal hernia where tissue, meant to be within the abdominal cavity, is forced outwards through defects in the muscular wall.

Figure 60.2 Divarification.

ABDOMINAL HERNIA

A hernia is the bulging of part of the contents of the abdominal cavity through a weakness in the abdominal wall.

Anatomical causes of abdominal wall herniation

Despite the complex design of the abdominal wall, the only natural weaknesses caused by inadequate muscular strength are the lumbar triangles and the posterior wall of the inguinal canal (**Figure 60.3**).

Many structures pass into and out of the abdominal cavity creating weakness which can lead to hernia formation. The most common example is the inguinal canal in males, along which the testis descends from abdomen to scrotum at the time of birth. The testicular artery, veins and vas pass though this canal (the round ligament in females). The resultant weakness leads to an indirect or lateral-type inguinal hernia. In adult surgery, 80% of all hernia repairs are for inguinal hernia. The evolutionary advantage of testicular descent must outweigh the disadvantage of a high risk of herniation. Other examples are: oesophagus → hiatus hernia, femoral vessels → femoral hernia, obturator nerve → obturator hernia, sciatic nerve → sciatic hernia.

Figure 60.3 Posterior wall defect.

An inguinal hernia (indirect) also occurs through the developmental failure of the processus vaginalis to close. As the testis descends, it pulls a tube of peritoneum along with it. This tube should naturally fibrose and become obliterated but often it fails to fibrose and allows a hernia to form. Recent studies have shown that calcitonin gene-related peptide and hepatocyte growth factor influence the closure of the processus, raising the possibility of a hormonal cause of hernia development.

Failure of normal development may lead to weakness of the abdominal wall. Examples are diaphragmatic, umbilical and epigastric hernias. Muscles which should unite during development fail to form strong unions with hernia development at birth or in later life.

Herniation at the umbilicus has both components, i.e. weakness due to structures passing through the abdominal wall in fetal life and developmental failure of closure.

The risk of inguinal hernia is related to the anatomical shape of the pelvis and is higher in patients having a wider and shorter pelvis.

Weakness of abdominal muscles may be the result of sharp trauma. Most commonly, this results from abdominal surgery but also occurs after stabbing. A surgical scar, even with perfect wound healing, has only 70% of the initial muscle strength. This loss of strength can result in herniation in at least 10% of surgical incisions. Smaller laparoscopic port-site incisions have a hernia rate of 1%. Increasing use of this surgical approach should lead to a fall in the incidence of incisional hernia.

Muscle damage by blunt trauma or tearing of the abdominal muscles requires exceptional force and is rare.

The sudden presence of a mass in the rectus muscle may be a rectus sheath haematoma, occasionally due to trauma but nowadays more often due to excessive anticoagulation therapy.

Primary muscle pathology and neurological conditions can lead to muscle weakness and occasionally present to the surgeon as a 'hernia'.

Summary box 60.1

Causes of hernia

- Basic design weakness
- Weakness due to structures entering and leaving the abdomen
- Developmental failures
- Genetic weakness of collagen
- Sharp and blunt trauma
- Weakness due to ageing and pregnancy
- Primary neurological and muscle diseases
- ? Excessive intra-abdominal pressure

Pathophysiology of hernia formation

A normal abdominal wall has sufficient strength to resist high abdominal pressure and prevent herniation of content. Herniation has been attributed to high pressures from

constipation, prostatic symptoms, excessive coughing in respiratory disease and obesity. However, it has been shown that hernia is no more common in Olympic weight lifters than the general population, suggesting that high pressure is not a major factor in causing a hernia. Many patients will first notice a hernia after excessive straining.

There is good evidence that hernia is a 'collagen disease' and due to an inherited imbalance in the types of collagen. This is supported by histological evidence and relationships between hernia and other diseases related to collagen, such as aortic aneurysm.

Hernia development is more common in pregnancy due to hormonally induced laxity of pelvic ligaments. It is also more common in elderly people due to degenerative weakness of muscles and fibrous tissue. A recent Swedish report has shown that inguinal hernia is less common in obese patients, with hernia risk being negatively related to body mass index (BMI), contrary to widespread belief. Hernia is more common in smokers.

Common principles in abdominal hernia

An abdominal wall hernia has two essential components, a defect in the wall and content, i.e. tissue that has been forced outwards through the defect. The weakness may be entirely in muscle, such as an incisional hernia. It may also be in fascia, similar to an epigastric hernia through the linea alba. It may have a bony component, such as a femoral hernia. The weakness in the wall is usually the narrowest part of the hernia which expands into the subcutaneous fat outside the muscle. The defect varies in size and may be very small or indeed very large. The nature of the defect is important to understanding the risk of hernia complications. A small defect with rigid walls traps the content and prevents it from freely moving in and out of the defect, increasing the risk of complications.

The content of the hernia may be tissue from the extraperitoneal space alone, such as fat within an epigastric hernia or urinary bladder in a direct inguinal hernia. However, if such a hernia enlarges then peritoneum may also be pulled into the hernia secondarily along with intraperitoneal structures such as bowel or omentum; a good example is a 'sliding type' of inguinal hernia.

More commonly, when peritoneum is lying immediately deep to the abdominal wall weakness, pressure forces the peritoneum through the defect and into the subcutaneous tissues. This 'sac' of peritoneum allows bowel and omentum to pass through the defect. In most cases, the intraperitoneal organs can move freely in and out of the hernia, a 'reducible' hernia, but if adhesions form or the defect is small, bowel can become trapped and unable to return to the main peritoneal cavity, an 'irreducible' hernia, with high risk of further complications. The narrowest part of the sac, at the abdominal wall defect, is called the 'neck of the sac'.

When tissue is trapped inside a hernia it is in a confined space. The narrow neck acts as a constriction ring impeding venous return and increasing pressure within the hernia. Resulting tension leads to pain and tenderness. If the hernia contains bowel then it may become 'obstructed', partially or totally. If the pressure rises sufficiently, arterial blood is not able to enter the hernia and the contents become ischaemic and may infarct. The hernia is then said to have 'strangulated'. The wall of the bowel perforates, releasing infected, toxic bowel content into the tissues and ultimately back into the peritoneal cavity. The risk of strangulation is highest in hernias that have a small neck of rigid tissue, leading first to irreducibility and on to strangulation. The term 'incarcerated' is not clearly defined and used to imply a hernia that is irreducible and developing towards strangulation.

Summary box 60.2

Types of hernia by complexity

- Occult – not detectable clinically; may cause severe pain
- Reducible – a swelling that appears and disappears
- Irreducible – a swelling that cannot be replaced in the abdomen, high risk of complications
- Strangulated – painful swelling with vascular compromise, requires urgent surgery
- Infarcted – when contents of the hernia have become gangrenous, high mortality

In a special circumstance (Richter's hernia) only part of the bowel wall enters the hernia. It may be small and difficult or even impossible to detect clinically. Bowel obstruction may not be present but the bowel wall may still become necrotic and perforate with life-threatening consequences. Femoral hernia may present in this way often with diagnostic delay and high risk to the patient (**Figure 60.4**).

An interstitial hernia occurs when the hernia extends between the layers of muscle and not directly through them. This is typical of a spigelian hernia (see below under **Spigelian hernia**).

An internal hernia is a term used when adhesions form within the peritoneal cavity. leading to abnormal pockets into which bowel can enter and become trapped. As there is no defect within the abdominal wall, the term 'hernia' is confusing.

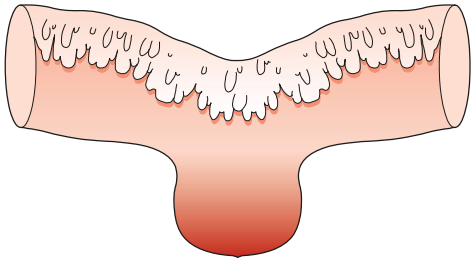

Figure 60.4 Diagrammatic representation of gangrenous Richter's hernia from a case of strangulated femoral hernia.

August Gottlieb Richter, 1742–1812, lecturer in Surgery, Göttingen, Germany described this form of hernia in 1777.

Clinical history and diagnosis in hernia cases

Patients are usually aware of a lump on the abdominal wall under the skin. Self-diagnosis is common. The hernia is usually painless but patients may complain of an aching or heavy feeling. Sharp, intermittent pains suggest pinching of tissue. Severe pain should alert the surgeon to a high risk of strangulation. One should determine whether the hernia reduces spontaneously or needs to be helped. The patient should be asked about symptoms that might suggest bowel obstruction.

It is important to know if this is a primary hernia or whether it is a recurrence after previous surgery. Recurrent hernia is more difficult to treat and may require a different surgical approach.

General questions about the cardiac and respiratory systems are necessary to assess a patient's anaesthetic risk.

In a man with a groin hernia, history of prostatic symptoms indicates a high risk of postoperative urinary retention.

Intake of anticoagulants such as warfarin is important because this impacts on future surgery. Many hernia operations can be performed as a day case or single overnight stay, so that suitability for such treatment needs to be assessed, including home support, distance from the hospital, mobility levels, etc.

Examination for hernia

The patient should be examined lying down initially and then standing as this will usually increase hernia size. In some cases no hernia will be apparent with the patient lying. The patient is asked to cough, when an occult hernia may appear. Divarification is best seen by asking a supine patient to simply lift his head off the pillow.

The overlying skin is usually of normal colour. If bruising is present this may suggest venous engorgement of the content. If there is overlying cellulitis then hernia content is strangulating and the case should be treated as an emergency.

In most cases a cough impulse is felt. Gentle pressure is applied to the lump and the patient is asked to cough. If an impulse is felt this is due to increased abdominal pressure being transmitted into the hernia. In cases where the neck is tight and the hernia irreducible there may be no cough impulse. This can lead to failure of diagnosis and is typical of femoral hernia where lack of an impulse leads the clinician to misdiagnose a lymph node. Cough impulse can also occur in a saphena varix (see Chapter 57), which may be referred to a surgeon as a suspected inguinal hernia. It is not unusual for a patient to describe an intermittent swelling but the surgeon finds nothing on examination. This is due to muscle tightening in an anxious patient.

If, on lying, the hernia does not reduce spontaneously, the surgeon asks the patient to attempt reduction because he may be well practised in this task although the surgeon might cause unnecessary discomfort. If neither the patient nor the surgeon can reduce the hernia then treatment is more urgent. An irreducible hernia may influence the decision between open and laparoscopic surgery. With the hernia reduced, the surgeon assesses the size, rigidity and number of defects. Multiple defects may be present in incisional hernia.

Summary box 60.3

Checks

- Reducibility
- Cough impulse
- Tenderness
- Overlying skin colour changes
- Multiple defects/contralateral side
- Signs of previous repair
- Scrotal content for groin hernia
- Associated pathology

Summary box 60.4

Examination

- A swelling with a cough impulse is not necessarily a hernia
- A swelling with no cough impulse may still be a hernia

Investigations for hernia

For most hernias, no specific investigation is required, the diagnosis being made on clinical examination. However, the patient may have symptoms suggesting a hernia, but no hernia is found, or have a swelling suggestive of hernia but with clinical uncertainty. It is important to be certain that any symptoms described are due to a hernia and not to coexisting pathology. There may also be a requirement for more detailed information than can be found by examination alone. A plain radiograph of the abdomen is of little value (**Figure 60.5**) although a hiatus hernia and diaphragmatic hernia may be seen on a chest radiograph. An ultrasound scan may be helpful in cases of irreducible hernia, where the differential diagnosis includes a mass or fluid collection, or when the nature of the hernia content is in doubt. Ultrasonography is very useful in the early postoperative period when a haematoma or seroma may develop, and be difficult to distinguish from

Figure 60.5 A radiograph showing spiral tacks causing chronic pain after transabdominal preperitoneal repair.

an early recurrence. Ultrasonography is non-invasive and low cost but operator dependent.

Computed tomography is helpful in complex incisional hernia, determining the number and size of muscle defects, identifying the content, giving some indication of presence of adhesions and excluding other intra-abdominal pathology such as ascites, occult malignancy and portal hypertension.

Contrast barium radiology is occasionally useful in the absence of CT. Contrast may also be injected directly into the peritoneum, a herniagram, to identify an occult sac, especially in occult inguinal hernia. Magnetic resonance imaging (MRI) can help in the diagnosis of sportsman's groin where pain is the presenting feature and the surgeon needs to distinguish an occult hernia from an orthopaedic injury.

Laparoscopy itself may be used. In incisional hernia, initial laparoscopy may determine that a laparoscopic approach is feasible or not depending on the extent of adhesions. In inguinal hernia repair by the transabdominal route, initial laparoscopy can determine the presence of an occult contralateral hernia which has been described in up to 20% of patients.

