

Ministry of Defence

Synopses of Causation

Hernia

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Disclaimer

This synopsis has been completed by medical practitioners. It is based on a literature search at the standard of a textbook of medicine and generalist review articles. It is not intended to be a meta-analysis of the literature on the condition specified.

Every effort has been taken to ensure that the information contained in the synopsis is accurate and consistent with current knowledge and practice and to do this the synopsis has been subject to an external validation process by consultants in a relevant specialty nominated by the Royal Society of Medicine.

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1. Definition

- 1.1. Hernia may affect a number of anatomical sites, and has a variety of causes. It is defined as a protrusion of an organ or part of an organ through its containing wall. In practical terms, the organ in question is nearly always a section of the bowel, protruding through the layers of the abdominal wall. In rare cases, the hernia may involve other organs such as the bladder or ovary. However, as these cases occur very infrequently, this synopsis will be limited to cases involving the bowel, unless otherwise stated.
- 1.2. A hernia is composed of three principal parts. Firstly, the section of bowel or other organ involved; secondly, a covering sac which is usually composed of [peritoneum](#); thirdly, the layers of the abdominal wall through which the bowel and its sac protrude.
- 1.3. Hernia is of clinical importance because the hernial sac and its contents have the potential to become lodged in the deficit in the muscle of the abdominal wall through which the hernia protrudes. This process can obstruct the blood supply serving the organ within the hernial sac. If this situation is allowed to persist, the organ becomes gangrenous and may perforate. In the case of hernia involving the bowel, the release of bowel organisms follows, with infection of the abdominal cavity and [peritonitis](#). Without rapid surgical intervention, the patient quickly progresses to generalised sepsis, organ failure and death.
- 1.4. The progressive clinical deterioration of a hernia can be broken down into five stages:
 - 1.4.1. **Reducible hernia** – the contents of the hernial sac can be returned to the abdominal cavity. The hernia either reduces itself when the patient lies down, or can be pushed back into place.
 - 1.4.2. **Irreducible hernia** – the contents of the sac cannot be returned to the abdominal cavity, but there are no other complications. Any irreducible hernia is predisposed to obstruction and strangulation, which may occur at any time.
 - 1.4.3. **Obstruction** – the bowel in the hernial sac has an adequate blood supply but the bowel itself is obstructed. In this situation, the patient usually experiences colicky abdominal pain and tenderness over the site of the hernia. It is extremely difficult to distinguish between obstruction and strangulation and an obstructed hernia should be treated as though strangulation is imminent.
 - 1.4.4. **Strangulation** – the blood supply to the bowel is impaired. The narrower the neck of the hernial sac, the greater the risk of strangulation. The impoverished blood supply results in the bowel wall becoming inflamed and weakened. At this stage, the patient will suffer severe pain over the site of the hernia, followed by generalised abdominal pain, nausea and vomiting. The hernia will appear extremely tense and tender on examination. Gangrene can occur within 6 hours.
 - 1.4.5. **Perforation** – the gangrenous bowel wall breaks down, releasing bowel contents into the abdominal cavity, leading to severe abdominal pain and sepsis.

2. Clinical Features

- 2.1. Whilst all hernias share the common features outlined above, the presentation and potential complications depend on the site at which it arises. Hernia is therefore classified according to its anatomical site.
- 2.2. The majority of hernias arise when a segment of bowel protrudes through the anterior abdominal wall. The commonest forms of abdominal hernia, in descending order of frequency in adults, are the inguinal (80%), epigastric (8%), incisional (7%) and femoral (5%) forms.¹
- 2.3. **Inguinal Hernia** is by far the commonest form of abdominal hernia. It predominantly affects males, with a male:female ratio of 20:1.¹ Nevertheless, it is also the commonest form of hernia seen in women.² An inguinal hernia arises when the abdominal contents protrude through the inguinal region of the abdominal wall. There are two forms of inguinal hernia; direct and indirect. In order to appreciate the difference between the two, it is necessary to outline the anatomy of the affected region.
- 2.3.1. The inguinal region is located around the area of the groin crease and extends from the [anterior superior iliac spine](#) to the [pubic tubercle](#). The inguinal ligament is situated between these two anatomical points.
- 2.3.2. The abdominal wall in this area is made up of three layers of muscle, the fibres of