Summary box 60.5

Investigations

- Plain radiograph – of little value
- Ultrasound scan – low cost, operator dependent
- CT scan – incisional hernia
- MRI – good in sportsman's groin with pain
- Contrast radiology – especially for inguinal hernia
- Laparoscopy – useful to identify occult inguinal hernia

Management principles

An abdominal wall hernia does not necessarily require repair. A patient may request surgery for relief of symptoms of discomfort, for cosmesis or to establish the diagnosis when in doubt. The surgeon should recommend repair when complications are likely, the most worrying being strangulation with bowel obstruction and bowel infarction. All cases of femoral hernia, with high risk of strangulation, should be repaired surgically. Any case of irreducible hernia, especially where there is pain and tenderness, should be offered repair unless coexisting medical factors place the patient at very high risk from surgery or anaesthesia. Increasing difficulty in reduction and increasing size are indications for surgery. Surgery should be offered to younger adult patients as symptoms and complications are likely over time.

Summary box 60.6

Management

- Not all hernias require surgical repair
- Small hernias can be more dangerous than large
- Pain, tenderness and skin colour changes imply high risk of strangulation
- Femoral hernia should always be repaired

In reality, most patients with a hernia should be offered repair. In elderly people, if the hernia is asymptomatic, small in size, can be reduced easily and is not causing anxiety, then observation alone should be sufficient. This policy, called 'watchful waiting', has been studied in asymptomatic inguinal hernia. One study reported such a policy to be safe but a second study was abandoned when a small number of patients developed strangulation. A truss can be used to control a hernia but few surgeons would recommend this approach. Small paraumbilical hernias are often seen. They cause few symptoms and usually contain fat or omentum with a very low risk of complications.

Large incisional hernias, particularly recurrent, present a major problem. Surgical repair is a complex procedure with significant risk of complications and later recurrence. When the neck is wide, the risk of strangulation is low. In obese and elderly patients, these risks may outweigh the benefits of surgery and it is common for surgeons to adopt a conservative approach.

Any patient who presents with acute pain in a hernia, particularly if it is irreducible, should be offered surgery. Often, in a patient with an irreducible hernia, after admission to hospital and adequate analgesia, the hernia will reduce due to muscle relaxation. The likelihood of similar episodes is very high and surgery should be recommended at this admission or soon after.

Surgical approaches to hernia

All surgical repairs follow the same basic principles:

1. reduction of the hernia content into the abdominal cavity with removal of any non-viable tissue and bowel repair if necessary;
2. excision and closure of a peritoneal sac if present or replacing it deep to the muscles;
3. reapproximation of the walls of the neck of the hernia if possible;
4. permanent reinforcement of the abdominal wall defect with sutures or mesh.

Reduction of hernia content is essential for a successful repair. It is rare for a surgeon to fail to reduce the hernia but extensive dissection can lead to bowel injury, sometimes requiring bowel resection with subsequent risks of infection and bowel anastomotic complications.

Excision and closure of the peritoneal sac are ideal but not essential. During laparoscopic repair of incisional hernia, surgeons will often leave the sac *in situ* after reducing the hernia contents, and simply fix a mesh over the neck to prevent recurrence. There is risk of fluid formation within the sac (seroma). This is a common complication in all forms of hernia repair. In lateral (indirect) inguinal hernia, most surgeons excise the peritoneal sac but some leading experts recommend that it be dissected from surrounding tissue and simply pushed back through the deep inguinal ring. In laparoscopic repair of inguinal hernias, surgeons simply pull the sac back into the abdominal cavity from within and do not excise it.

Closure of the abdominal wall defect is ideal but may not be possible when the defect is large or tissues are rigid. Plastic surgical techniques have been developed to 'borrow' tissue from elsewhere in order to cover large muscle defects, but usually at the cost of leaving a weak area elsewhere. Over the past 20–30 years, surgeons have realised that simple closure of a hernia defect by sutures alone leads to a high recurrence rate.

Additional reinforcement of the defect with a non-absorbable mesh is now widely practised in most hernia repairs and evidence has shown that recurrence rates have improved but recurrence still remains a problem. There is some evidence that mesh repair delays but does not prevent recurrence. With improved surgical techniques and new meshes it is hoped that recurrence after surgery will fall further. Mesh repair has become so important in hernia surgery that some understanding of mesh technology is essential for the modern surgeon.

Mesh in hernia repair

The term 'mesh' refers to prosthetic material, either a net or a flat sheet, which is used to strengthen a hernia repair. Mesh can be used:

- to bridge a defect: the mesh is simply fixed over the defect as a tension-free patch;
- to plug a defect: a plug of mesh is pushed into the defect;
- to augment a repair: the defect is closed with sutures and the mesh added for reinforcement.

A well-placed mesh should have good overlap around all margins of the defect, at least 2 cm but up to 5 cm if possible. Suturing a mesh edge to edge into the defect (inlay), with no overlap, is not recommended. Mesh plug repairs have gained some popularity in small defects especially where overlap is hard to achieve. Plug operations are fast but plugs can form a dense 'meshoma' of plug and collagen. Other complications include migration, erosion into adjacent organs, fistula formation and chronic pain.

Mesh types

The wide array of meshes available can be classified as follows.

GROSS STRUCTURE

Net meshes are woven or knitted. Flat sheets are not porous but can be perforated with multiple holes. Net meshes allow fibrous tissue in growth between the strands and becoming adherent and integrated into host tissues within a few months. Initial fixation of the mesh is by glue, sutures or staples which may be absorbable. In laparoscopic inguinal hernia, no fixation is required at all as friction is sufficient to hold the mesh. 'Sheet' meshes do not allow host tissue in growth but become encapsulated by fibrous tissue. They always require strong, non-absorbable fixation to prevent mesh migration.

SYNTHETIC MESH

Most meshes used today are synthetic polymers of polypropylene, polyester or polytetrafluoroethylene (PTFE) (Figure 60.6). They are non-absorbable and provoke little tissue reaction. Polypropylene makes a strong monofilament mesh.

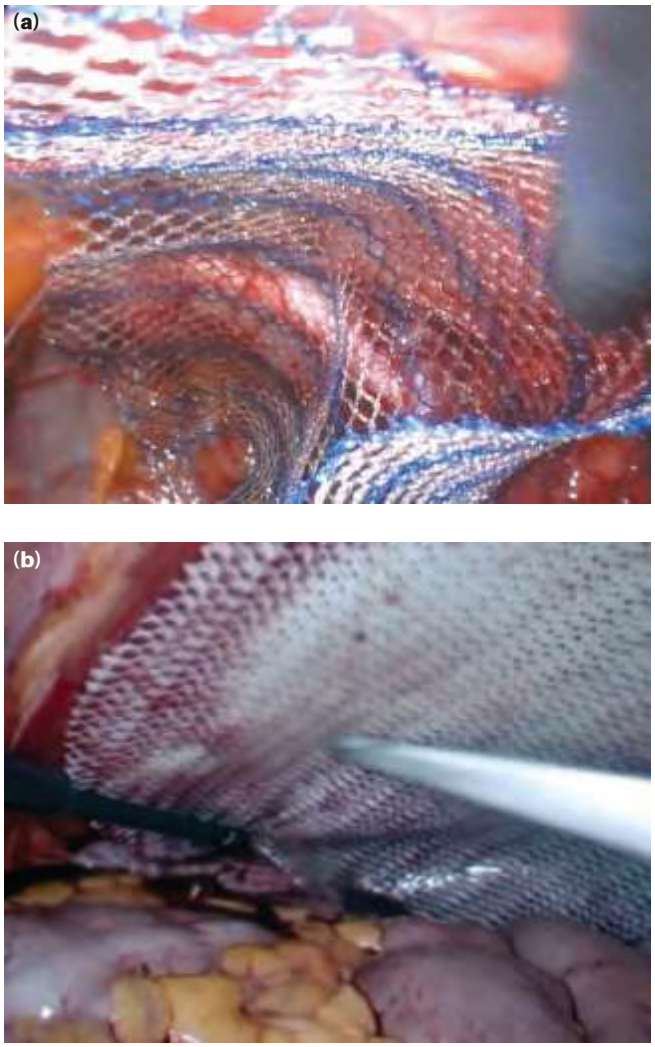

Figure 60.6 **(a)** Polypropylene mesh in totally extraperitoneal inguinal hernia repair and **(b)** polyester mesh in a paraumbilical hernia repair.

It does not have any antibacterial properties but its hydrophobic nature and monofilament microstructure impede bacterial in-growth. Polyester is a braided filament mesh. This structure may allow infection to take hold, aided by its hydrophilic property. However, this property also allows rapid vascular and cellular infiltration within the fibrils, aiding host immune responses to infection and providing a stronger host–tissue interface. PTFE meshes are flat sheets and as a result do not allow any tissue in-growth. They are used as a non-adhesive barrier between tissue layers.

WEIGHT AND POROSITY

Synthetic meshes are very strong and early meshes were much stronger than a human abdominal wall, so they are considered as 'over-engineered'. All meshes provoke a fibrous reaction. More dense or heavyweight meshes provoke a greater reaction, leading to collagen contraction and stiffening. The term 'mesh shrinkage' is often used to describe a progressive decrease in size of a mesh over time. It is due to natural contraction of fibrous tissue embedded in the mesh, reducing the

area of mesh itself. This can lead to tissue tension and pain, a common complication of mesh repair. It can also lead to hernia recurrence if the mesh no longer covers the defect. Meshes can shrink by up to 50% and, in occasional cases, even more. Meshes with thinner strands and larger spaces between them, 'lightweight, large-pore meshes', are preferred because they have better tissue integration, less shrinkage, more flexibility and improved comfort.

The terms 'light', 'medium' and 'heavy' are not precisely defined but meshes <40 g/m^2 are generally referred to as light and meshes >80 g/m^2 as heavy.

BIOLOGICAL MESH

There are 'biological meshes' that are sheets of sterilised, decellularised, non-immunogenic connective tissue. They derive from human or animal dermis, bovine pericardium or porcine intestinal submucosa. They provide a 'scaffold' to encourage neovascular in-growth and new collagen deposition. Host enzymes eventually break down the biological implant, which is replaced and remodelled with 'normal' host fibrous tissue. The rates of enzymatic degradation and collagen deposition vary between products and also depend on the local environment of the mesh. In the presence of infection, some biological meshes rapidly break down and weaken before remodelling can occur. Others remain strong, their labyrinthine microstructure allowing vascular in-growth to aid infection resistance. The choice of biological mesh depends on the clinical situation for which it is to be used. They are expensive.

ABSORBABLE MESHES

There are also synthetic absorbable meshes, such as those made from polyglycolic acid fibre. They are used in temporary abdominal wall closure and to buttress sutured repairs. They have no current role in hernia repair because they absorb and induce minimal collagen deposition.

TISSUE-SEPARATING MESHES

Most meshes induce fibrosis and, if placed within the peritoneal cavity, promote unwanted adhesions. New meshes have been designed for intraperitoneal use. Most of these have very different surfaces, one being sticky and one slippery. Good adherence and host–tissue in-growth is required on the parietal (muscle) side of the mesh, but the opposite (bowel) side needs to prevent adhesions to bowel. Usually one side of the mesh is coated by material that prevents adhesions (**Figure 60.7**), such as polycellulose, collagen, PTFE. A recent mesh made entirely of a sheet of condensed PTFE with multiple perforations can be used intraperitoneally because the peritoneum will grow in through its perforations whereas bowel will not adhere to its inside.

Figure 60.7 Adhesions to mesh.

Summary box 60.7

Mesh characteristics

- Woven, knitted or sheet
- Synthetic or biological – mainly synthetic
- Light, medium or heavyweight – lightweight becoming more popular
- Large pore, small pore – large pore causes less fibrosis and pain
- Intraperitoneal use or not – non-adhesive mesh on one side
- Non-absorbable or absorbable – mainly non-absorbable

Positioning the mesh

The strength of a mesh repair depends on host–tissue in-growth. Meshes should be placed on a firm, well-vascularised tissue bed with generous overlap of the defect. The mesh can be placed:

- just outside the muscle in the subcutaneous space (onlay);
- within the defect (inlay) – only applies to mesh plugs in small defects;
- between fascial layers in the abdominal wall (intraparietal or sublay);
- immediately extraperitoneally, against muscle or fascia (also sublay);
- intraperitoneally.

At open surgery all of these planes are used but laparoscopic surgeons currently use only intraperitoneal or extraperitoneal planes (**Figure 60.8**).

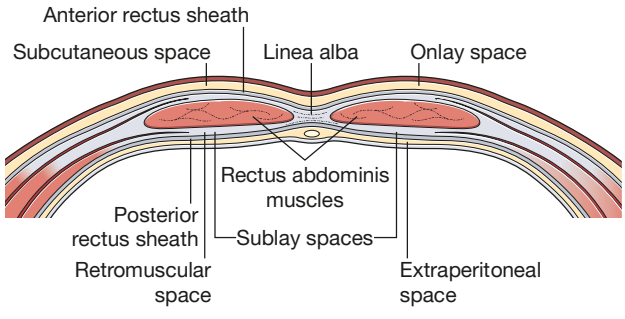

Figure 60.8 Diagrammatic representation of the various layers into which meshes are placed in ventral hernia repair.

Limitations to the use of mesh

The presence of infection limits the use of mesh, particularly heavyweight types. If a mesh becomes infected then it often needs to be removed. Some infected meshes can be salvaged using a combination of debridement of non-incorporated mesh, appropriate antibiotics and modern vacuum-assisted dressings.

Meshes are expensive, especially those for intraperitoneal use, but prices are falling and there are reports of low-cost solutions such as mosquito netting!

SPECIFIC HERNIA TYPES

Hernia sites are shown in **Figure 60.9**.

Inguinal hernia

The inguinal hernia, often referred to as a 'rupture' by patients, is the most common hernia in men and women but much more common in men. There are two basic types that are fundamentally different in anatomy, causation and complications. However, they are anatomically very close to each other, surgical repair techniques are very similar and ultimate reinforcement of the weakened anatomy is identical, so they are often referred to together as inguinal hernia.

Summary box 60.8

Inguinal hernia

- Types – lateral (oblique, indirect); medial (direct), sliding
- Origin – congenital or acquired
- Anatomy – inguinal canal
- Classification – latest European Hernia Society
- Diagnosis – usually clinical but radiological in special circumstances
- Surgery – open and laparoscopic

The congenital inguinal hernia is known as indirect, oblique or lateral whereas the acquired hernia is called direct or medial. There is a third 'sliding' hernia that is acquired but is lateral in position (see below).

Basic anatomy of the inguinal canal

As the testis descends from the abdominal cavity to the scrotum in males it firsts passes through a defect called the deep inguinal ring in the transversalis fascia, just deep to the abdominal muscles. This ring lies midway between the anterior superior iliac spine and the pubic tubercle, approximately 2–3 cm above the femoral artery pulse in the groin. The inferior epigastric vessels lie just medial to the deep inguinal ring, passing from the iliac vessels to rectus abdominis. Muscle fibres of the innermost two layers of the lateral abdominal wall, the transversus muscle and the internal oblique muscle, arch over the deep inguinal ring from lateral to medial before descending to become attached to the pubic tubercle. These two muscles fuse and become tendinous, hence this arch is referred to as the conjoint tendon. Below this arch there is no muscle but only transversalis fascia and external oblique aponeurosis, resulting in weakness (**Figure 60.10**).

The testis proceeds medially and downwards along the inguinal canal. Anterior to the canal is the aponeurosis of the external oblique muscle, the fibres of which run downwards and medially. The testis finally emerges through a V-shaped defect in the aponeurosis, the superficial inguinal ring, and descends into the scrotum. The inguinal canal is roofed by the conjoint tendon, its posterior wall is transversalis fascia, an anterior wall is the external oblique aponeurosis and a floor, which is also the external oblique, that rolls inwards at its lower margin and thickens to become the inguinal (Poupart's) ligament. The inguinal canal in males contains the testicular artery, veins, lymphatics and the vas deferens. In females, the round ligament descends through the canal to end in the vulva. Three important nerves, the ilioinguinal, the iliohypogastric and the genital branch of the genitofemoral nerve, also pass through the canal.

As the testis descends, a tube of peritoneum is pulled with the testis and wraps around it ultimately to form the tunica vaginalis. This peritoneal tube should obliterate, possibly under hormonal control, but it commonly fails to fuse either in part or totally. As a result, bowel within the peritoneal cavity is able to pass inside the tube down towards the scrotum. Inguinal hernia in neonates and young children is always of this congenital type. However, in other patients, the muscles around the deep inguinal ring can prevent a

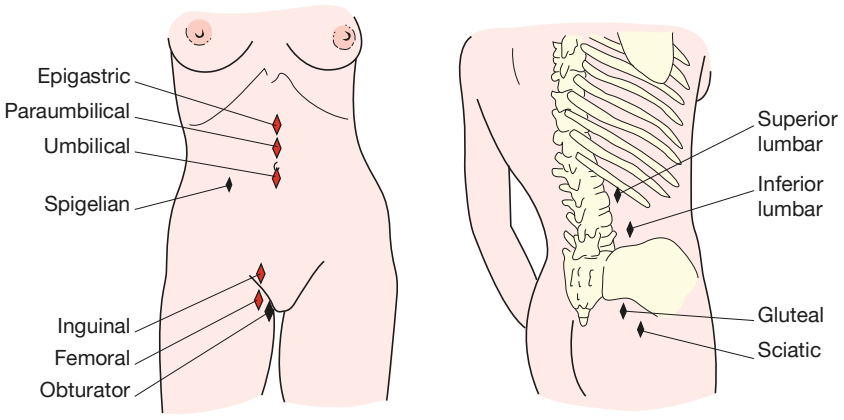

Figure 60.9 Diagram to show the sites of abdominal wall hernias, common in red and rare in black. Incisional and parastomal hernias can be found at various sites.

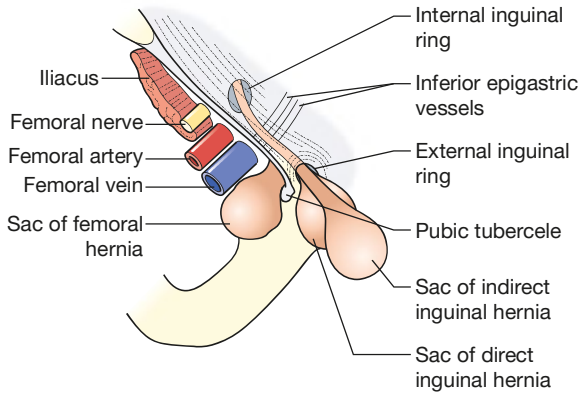

Figure 60.10 The close relationships of direct inguinal, indirect inguinal and femoral hernias.

Figure 60.11 A huge scrotal hernia that has descended into the scrotum. The overlying skin has become gangrenous and sloughed away (courtesy of Dr Anupam Rai, Jabalpur, India).

hernia from developing until later in life, when, under the constant positive abdominal pressure, the deep inguinal ring and muscles are stretched and a hernia becomes apparent. As the hernia increases in size, the contents are directed down into the scrotum. These hernias can become massive and may be referred to as a scrotal hernia (Figure 60.11).

An indirect hernia is lateral because its origin is lateral to the inferior epigastric vessels. It is also oblique as the hernia passes obliquely from lateral to medial through the abdominal muscle layers.

The second type of inguinal hernia, referred to as direct or medial, is acquired. It is a result of stretching and weakening of the abdominal wall just medial to the inferior epigastric (IE) vessels. Looked at from within the abdominal cavity, there is a triangle referred to as Hasselbach's triangle, the three sides of which are the IE vessels laterally, the lateral edge of rectus abdominis medially and the pubic bone below (the iliopubic tract) (Figure 60.12). This area is weak because the abdominal wall here consists of only transversalis fascia covered by the external oblique aponeurosis. A direct, medial hernia is more likely in elderly patients. It is broadly based and therefore unlikely to strangulate. The medially placed bladder can be pulled into a direct hernia (Figure 60.13).

The third type of inguinal hernia is referred to as a sliding hernia. This is also an acquired hernia due to weakening of the abdominal wall, but occurs at the deep inguinal ring lateral to the IE vessels. Retroperitoneal fatty tissue is pushed downwards along the inguinal canal. As more tissue enters the hernia, peritoneum is pulled with it, thus creating a sac. However, the sac has formed secondarily, distinguishing it from a classic indirect hernia. On the left side, sigmoid colon may be pulled into a sliding hernia and on the right side the caecum. Surgeons need extra caution during repair because the wall of the large bowel may not be covered by peritoneum and can be damaged.

Occasionally, both lateral and medial hernias are present in the same patient (pantaloon hernia).

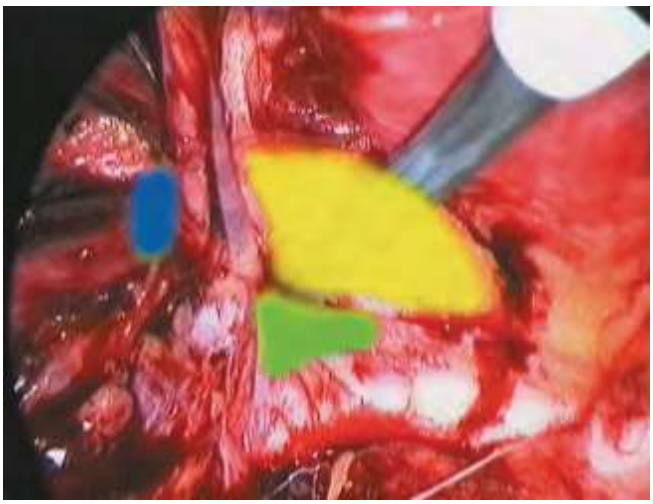

Figure 60.12 Laparoscopic view of the posterior inguinal region with hernia defects highlighted: yellow, medial inguinal; blue, lateral inguinal; green, femoral.

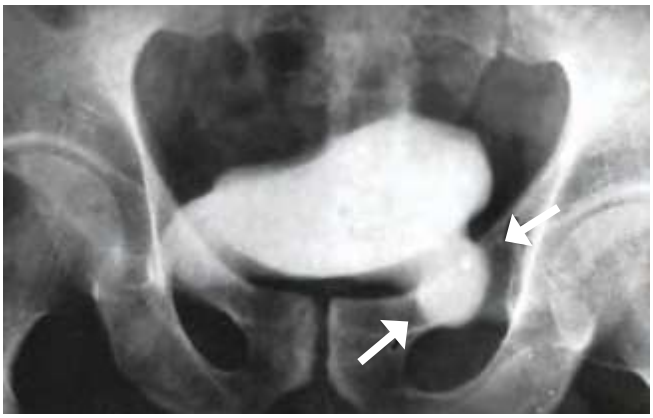

Figure 60.13 This cystogram shows the urinary bladder, part of which has descended into a left direct inguinal hernia (arrows).

Classification

Many surgeons over the past 100 years have attempted to classify inguinal (and femoral) hernias, including Casten, Halverson and McVay, Zollinger, Ponka, Gilbert and Nyhus. The European Hernia Society has recently suggested a simplified system of:

- primary or recurrent (P or R);
- lateral, medial or femoral (L, M or F);
- defect size in fingerbreadths assumed to be 1.5 cm.

A primary, indirect, inguinal hernia with a 3-cm defect size would be PL2.

Diagnosis of an inguinal hernia

In most cases, the diagnosis of an inguinal hernia is simple and patients often know their diagnosis because they are so common. Usually these hernias are reducible presenting as intermittent swellings, lying above and lateral to the pubic tubercle, with an associated cough impulse. Often the hernia will reduce on lying and reappear on standing. With the patient lying down, the patient is asked to reduce the hernia if it has not spontaneously reduced. If the patient cannot then the surgeon gently attempts to reduce the hernia. Once reduced, the surgeon identifies the bony landmarks of the anterosuperior iliac spine and pubic tubercle to landmark the deep inguinal ring at the mid-inguinal point. Gentle pressure is applied at this point and the patient asked to cough. If the hernia is controlled with pressure on the deep inguinal ring then it is likely to be indirect/lateral and if the hernia appears medial to this point then it is direct/medial. Other examination techniques have been suggested but even experienced surgeons find it difficult to distinguish lateral and medial hernias with certainty (Figure 60.14).

Figure 60.14 Oblique left inguinal hernia that became apparent when the patient coughed and persisted until it was reduced when he lay down.

Diagnostic difficulties

Confirmation of the diagnosis may not be possible when the patient describes an intermittent swelling but nothing is found on examination. Surgeons will often accept the diagnosis on history alone but re-examination at a later date or investigation by ultrasound scan may be requested.

If an inguinal hernia becomes irreducible and tense there may be no cough impulse. Differential diagnosis would include a lymph node groin mass or an abdominal mass (Figure 60.15). Such cases require urgent investigation by either ultrasonography or CT.

Large scrotal hernias may be misdiagnosed as a hydrocele or other testicular swelling. The surgeon should be able to identify the upper limit of a scrotal swelling but a large scrotal hernia has no upper limit because it extends back along the inguinal canal to the peritoneal cavity. In cases of doubt, ultrasonography should establish the diagnosis.

As inguinal hernia is so common, less-experienced clinicians might suggest this diagnosis when referring cases of femoral hernia or spigelian hernia. Also patients with a saphena varix may present with a swelling that increases in size on standing and with a definite cough impulse and be misdiagnosed as a hernia. The same can be true for a varicocele.

It is essential to examine the scrotal contents to exclude other pathologies and to check that the patient has two testes. It is important to examine the opposite side because contralateral hernia is common. Even if the contralateral side is weak, then bilateral repair should be recommended because the risk of contralateral recurrence is high. Of all patients 10% will present with bilateral inguinal hernias and up to 20% more will have an occult contralateral hernia on laparoscopic evaluation. A patient with a single hernia has a lifetime 33% risk of developing a hernia on the other side. Some surgeons have suggested that all patients should be offered bilateral repair, especially if laparoscopic surgery is planned, but this is not widespread practice at present.

Figure 60.15 Malignant mass of nodes.

Investigations for inguinal hernia

Most cases require no diagnostic tests but ultrasonography, CT and MRI are occasionally used. A herniogram involves the injection of contrast into the peritoneal cavity followed by screening which shows the presence of a sac or asymmetrical bulging of the inguinal anatomy.

Management of inguinal hernia

It is safe to recommend no active treatment in cases of early, asymptomatic, direct hernia, particularly in elderly patients who do not wish for surgical intervention. These patients should be warned to seek early advice if the hernia increases in size or becomes symptomatic. Surgical trusses are not recommended but may be required for occasional patients who refuse any form of surgical intervention.

Elective surgery for inguinal hernia is a common and simple operation. It can be undertaken under local, regional or general anaesthesia with minimal risk, even in high-risk patients.

HERNIOTOMY

In children who have lateral hernias with a persistent processus, it is sufficient just to remove and close the sac. This is called a herniotomy. In adult surgery, herniotomy alone has a high recurrence rate and some form of muscle strengthening is added (herniorrhaphy).

OPEN SUTURE REPAIR

In 1890, Eduardo Bassini described suture repair for inguinal hernia (**Figure 60.16**). This was a massive leap forward and has been the basis of open repair for over 100 years. The surgeon enters the inguinal canal by opening its anterior wall, the external oblique aponeurosis. The spermatic cord is dissected free and the presence of a lateral or a medial hernia is confirmed. The sac of a lateral hernia is separated from the cord, opened and any contents reduced. The sac is then sutured closed at its neck and excess sac removed. If there is a medial hernia then it is inverted and the transversalis fascia is suture plicated. Sutures are now placed between the conjoint tendon above and the inguinal ligament below, extending from the pubic tubercle to the deep inguinal ring. The posterior wall of the inguinal canal is thus strengthened.

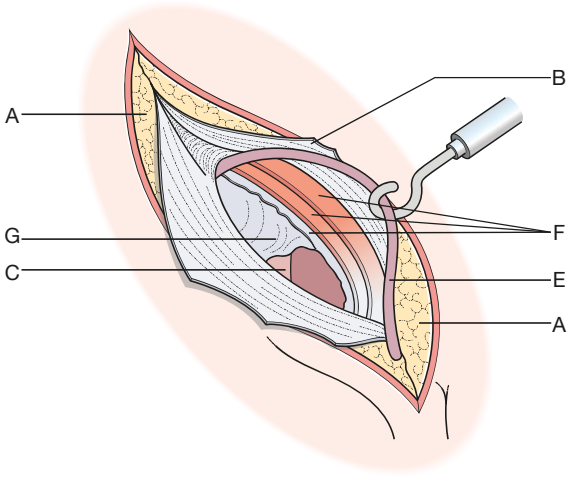

Figure 60.16 Bassini's original diagram. A, subcutaneous fat; B, external oblique; C, iliac vein; E, spermatic cord; F, nerves in inguinal canal; G, transversalis fascia.

Over 150 modifications to Bassini's operation have been described with little or no benefit except for the Shouldice modification. In this operation, the transversalis fascia is opened by a central incision from the deep inguinal ring to the pubic tubercle and then closed to create a double-thick, two-layered posterior wall (double breasting). The external oblique is closed in similar fashion. Expert centres have reported lifetime failure rates of less than 2% after Shouldice repair but it is a technically demanding operation which, in general hands, gives results identical to Bassini's repair.

Today, when a Bassini-type operation is done, most surgeons use a continuous, non-absorbable nylon or polypropylene suture which is darned between the conjoint tendon and inguinal ligament. This operation was described by Maloney, and recently published large randomised trials have reported excellent results when compared with mesh techniques. It is the most common operation performed in countries where mesh is too expensive.

Suture repair is still under development and, recently, Desarda has described an operation where a 1- to 2-cm strip of external oblique aponeurosis lying over the inguinal canal is isolated from the main muscle, but left attached both medially and laterally. It is then sutured to the conjoint tendon and inguinal ligament, reinforcing the posterior wall of the inguinal canal. As the abdominal muscles contract, this strip of aponeurosis tightens to add further physiological support to the posterior wall. This operation is currently being evaluated.

OPEN FLAT MESH REPAIR

Synthetic mesh has been used since the 1950s to reinforce hernia repair, and in the 1980s Lichtenstein described a tension-free, simple, flat, polypropylene mesh repair for inguinal hernia (**Figure 60.17**). The initial part of the operation is identical to Bassini's. Once the hernia sac has been removed and any medial defect closed, a piece of mesh, measuring 8 × 15 cm, is placed over the posterior wall, behind the spermatic cord, and is split to wrap around the spermatic cord at the deep inguinal ring. Loose sutures hold the mesh to the inguinal ligament and conjoint tendon. Two major advantages are claimed: lowered hernia recurrence rates and accelerated postoperative recovery. Randomised trials show that hernia recurrence within the first 2 years is lowered but acute pain scores are similar. Recent research comparing Lichtenstein's repair with laparoscopic surgery has identified chronic pain as the most common complication of open flat mesh repair with rates reported as high as 20%. Nevertheless, today, Lichtenstein's repair is the most common operation for inguinal hernia in resource-rich countries.

Eduardo Bassini, 1844–1924, Professor of Surgery, Padua, Italy, described this method of herniorraphy in 1889.

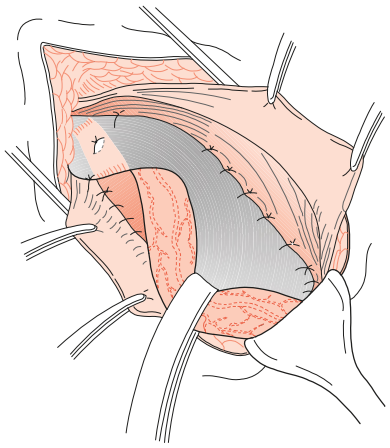

Figure 60.17 Lichtenstein's repair.

OPEN PLUG/DEVICE/COMPLEX MESH REPAIR

Surgeons and industry have been highly creative, attempting to improve on simple flat mesh repair. A surgeon in Europe has over 200 different products and techniques from which to choose. Shaped mesh plugs have gained much attention, being simple to insert into the defect and requiring little if any fixation. However, they can become solid (meshoma) and also migrate. Meshes have been designed to be placed beneath the transversalis fascia. The surgeon introduces a finger through the deep inguinal ring and bluntly (and blindly) opens the preperitoneal space deep to the inguinal canal into which a mesh is inserted. A two-layered mesh ('hernia system'), in which the inner layer is placed deep to transversalis fascia and the outer layer superficial to it, is also gaining popularity. To date, there is little evidence to show that any of these techniques is superior to Lichtenstein's operation.

OPEN PREPERITONEAL REPAIR

This approach was first described by Annandale in 1880, but was largely discarded until the 1950s when Stoppa, a French surgeon, described it with mesh reconstruction. It is useful when multiple attempts at open standard surgery have failed and the hernia(s) keeps recurring. It may now be superseded by the totally extraperitoneal laparoscopic approach, which is modelled on Stoppa's operation and first described by Ger, also French.

LAPAROSCOPIC INGUINAL HERNIA REPAIR

Two techniques are described and have been extensively studied in randomised trials. The totally extraperitoneal (TEP) approach is more widely used than the transabdominal preperitoneal (TAPP) approach. In both, the aim of surgery is to reduce the hernia and hernia sac within the abdomen, and then place a 10 × 15 cm mesh just deep to the abdominal wall, extending across the midline into the retropubic space and 5 cm lateral to the deep inguinal ring. The mesh covers Hasselbach's triangle, the deep inguinal ring and the femoral canal. In TEP, the surgeon is able to create a space just deep to the abdominal muscles without entering the peritoneal cavity whereas, in TAPP, the surgeon enters the peritoneal cavity then incises the peritoneum above the hernia defects, and reflects it away from the muscles, essentially entering the same space as in TEP. Once the hernia has been reduced, an identical mesh is inserted and the peritoneum closed over the mesh (**Figures 60.18 and 60.19**).

Over 60 randomised trials have compared laparoscopic surgery with Lichtenstein's repair. They show that, although the laparoscopic operation takes longer to perform, proven advantages are reduced pain both after surgery and up to 5 years later, more rapid return to full activity, and the reduced incidence of the wound complications of infection, bleeding and seroma. Laparoscopic surgery is of particular benefit in bilateral cases and in patients with hernia recurrence after open surgery. National statistics show that the proportion of cases performed laparoscopically is slowly rising, but all agree that there is a slow learning curve associated with these technically demanding operations.

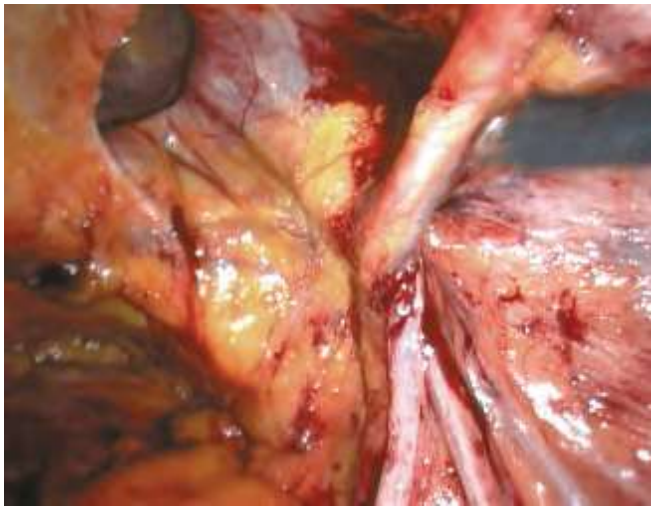

Figure 60.18 Right/medial direct hernia – laparoscopic view. Note the medial (direct) defect upper left, the inferior epigastric vessels upper right and the structures of the spermatic cord lower right.

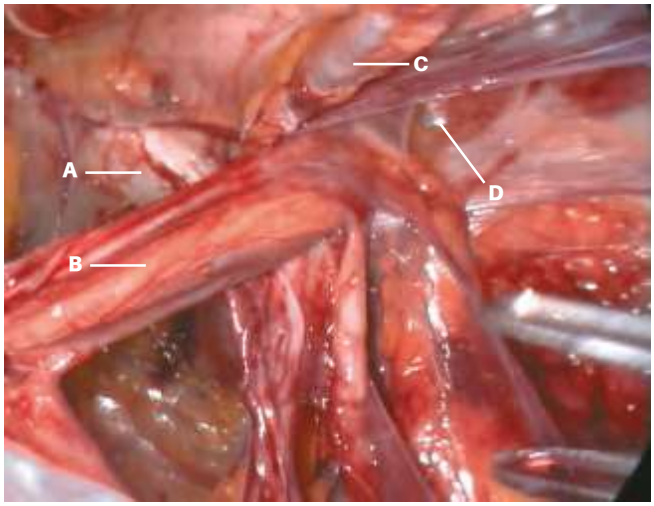

Figure 60.19 Right/lateral indirect hernia – laparoscopic view. A, arch of pubic bone; B, vas deferens and testicular vessels retracted medially; C, inferior epigastric vessels; D, deep inguinal ring (hernia defect).

Summary box 60.9

Operations for inguinal hernia

- Herniotomy
- Open suture repair
  - Bassini
  - Shouldice
  - Desarda
- Open flat mesh repair
  - Lichtenstein
- Open complex mesh repair
  - Plugs
  - Hernia systems
- Open preperitoneal repair
  - Stoppa
- Laparoscopic repair
  - TEP
  - TAPP

EMERGENCY INGUINAL HERNIA SURGERY

Of inguinal hernia patients 95% present at clinics and only 5% as an emergency with a painful irreducible hernia that may progress to strangulation and possible bowel infarction. The morbidity and mortality of emergency inguinal hernia surgery are high and surgery needs to be performed rapidly in a well-resuscitated patient with adequate postoperative high dependency or intensive care if necessary. The principles of surgery are the same as in an elective setting. Open surgery is preferred when a hernia is irreducible or if there is any risk of bowel resection. Infection may complicate these cases but most surgeons would still use a lightweight, synthetic mesh repair covered by appropriate antibiotics.

COMPLICATIONS OF INGUINAL HERNIA SURGERY

Despite this being a common procedure and technically straightforward, postoperative complications are common. Immediate complications include bleeding (which may be due to accidental damage to the inferior epigastric or iliac vessels) and urinary retention that may require catheterisation. Occasional over-enthusiastic infusion of local anaesthetic may lead to femoral nerve blockade, the patient being unable to move a leg. This usually resolves over 12 hours but is alarming.

Over the next week, seroma formation and wound infection may occur. Seroma is due to an excessive inflammatory response to sutures or mesh and cannot be prevented. In most cases the fluid resolves spontaneously but may require aspiration. After laparoscopic surgery, a seroma may be misdiagnosed as an early recurrence. Wound infection is not uncommon. Many surgeons use routine prophylactic antibiotics but recent studies suggest little benefit even when mesh is used.

In the longer term, hernia recurrence and chronic pain are the main concerns. No operation can be guaranteed to be recurrence free. Evidence shows that mesh repairs have lower recurrence rates than suture repairs, but there is no difference between the various mesh repairs and no difference between open and laparoscopic surgery. There is very strong evidence that specialist hernia surgeons will have lower recurrence rates whatever technique they use.

Chronic pain, defined as pain present 3 months after surgery, is common after all forms of surgery. It is less common and less severe after laparoscopic surgery. Different types of pain have been described but the most severe is neuralgic pain due to nerve irritation. This may be the result of nerve injury at the time of operation or chronic irritation of nerves by suture material or mesh. Careful identification and protection of all three nerves passing along the inguinal canal reduces the incidence of neuralgic pain. This type of pain is also very uncommon after laparoscopic surgery that is performed at a deeper level away from the nerves. Some contribution to chronic pain may be due to the mesh, which can become embedded in a dense collagenous reaction with shrinkage. This causes tissue tension and rigidity.

Rarely, damage to the testicular artery can lead to testicular infarction, perhaps the most serious complication of inguinal hernia surgery. There is no good evidence that hernia surgery has an effect on male fertility despite extensive study in this area.

Summary box 60.10

Complications

- Early pain, bleeding, urinary retention, anaesthetic related
- Medium seroma, wound infection
- Late chronic pain, testicular atrophy

Sportsman's hernia

This specific entity is well described and presents as severe pain in the groin area, extending into the scrotum and upper thigh. It is almost entirely restricted to young men who play contact sports such as football and rugby. The pain can be debilitating and prevent the patient from exercising. On examination there may be some tenderness in the region of the inguinal canal, over the pubic tubercle, and over the insertion of the thigh adductor muscles. Usually no hernia can be felt and only occasionally can a true inguinal hernia be found.

In most cases, the pain is due to an orthopaedic injury, such as adductor strain or pubic symphasis diastasis. However, some believe that it can be due to muscle tearing (Gilmore's groin) or stretching of the posterior wall of the inguinal canal. Other causes of pain should be excluded, such as hip, pelvic or lumbar spinal disease and bladder/prostate problems. MRI is most likely to detect an orthopaedic problem but ultrasonography, herniography or even laparoscopy may be used.

There are many anecdotal reports of successful treatment using all types of inguinal hernia surgery, suture and mesh, open and laparoscopic, but no randomised trials. Hernia surgery should be a last resort and the patient warned of a significant risk of failure to cure the pain.

Femoral hernia

Basic anatomy

The iliac artery and vein pass below the inguinal ligament to become the femoral vessels in the leg. The vein lies

medially and the artery just lateral to the artery with the femoral nerve lateral to the artery. They are enclosed in a fibrous sheath. Just medial to the vein is a small space containing fat and some lymphatic tissue (node of Cloquet). It is this space which is exploited by a femoral hernia. The walls of a femoral hernia are the femoral vein laterally, the inguinal ligament anteriorly, the pelvic bone covered by the iliopectineal ligament (Astley Cooper's) posteriorly and the lacunar ligament (Gimbernat's) medially. This is a strong curved ligament with a sharp unyielding edge which impedes reduction of a femoral hernia (Figure 60.20).

The female pelvis has a different shape to the male, increasing the size of the femoral canal and the risk of hernia. In old age, the femoral defect increases and femoral hernia is commonly seen in low-weight, elderly women. There is a substantial risk of developing a femoral hernia after a sutured inguinal hernia repair (Denmark Hernia Registry).

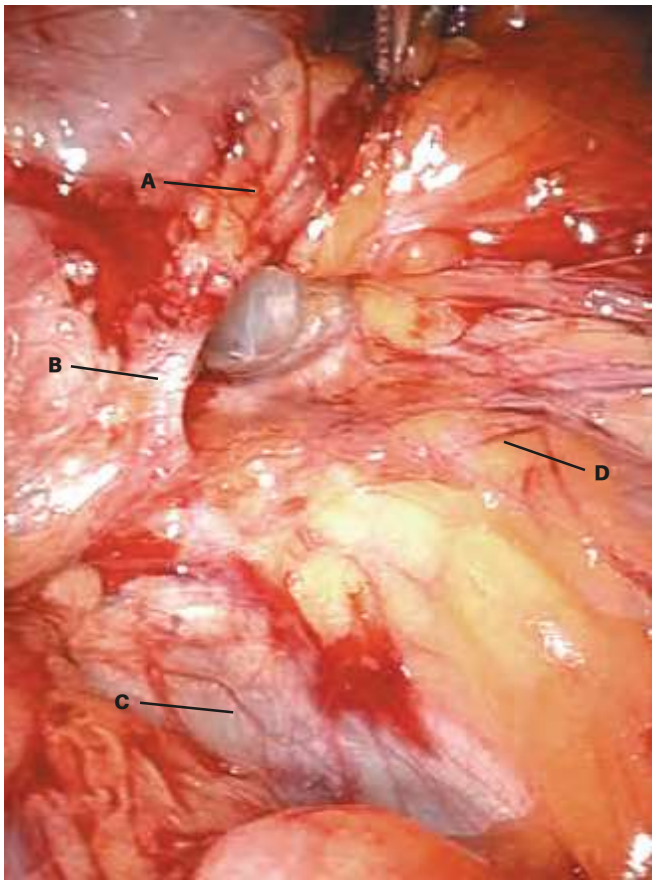

Figure 60.20 Right femoral hernia – laparoscopic view. The slightly oblique inguinal ligament can be seen superolaterally above the defect. The external iliac vein is not seen. A, Inguinal ligament; B, lacunar ligament; C, arch of pubic bone; D, fatty tissue overlying iliac vessels.

Summary box 60.11

Femoral hernia

- Less common than inguinal hernia
- It is more common in women than in men
- Easily missed on examination
- Of cases 50% present as an emergency with very high risk of strangulation

Diagnosis of femoral hernia

Diagnostic error is common and often leads to delay in diagnosis and treatment. The hernia appears below and lateral to the pubic tubercle and lies in the upper leg rather than in the lower abdomen. Inadequate exposure of this area during routine examination leads to failure to detect the hernia. The hernia often rapidly becomes irreducible and loses any cough impulse due to the tightness of the neck. It may only be 1–2 cm in size and can easily be mistaken for a lymph node. As it increases in size, it is reflected superiorly and becomes difficult to distinguish from a medial direct hernia, which arises only a few centimetres above the femoral canal. A direct inguinal hernia leaves the abdominal cavity just above the inguinal ligament and a femoral hernia just below (Figure 60.21).

Figure 60.21 The patient has a left femoral and a right inguinal hernia.

Summary box 60.12

Differential diagnosis

- Direct inguinal hernia
- Lymph node
- Saphena varix
- Femoral artery aneurysm
- Psoas abscess
- Rupture of adductor longus with haematoma

Jules Germain Cloquet, 1790–1883, Professor of Anatomy and Surgery, Paris, France.
Sir Astley Paston Cooper, 1768–1841, surgeon, Guy's Hospital, London, UK, received a baronetcy and 1000 guineas for successfully removing an infected wen from the head of King George IV at Brighton in 1821.
Manoel Louise Antonio don Gimbernat, 1734–1816, Professor of Anatomy, Barcelona, Spain and later Director of the Royal College of Surgeons in Spain.

Investigations

In routine cases, no specific investigations are required. However, if there is uncertainly then ultrasonography or CT should be requested. In the emergency patient, bowel obstruction usually occurs and a plain radiograph is likely to show small bowel obstruction. All patients with unexplained small bowel obstruction should undergo careful examination for a femoral hernia. It is now common to perform CT scanning in cases of bowel obstruction primarily to exclude malignancy, but it can identify an obstructing femoral hernia missed by clinicians.

Surgery for femoral hernia

There is no alternative to surgery for femoral hernia and it is wise to treat such cases with some urgency. There are three open approaches and appropriate cases can be managed laparoscopically.

LOW APPROACH (LOCKWOOD)

This is the simplest operation for a femoral hernia but suitable only when there is no risk of bowel resection. It can easily be performed under local anaesthesia. A transverse incision is made over the hernia. The sac of the hernia is opened and its contents reduced. The sac is also reduced and non-absorbable sutures are placed between the inguinal ligament above and the fascia overlying the bone below. A small incision can be made in the medial lacunar ligament to aid reduction but there may be an abnormal branch of the obturator artery just deep to it, which can bleed. The femoral vein, lateral to the hernia, needs to be protected. Some surgeons place a mesh plug into the hernia defect for further reinforcement.

THE INGUINAL APPROACH (LOTHEISSEN)

The initial incision is identical to that of Bassini's or Lichtenstein's operation into the inguinal canal. The spermatic cord (or round ligament) is mobilised and the transversalis fascia opened from deep inguinal ring to the pubic tubercle. A femoral hernia lies immediately below this incision and can be reduced by a combination of pulling from above and pushing from below. If necessary, the peritoneum can be opened to help with reduction. Once reduced, the neck of the hernia is closed with sutures or a mesh plug, protecting the iliac vein throughout. The layers are closed as for inguinal hernia and the surgeon may place a mesh into the inguinal canal to protect against development of an inguinal hernia.

Some surgeons believe that exploration of the femoral canal to exclude a hernia should be a routine part of inguinal hernia surgery but most surgeons do not do this.

HIGH APPROACH (McEVEDY)

This more complex operation is ideal in the emergency situation where the risk of bowel strangulation is high. It requires regional or general anaesthesia. A horizontal incision (classically vertical) is made in the lower abdomen centred at the lateral edge of the rectus muscle. The anterior rectus sheath is incised and the rectus muscle displaced medially. The surgeon proceeds deep to the muscle in the preperitoneal space. The femoral hernia is reduced and the sac opened to allow careful inspection of the bowel, and a decision made regarding the need for bowel resection. This is performed if necessary. In dubious cases, the bowel is replaced into the peritoneal cavity for 5 minutes and then re-examined. The femoral defect is then closed with sutures, mesh or plug. This approach allows a generous incision to be made in the peritoneum, which aids inspection of the bowel and facilitates bowel resection.

LAPAROSCOPIC APPROACH

Both the TEP and TAPP approaches can be used for a femoral hernia and a standard mesh inserted. This is ideal for reducible femoral hernias presenting electively, but not for emergency cases or irreducible hernia.

VENTRAL HERNIA

This term refers to hernias of the anterior abdominal wall. Inguinal and femoral hernias are not included even though they are ventral. Lumbar hernia is included despite being dorsolateral. The European Hernia Society classification (2009) distinguished primary ventral from incisional hernia but did not include parastomal hernia. We have included parastomal hernia and traumatic hernia.

Summary box 60.13

Ventral hernias

- Umbilical–paraumbilical
- Epigastric
- Incisional
- Parastomal
- Spigelian
- Lumbar
- Traumatic

Umbilical hernia

The umbilical defect is present at birth but closes as the stump of the umbilical cord heals, usually within a week of birth. This process may be delayed, leading to the development of herniation in the neonatal period. The umbilical ring may also stretch and reopen in adult life.

Charles Barrett Lockwood, 1856–1914, surgeon, St Bartholomew's Hospital, London, UK.
George Lotheissen, 1868–1941, surgeon, the Kaiser Franz Joseph Hospital, Vienna, Austria, described this operation in 1898.
Peter George McEvedy, 1890–1951, surgeon, Ancoats Hospital, Manchester, UK.

Umbilical hernia in children

This common condition occurs in up to 10% of infants, with a higher incidence in premature babies. The hernia appears within a few weeks of birth and is often symptomless, but increases in size on crying and assumes a classic conical shape. Sexes are equally affected but the incidence in black infants is up to eight times higher than in white. Obstruction and/or strangulation is extremely uncommon below the age of 3 years.

TREATMENT

Conservative treatment is indicated under the age of 2 years when the hernia is symptomless. Parental reassurance is all that is necessary. Of hernias 95% will resolve spontaneously. If the hernia persists beyond the age of 2 years it is unlikely to resolve and surgical repair is indicated.

SURGERY

A small curved incision is made immediately below the umbilicus. The neck of the sac is defined, opened and any contents are returned to the peritoneal cavity. The sac is closed and redundant sac excised. The defect in the linea alba is closed with interrupted sutures.

Summary box 60.14

Umbilical hernia in children

- Common in infants and most resolve spontaneously
- Rarely strangulate

Umbilical hernia in adults

Conditions that cause stretching and thinning of the midline raphe (linea alba), such as pregnancy, obesity and liver disease with cirrhosis, predispose to reopening of the umbilical defect. In adults, the defect in the median raphe is immediately adjacent to (most often above) the true umbilicus, although at operation this is indistinguishable. The term 'paraumbilical hernia' is commonly used. The defect is rounded with a well-defined fibrous margin. Small umbilical hernias often contain extraperitoneal fat or omentum. Larger hernias can contain small or large bowel but, even when very large, the neck of the sac is narrow compared with the volume of its contents. As a result, in adults, umbilical hernias that include bowel are prone to become irreducible, obstructed and strangulated.

CLINICAL FEATURES

Patients are commonly overweight with a thinned and attenuated midline raphe. The bulge is typically slightly to one side of the umbilical depression, creating a crescent-shaped appearance to the umbilicus (**Figure 60.22**). Women are affected more than men. Most patients complain of pain due to tissue tension or symptoms of intermittent bowel obstruction. In large hernias, the overlying skin may become thinned, stretched and develop dermatitis.

Figure 60.22 A small paraumbilical hernia.

TREATMENT

As a result of the high risk of strangulation, surgery should be advised in cases where the hernia contains bowel. Small hernias may be left alone if they are asymptomatic, but they may enlarge and require surgery at a later date. Surgery may be performed open or laparoscopically.

OPEN UMBILICAL HERNIA REPAIR

Very small defects less than 1 cm in size may be closed with a simple figure-of-eight suture, or repaired by a darn technique where a non-absorbable, monofilament suture is crisscrossed across the defect and anchored firmly to the fascia all around.

Defects up to 2 cm in diameter may be sutured primarily with minimal tension, although, the larger the defect, the more tension and the more likely it is that mesh reinforcement will be beneficial. The classic repair was described by Mayo. A transverse incision is made and the hernia sac dissected, opened and its content reduced. Any non-viable tissue is removed, sometimes involving bowel resection. The peritoneum is closed. The defect in the anterior rectus sheath is extended laterally on both sides and elevated to create an upper and lower flap. The lower flap is then inserted beneath the upper flap and sutured to it, with the upper flap being brought downwards over it so that the tissue is two layered (double breasted). Non-absorbable sutures are used. There is often a large subcutaneous space. A suction drain is placed to reduce the risk of seroma and haematoma. The skin is closed but stretched or redundant skin may need to be excised (apronectomy) to achieve a better cosmetic result. Today, with modern suture materials, surgeons simply close the anterior sheath in a single layer.

William James Mayo, 1861–1939, surgeon, the Mayo Clinic, Rochester, MN, USA, described this operation in 1901. He and his brother Charles Horace Mayo (1865–1939) joined their father's private practice in Rochester. This practice became the Mayo Clinic. Their father William Worrall Mayo was born in Manchester, UK in 1819.

Figure 60.23 A massive paraumbilical hernia – operative view.

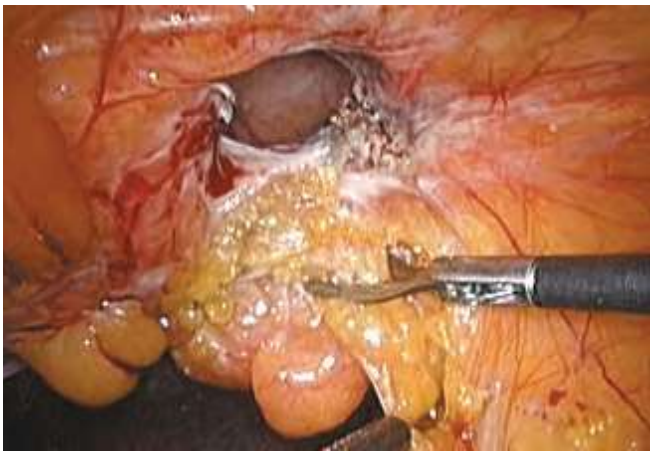

Figure 60.24 Paraumbilical defect – laparoscopic view.

For defects larger than 2 cm in diameter, mesh repair is recommended (Figure 60.23). The mesh may be placed in one of several anatomical planes:

- Within the peritoneal cavity – a tissue separating mesh is placed through the defect and spread out on the underside of the abdominal wall and fixed to it, ideally with an overlap of 5 cm in each direction. This is a quick repair but requires the use of expensive mesh.
- In the retromuscular space – the linea alba is opened vertically and both left and right posterior rectus sheaths are incised 1 cm to the side of the midline exposing the rectus muscle. The posterior sheaths are sutured together and the muscles elevated away from the sheath to develop the retromuscular space into which a sheet of mesh is placed and fixed by sutures. The mesh should overlap the midline by 5 cm laterally and the umbilicus vertically. It should therefore be a minimum diameter of 10 cm. A drain may be placed deep to the linea alba. This is a very secure repair but requires extensive dissection.
- In the extraperitoneal space – it is difficult, but possible, to develop the plane below the posterior rectus sheath, just outside the peritoneum. Care must be taken to avoid 'button-holing' the peritoneum because it is thin and fragile. Mesh can then be tucked into in this space, ensuring a good overlap as before. Ideally, the linea alba is closed over the mesh but, if this is not possible, a flap of peritoneal sac can be used to cover the mesh. This is a good repair, but, if the peritoneum is extensively damaged during the dissection, it will have to be abandoned in favour of an alternative technique.
- In the subcutaneous plane – this is the simplest technique, called an onlay mesh. The peritoneal sac and contents are dealt with as above. An attempt is made to close linea alba vertically with sutures and a disc of mesh is placed on the anterior rectus sheath and sutured to it. The mesh is lying in the subcutaneous space and is prone to infection.

LAPAROSCOPIC UMBILICAL HERNIA REPAIR

Three ports are placed laterally on the abdominal wall, usually on the left side unless adhesions from previous surgery are likely. The contents of the hernia are reduced by traction and external pressure. The falciform ligament above and the median umbilical fold below may need to be taken down if they interfere with mesh placement. A disc of non-adherent mesh, designed for intraperitoneal use, is introduced and positioned on the under surface of the abdominal wall, centred on the defect. It is then fixed to the peritoneum and posterior rectus sheaths using staples, tacks or sutures. This is a simple and secure repair, which achieves generous overlap without surgical damage to umbilicus and surrounding fascia (Figure 60.24). However, it requires specialised equipment and expensive tissue-separating mesh. Intraperitoneal meshes can cause severe pain lasting for 24–48 hours after surgery which can mimic peritonitis.

EMERGENCY REPAIR OF UMBILICAL HERNIA

Incarceration, bowel obstruction and strangulation are frequent because of the narrow neck and the fibrous edge of the defect in the midline raphe. Delay to surgery can lead to gangrene of the omentum or bowel. Large hernias are often multiloculated and there may be strangulated bowel in one component when other areas are clinically soft and a non-tender hernia.

SURGERY

In cases of simple incarceration without clinical evidence of strangulation, repair may be attempted laparoscopically but reduction of the contents can be very difficult if the hernia contains bowel. Most emergency repairs are performed by open surgery. In the presence of established strangulation it is unwise to place mesh at all because of the risk of infection, so an open sutured repair should be performed, accepting a high risk of later recurrence. Alternatively, a two-stage repair could be planned: the hernia contents being dealt with initially with little attempt made to close the defect and then subsequent definitive mesh repair once sepsis has been controlled.

Epigastric hernia

These hernias arise through the midline raphe (linea alba) any where between the xiphoid process and the umbilicus, usually midway. When close to the umbilicus they are called supraumbilical hernias. Epigastric hernias begin with a transverse split in the midline raphe so, in contrast to umbilical hernias, the defect is elliptical. It has been hypothesised that the defect occurs at the site where small blood vessels pierce the linea alba or, more likely, that it arises at weaknesses due to abnormal decussation of aponeurotic fibres related to heavy physical activity (Figure 60.25).

Epigastric hernia defects are usually less than 1 cm in maximum diameter and commonly contain only extraperitoneal fat, which gradually enlarges, spreading in the subcutaneous plane to resemble the shape of a mushroom. When very large they may contain a peritoneal sac but rarely any bowel. More than one hernia may be present. The most common cause of 'recurrence' is failure to identify a second defect at the time of original repair.

Clinical features

The patients are often fit, healthy men aged between 25 and 40 years. These hernias can be very painful even when the swelling is the size of a pea, due to the fatty contents becoming nipped sufficiently to produce partial strangulation. The pain may mimic that of a peptic ulcer but symptoms should not be ascribed to the hernia until gastrointestinal pathology has been excluded. A soft midline swelling can often be felt more easily than seen. It may be locally tender. It is unlikely to be reducible because of the narrow neck. It may resemble a lipoma. A cough impulse may or may not be felt.

Treatment

Very small epigastric hernias have been known to disappear spontaneously, probably due to infarction of the fat. Small-to-moderate-sized hernias without a peritoneal sac are not inherently dangerous and surgery should be offered only if the hernia is sufficiently symptomatic.

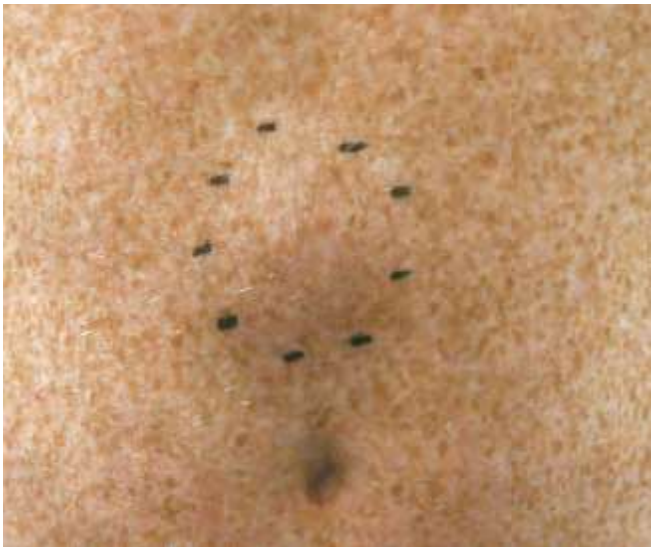

Figure 60.25 Epigastric hernia – external view.

Surgery

This may be done by open or laparoscopic surgery. At open surgery, a vertical or transverse incision is made over the swelling and down to the linea alba. Protruding extraperitoneal fat can simply be pushed back through the defect or excised. Often a small vessel is present in the hernia content that can cause troublesome bleeding. The defect in the linea alba is closed with non-absorbable sutures in adults and absorbable sutures in children. In larger hernias and when a peritoneal sac is present, the surgical approach is similar to an umbilical mesh repair.

Laparoscopic repair is very similar to that for umbilical hernia except that the defect is hidden behind the falciform ligament which must be taken down from the undersurface of the abdominal wall. The margins of the defect must be clearly exposed and the fatty contents reduced before the mesh is placed. Simply placing a mesh under the linea midline may not in fact remove the hernia when its contents are extraperitoneal fat.

Incisional hernia

These arise through a defect in the musculofascial layers of the abdominal wall in the region of a postoperative scar. Thus they may appear anywhere on the abdominal surface.

Incidence and aetiology

Incisional hernias have been reported in 10–50% of laparotomy incisions and 1–5% of laparoscopic port-site incisions. Factors predisposing to their development are patient factors (obesity, general poor healing due to malnutrition, immunosuppression or steroid therapy, chronic cough, cancer), wound factors (poor quality tissues, wound infection) and surgical factors (inappropriate suture material, incorrect suture placement).

An incisional hernia usually starts as disruption of the musculofascial layers of a wound in the early postoperative period. Often the event passes unnoticed if the overlying skin wound has healed securely. Many incisional hernias may be preventable with the use of good surgical technique. The classic sign of wound disruption is a serosanguineous discharge.

Clinical features

These hernias commonly appear as a localised swelling involving a small portion of the scar but may present as a diffuse bulging of the whole length of the incision (Figure 60.26). There may be several discrete hernias along the length of the incision and unsuspected defects are often found at surgery (Figure 60.27). Incisional hernias tend to increase steadily in size with time. The skin overlying large hernias may become thin and atrophic so that peristalsis may be seen in the underlying intestine. Vascular damage to skin may lead to dermatitis. Attacks of partial intestinal obstruction are common because there are usually coexisting internal adhesions. Strangulation is less frequent and most likely to occur when the fibrous defect is small and the sac is large. Most incisional hernias are broad-necked and carry a low risk of strangulation.

Figure 60.26 A large multilocular incisional hernia.

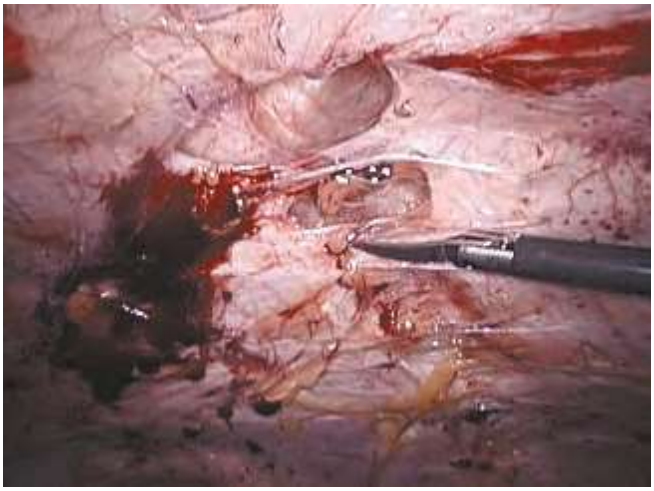

Figure 60.27 Multiple defects seen during laparoscopic operation.

Summary box 60.15

Incisional hernia

- Incidence 10–50% after surgery
- Causation due to patient, wound and surgeon factors
- Wide variation in size
- Often multiple defects within the same scar
- Obstruction is common but strangulation is rare
- Open and laparoscopic repairs possible

Treatment

Asymptomatic incisional hernias may not require treatment at all. The wearing of an abdominal binder or belt may prevent the hernia from increasing in size.

Principles of surgery

For most incisional hernias, surgery is relatively straightforward and both open and laparoscopic options are available. A number of principles apply, irrespective of the technique used.

The repair should cover the whole length of the previous incision. Approximation of the musculofascial layers should be done with minimal tension and prosthetic mesh should be used to reduce the risk of recurrence. Mesh may be contraindicated in a contaminated field, e.g. bowel injury during the dissection but, in a clean-contaminated field, such as after an elective bowel resection, mesh may be used if placed in a different anatomical plane to the contamination, such as in the extraperitoneal/retromuscular space. Appropriate systemic antibiotics should be used.

OPEN REPAIR

Simple suture techniques without the use of prosthetic mesh for reinforcement, even with layered closure such as in Mayo, 'keel' or da Silva repairs, are not recommended today because of the high risk of recurrence. However, they may be the only option in the presence of gross contamination such as peritonitis.

The previous incision is opened along its full length to reveal any clinically unsuspected defects. The hernial sac, its neck and the margins of the defect are fully exposed. The sac can be opened, contents reduced, local adhesions divided and any redundant sac excised to allow safe reclosure of the peritoneum.

Mesh can be placed in one of several planes as for umbilical hernia repair. The simplest approach is an onlay mesh but increasingly the retromuscular sublay repair is preferred by expert surgeons and is described below.

RETROMUSCULAR SUBLAY MESH REPAIR

Vertical incisions are made through the fascia surrounding the rectus abdominis muscles so that the muscle can be separated and elevated from the posterior rectus sheath below. If possible, the medial edges of the posterior rectus sheath edges are sutured together with a continuous suture. In very large defects this may not be possible and below the arcuate line where the posterior sheath is deficient, being peritoneum and transversalis fascia only. In the case of transverse incision, where the defect extends lateral to the rectus sheath, internal oblique and transversus abdominis muscles form the posterior layer. A sheet of lightweight, large-pore, prosthetic, elastic mesh is then laid between this posterior rectus sheath and belly/bellies of the rectus muscle. It is fixed to the sheath by interrupted sutures. The mesh must be large enough to ensure a 5-cm overlap of the underlying fascial defect in all directions. Careful haemostasis and meticulous asepsis are essential during this operation. The anterior rectus sheaths are then sutured together over the mesh so that, ideally, the mesh is completely covered by muscle and fascia and is not lying in the subcutaneous plane. Redundant skin may need to be excised. The risk of postoperative serous fluid collections is reduced by suction drainage.

LAPAROSCOPIC REPAIR

Incisional hernias are increasingly being repaired by laparoscopic mesh techniques. Laparoscopy and division of adhesions is initially performed. Hernia contents are reduced and the fibrous margins of the hernia defect(s) are exposed. Often the falciform ligament and median umbilical fold need to be

taken down. Some surgeons prefer to suture close the muscle defects first and then reinforce with mesh. Others simply fix the mesh under the defect with adequate overlap. The use of a tissue-separating mesh is essential. Various techniques have been described to size and then position the mesh accurately. The mesh is fixed to the abdominal wall by staples or transfascial sutures which pass through all muscle layers to hold the mesh.

In the presence of dense peritoneal adhesions, the laparoscopic surgeon needs to take great care because injury to the bowel is possible and may not be recognised. Diathermy is not used. If occult bowel injury does occur it can lead to postoperative peritonitis, which is an extremely dangerous complication.

Management of the very large incisional hernia

Very large incisional hernias often require careful thought before treatment begins. If the volume of the sac is more than 25% of the volume of the abdominal cavity (and this can be calculated from CT images), then there are likely to be issues of loss of abdominal domain when the hernia is repaired. The contents of the hernia, which have been outside the abdominal cavity for a long time, will not fit back inside or, if they do, it will result in high tension. High intra-abdominal pressure can lead to visceral compression and pulmonary complications due to impaired diaphragmatic movement. A tight abdomen can lead to wound breakdown and failure of the repair.

Techniques to overcome the potential loss of abdominal domain include preoperative abdominal expansion with progressive preoperative pneumoperitoneum over several weeks, resection of the omentum and/or colon at the time of repair, the use of prosthetic mesh to span the uncloseable gap in the musculofascial layer, or the use of musculofascial advancement or transpositional flaps to achieve closure.

Even if loss of domain is not a concern, large defects can still be very difficult to close and the same special techniques may need to be used to avoid producing excessive tension in the repair. Ramirez's component separation technique, which incorporates relaxing incisions in the external oblique aponeurosis and/or the posterior sheath, is very useful because this enables either the anterior or the posterior component of the rectus sheath to be drawn together. It may then be reinforced with a mesh.

Patients with poor quality or redundant skin may benefit from a wedge excision of skin and fat (lipectomy) to improve the abdominal contour postoperatively. Repair of these very large hernias is highly specialised surgery and is best done in specialist centres.

Reducing the risk of incisional hernia

The incidence of incisional hernia may be reduced by improving the patient's general condition preoperatively where possible, e.g. weight loss for obesity or improving nutritional state for malnutrition. Closing the fascial layers with non-absorbable, or very slowly absorbable, sutures of adequate gauge is important. Traditional teaching was that sutures should be 1 cm deep and 1 cm apart. Recent work has shown that lower incisional hernia rates and reduced infection rates are gained when smaller and closer bites are used with a 2/0 suture rather than traditional heavier materials.

There is no evidence that interrupted sutures are better or worse than continuous. However, if continuous suturing is used, the tissue bites must not be too near the fascial edge or pulled too tight because they may cut out. It has also been confirmed that the optimal ratio of suture length to wound length is 4:1 (Jenkins' rule). If less length than this is used, the suture bites are too far apart or too tight and the converse applies if more length than this is used.

Drains should be brought out through separate incisions and not through the wound itself because this leads to hernia formation.

Recent reports have suggested that placement of a prophylactic mesh in patients at high risk of hernia formation will substantially reduce that risk. This has been reported in obese patients undergoing bariatric surgery and also to prevent parastomal herniation, which occurs in up to 50% of patients.

Spigelian hernia

These hernias are uncommon although are probably underdiagnosed. They affect men and women equally and can occur at any age, but are most common in elderly people. They arise through a defect in the spigelian fascia, which is the aponeurosis of transversus abdominis. Often these hernias advance through the internal oblique as well and spread out deep to the external oblique aponeurosis. The spigelian fascia extends between the transversus muscle and the lateral border of the rectus sheath from the costal margin to the groin, where it blends into the conjoint tendon. Most spigelian hernias appear below the level of the umbilicus near the edge of the rectus sheath, but they can be found anywhere along the spigelian line (**Figure 60.28**). There is a common

Figure 60.28 Spigelian hernia.

Adrian Van der Spieghel (Spigelius), 1578–1625, Professor of Anatomy, Padua, Italy.

misconception that they protrude below the arcuate line as a result of deficiency of the posterior rectus sheath at that level, but in fact the defect is almost always above the arcuate line. In young patients they usually contain extraperitoneal fat only but in older patients there is often a peritoneal sac and they can become very large indeed.

They have also been described in infants and may be congenital, reflecting incomplete differentiation of the mesenchymal layers within the abdominal wall.

Clinical features

Young patients usually present with intermittent pain, due to pinching of the fat, similar to an epigastric hernia. A lump may or may not be palpable because the fatty hernia is small and the overlying external oblique is intact. Older patients generally present with a reducible swelling at the edge of the rectus sheath and may have symptoms of intermittent obstruction. The diagnosis should be suspected because of the location of the symptoms and is confirmed by CT. Ultrasonography has the advantage that it can be performed in the upright patient because no defect may be visible with the patient lying down.

Treatment

Surgery is recommended because the narrow and fibrous neck predisposes to strangulation. Surgery can be open or laparoscopic. At open surgery a skin crease is made over the hernia, but no abnormality will be seen until the external oblique is opened. The sac and contents are dealt with and the small defect in the spigelian fascia is repaired by suture or mesh laid deep to the external oblique aponeurosis. The plane of the mesh can be extended medially into the posterior rectus sheath if required. The external oblique aponeurosis is closed over the mesh.

Laparoscopy is useful if no sac is palpable, but, in young patients with a hernia containing only extraperitoneal fat, no hernia will be seen from within the peritoneum. In such cases, the peritoneum can be incised and the extraperitoneal plane explored for the small defect, which can then be closed by either suture or mesh. When an intraperitoneal sac is present, laparoscopic repair can be performed using either the intraperitoneal onlay of mesh (IPOM) or TAPP technique.

Summary box 60.16

Spigelian hernia

- Rare
- Often misdiagnosed
- High risk of complications

Lumbar hernia

Most primary lumbar hernias occur through the inferior lumbar triangle of Petit bounded below by the crest of the ilium, laterally by the external oblique muscle and medially by latissimus dorsi (**Figure 60.29**). Less commonly, the sac comes through the superior lumbar triangle, which is bounded by the twelfth rib above, medially by sacrospinalis and laterally by the posterior border of the internal oblique muscle. Primary lumbar hernias are rare, but may be mimicked by incisional hernias arising through flank incisions for renal operations, or through incisions for bone grafts harvested from the iliac crest.

Figure 60.29 Inferior lumbar hernia, which contained caecum, appendix and small bowel. Note the filarial skin rash on the buttocks (courtesy of VJ Hartfield, formerly of south-east Nigeria).

Differential diagnosis

A lumbar hernia must be distinguished from:

- a lipoma;
- a cold (tuberculous) abscess pointing to this position;
- a pseudo-hernia due to local muscular paralysis. Lumbar pseudo-hernia can result from any interference with the nerve supply of the affected muscles, the most common cause being injury to the subcostal nerve during a kidney operation.

Treatment

The natural history is for these hernias to increase in size and surgery is recommended. Lumbar hernias can be approached by open or laparoscopic surgery. The defects can be difficult to close with sutures and mesh is recommended.

The TAPP laparoscopic approach is gaining popularity. With the patient in a semilateral position ports are inserted well away from the defect. The peritoneum is incised above the hernia and dissected back to expose the muscle defect. The content, often extraperitoneal fat, is reduced and a mesh fixed with ample overlap. The peritoneum can then be resutured or tacked back to cover the mesh.

Jean Louis Petit, 1674–1750, Director of the Academie de Chirurgie, Paris, France.

Lumbar incisional hernias can be approached in the same way but large ones, especially if there is a component of neuropathic muscle atrophy causing a diffuse bulge (pseudo-hernia), can be very difficult and muscle-flap double breasting with mesh reinforcement may be required.

Parastomal hernia

When surgeons create a stoma, such as a colostomy or ileostomy, they are effectively creating a hernia by bringing bowel out through the abdominal wall. The muscle defect created tends to increase in size over time and can ultimately lead to massive herniation around the stoma. The rate of parastomal hernia is over 50%. For patients, it is very difficult to manage a stoma that is lying adjacent to or atop a large hernia. Stoma appliance bags fit poorly leading to leakage.

The ideal surgical solution for the patient is to rejoin the bowel and remove the stoma altogether, but this is not always possible. The stoma may be re-sited but further recurrence is likely. Various open suture and mesh techniques have been described to repair parastomal hernia but failure rates are high. Meshes are best placed in the retromuscular space. Laparoscopic repair is also possible using a large mesh with a central hole. It can be positioned around the bowel onto the parietal peritoneum.

Recent reports (Millbourne *et al.*) have described the use of prophylactic mesh insertion at the time of formation of the stoma. A lightweight, polypropylene mesh is inserted in the retromuscular space so that the bowel passes through a hole in the mesh centre. Using this technique, parastomal hernia rates have been reduced significantly.

Traumatic hernia

These hernias arise through non-anatomical defects caused by injury. They can be classified into three types:

1. Hernias through abdominal stab wound sites. These are effectively incisional hernias.
2. Hernias protruding through splits or tears in the abdominal muscles after blunt trauma.
3. Abdominal bulging secondary to muscle atrophy that occurs as a result of nerve injury or other traumatic denervation. Akin to the lumbar pseudo-hernia seen after open nephrectomy, these can arise after a chest injury with damage to the intercostal nerves.

Clinical features

Traumatic hernias present as any other hernia. The key to the aetiology is in the history and the non-anatomical location of the hernia.

Treatment

Surgery may be justified if the hernia is sufficiently symptomatic, or if investigations suggest a narrow neck and hence a risk of obstruction or strangulation. Stab wound traumatic hernias are straightforward to repair using open or laparoscopic techniques as for other ventral hernias. Diffuse abdominal bulges are more difficult to correct and require some form of plication of the stretched musculofascial layer with mesh reinforcement to prevent further bulging in the future. Some bulging may persist, however.

Rare external hernias

Perineal hernia

This type of hernia is very rare and includes:

- postoperative hernia through a perineal scar, which may occur after excision of the rectum;
- median sliding perineal hernia, which is a complete prolapse of the rectum;
- anterolateral perineal hernia, which occurs in women and presents as a swelling of the labium majus;
- posterolateral perineal hernia, which passes through the levator ani to enter the ischiorectal fossa.

TREATMENT

A combined abdominoperineal operation is generally the most satisfactory for the last two types of hernia. The hernia is exposed by an incision directly over it. The sac is opened and its contents are reduced. The sac is cleared from surrounding structures and the wound closed. With the patient in semi-Trendelenburg position, either laparoscopically or at open surgery, the abdomen is opened and the mouth of the sac exposed. The sac is inverted, ligated and excised, and the pelvic floor repaired by muscle apposition and, if indicated, buttressing of the repair with prosthetic mesh.

Obturator hernia

Obturator hernia, which passes through the obturator canal, occurs six times more frequently in women than in men. Most patients are aged >60 years. The swelling is liable to be overlooked because it is covered by pectineus. It seldom causes a definite swelling in Scarpa's triangle, but, if the limb is flexed, abducted and rotated outwards, the hernia sometimes becomes apparent. The leg is usually kept in a semi-flexed position and movement increases the pain. In more than 50% of cases of strangulated obturator hernia, pain is referred along the obturator nerve by its geniculate branch to the knee. On vaginal or rectal examination the hernia can sometimes be felt as a tender swelling in the region of the obturator foramen.

These hernias have often undergone strangulation, frequently of the Richter type, by the time of presentation.

TREATMENT

Surgery is indicated. The diagnosis is rarely made preoperatively and so it is often approached through a laparotomy incision. The full Trendelenburg position is adopted. The constricting agent is the obturator fascia, which can be stretched by inserting the operator's index finger, or suitable forceps, through the gap in the fascia. Content is reduced. If incision

Antonio Scarpa, 1747–1832, Professor of Anatomy, Pavia, Italy.

of the fascia is required, it is made parallel to the obturator vessels and nerve. The contents of the sac are dealt with in a standard manner. The defect cannot simply be closed because one margin is bone and the obturator nerve and vessels run through it. It is best closed using a mesh plug. In the absence of mesh or in an infected field, the broad ligament can be used as a plug.

Laparoscopic TAPP repair may also be performed again using a mesh. To avoid nerve injury, glue can be used to fix a mesh over the defect.

Gluteal and sciatic hernias

Both of these hernias are very rare. A gluteal hernia passes through the greater sciatic foramen, either above or below piriformis. A sciatic hernia passes through the lesser sciatic foramen. Differential diagnosis must be made between these conditions and:

- a lipoma or other soft tissue tumour beneath gluteus maximus;
- a tuberculous abscess;
- a gluteal aneurysm.

All doubtful swellings in this situation can be characterised with CT scanning but, if in doubt, they should be explored by operation.

UMBILICAL CONDITIONS IN THE ADULT

Chronic infection

Chronic infection occurs in the umbilical area, particularly in patients with poor hygiene. It may also occur in obese people and when a paraumbilical hernia is present. It can be due to a plug of keratin causing chronic irritation. It is often encountered during elective surgery and may complicate the insertion of a laparoscope port at the umbilicus. A range of bacteria and fungi can be involved. Occasionally, a rapid-onset, superficial cellulitis occurs even after minor surgery in this region. It is normally a streptococcus and can be treated with penicillin or other appropriate antibiotic. Pre-existing infection should be treated before surgery where possible.

Chronic fistula

Patients may present with a persistent discharge from the umbilical area. This may be due to simple, superficial infection or possibly an infected epidermoid cyst within the umbilicus. However, it may also be due to a fistulous connection to deeper structures.

In normal patients, the umbilicus is connected to the liver, bladder and gynaecological organs by various ligaments. Diseases of these organs, such as infection or malignancy, can extend along these ligaments to appear at the umbilicus as a mass or fistulous discharge.

Chronic fistula may be a complication of umbilical hernia repair due to chronic infection of a mesh or around non-absorbable suture material. In most cases this problem arises soon after surgery but occasionally a chronic infection can occur months or even years after an operation. Antibiotics may help but most commonly the synthetic suture or mesh will need to be removed with a risk of recurrence of the hernia.

In fetal life the umbilicus was also connected to the gut by the vitellointestinal duct. In most patients this duct becomes totally obliterated and vanishes. The bowel end of the duct may persist as Meckel's diverticulum. More rarely, the umbilical end persists, leading to chronic discharge. If an abnormal connection between bowel and umbilicus persists, then this band can act as a cause of adhesional intestinal obstruction.

Patent urachus

A connection between the urinary bladder and umbilicus usually presents in later life. This is due to increased pressure in the bladder as a result of obstruction from conditions such as prostatic hypertrophy. The cause of obstruction should be dealt with initially, but if the problem persists then surgical excision of the patent urachus might be considered.

Malignancy at the umbilicus

Primary squamous carcinoma may occur. If tumour presents at the umbilicus it is most probably due to spread from the internal organs along internal ligaments, e.g. from the liver along the falciform ligament. A malignant mass at the umbilicus is called a Sister Joseph's nodule. It usually indicates very advanced malignant disease and surgery probably has little to offer (**Figure 60.30**).

GENERAL INFECTION OF THE ABDOMINAL WALL

The skin of the abdominal wall, similar to all skin, is prone to develop superficial infection that may be spontaneous, due to minor trauma or infection of skin lesions such as an epidermoid cyst. Although antibiotics will suffice in most

Johann Frederick Meckel (the Younger), 1781–1833, Professor of Anatomy and Surgery, Halle, Germany, described his diverticulum in 1809.
Alexis Littre, 1658–1726, surgeon and lecturer in anatomy, Paris, France, described Meckel's diverticulum in a hernial sac in 1700, 81 years before Meckel was born.
The neoplastic nodule sited at the umbilicus is known as **Sister Joseph's nodule**. Sister Mary Joseph made the observation that her patients with terminal cancer sometimes developed a red papular lesion in the umbilicus. She and William Mayo published this observation in 1928. However, it was Hamilton Bailey who coined the term 'Sister Mary Joseph's nodule' in 1949.
Sister Mary Joseph (nee Julia Dempsey), Nursing Superintendent, St Mary's Hospital, which became the Mayo Clinic, Rochester, MN, USA.

Figure 60.30 Secondary nodule at the umbilicus – Sister Joseph's nodule.

patients, if an abscess develops then surgical drainage may be required.

The close proximity of bowel and bowel organisms opens the abdominal wall to attack from a wide range of highly virulent bacteria. Most commonly, these are released during abdominal surgery such as appendicectomy and hence the need for appropriate antibiotic prophylactic cover.

Synergistic gangrene

This rare condition is due to the synergistic action of non-haemolytic streptococci and staphylococci causing rapid tissue necrosis and overwhelming systemic infection (**Figure 60.31**). It requires immediate administration of high-dose, broad-spectrum, powerful antibiotics in combination with early debridement of any non-viable tissue. Hyperbaric oxygen therapy has been advocated.

Other forms of severe abdominal wall infections occur, generally known as necrotising fasciitis (e.g. Fournier's gangrene). All of these conditions have a high associated morbidity and mortality. They occur in debilitated and immunocompromised patients but can occasionally occur in healthy patients. Rapid diagnosis and aggressive surgical debridement treatment are the key to success.

Figure 60.31 Bacterial synergistic gangrene of the chest and abdominal wall. The area has become gangrenous and looks like suede leather. Beware of amoebiasis cutis.

Cutaneous fistula

Due to the thickness of the abdominal wall, it is rare for abdominal inflammatory conditions to discharge spontaneously through the wall to the skin. Chronic intraperitoneal abscesses arising after occult bowel perforation, appendicitis, diverticulitis and cholecystitis are the most likely sources. CT will locate the internal abscess and suggest the likely origin. Treatment today is usually by CT- or ultrasound-guided drainage but the surgeon may be called on to remove the source organ, e.g. gall bladder.

Malignancy in its later stages can occasionally erode through the abdominal wall.

Crohn's disease also has a tendency to fistulate into adjacent organs and may develop an enterocutaneous fistula.

Abdominal compartment syndrome

Surgeons are increasingly aware of the harmful effect of high intra-abdominal pressures that can occur in severe intra-abdominal sepsis, such as pancreatitis and also aortic aneurysm rupture. High pressure leads to reduced blood flow and tissue ischaemia, which contributes to multiorgan failure. Although the abdominal wall has elasticity, if intra-abdominal volume increases due to fluid, gas, pus, tissue oedema, etc., then maximal capacity may be reached and pressure rises to a critical level. Tension-releasing incisions, equivalent to a fasciotomy, have been suggested, although this is not widely practised.

In some cases, after surgery for severe intraperitoneal sepsis, the surgeon cannot close the abdomen and may leave the incision wide open, covering abdominal contents with mesh or a saline-soaked dressing, planning to return at a future date to close the defect. This is called a laparostomy.

Neoplasms of the abdominal wall

As the abdominal wall is composed of muscle, fascia and bone, benign and malignant tumours can arise from each, although these are rare.

Desmoid tumour

This is usually considered by pathologists to be a hamartoma and is more common in women. Some, however, believe it to be a fibroma and possibly the result of repeated trauma. Desmoids have been reported in familial adenomatous polyposis (FAP). Histologically, they contain plasmoidal cell masses resembling giant cells. They undergo central myxomatous change. Surgical excision with a wide margin is required to prevent recurrence, which is a frequent problem.

Fibrosarcoma

These tumours can occur anywhere in the body. They are generally highly malignant and respond poorly to both radio- and chemotherapy. Wide excision will often require plastic surgical reconstruction.

FURTHER READING

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Millbourn D, Cengiz Y, Israelsson LA. Effect of stitch length on wound complications after closure of midline incisions. *Arch Surg* 2009; **144**: 1056–9.

WEBSITE ADDRESSES

Classification of groin hernia: www.herniaweb.org/documents/EHS_groin_hernia_classification.pdf

Guidelines for management of groin hernia: www.herniaweb.org/documents/EHS_Guidelines.pdf

European classification of primary and incisional abdominal wall hernias: www.ncbi.nlm.nih.gov/pmc/articles/PMC2719726/

NICE guidelines for laparoscopic inguinal hernia repair: guidance.nice.org.uk/TA83

SIGN guidelines for antibiotics in surgery (including hernia): www.sign.ac.uk/pdf/sign104.pdf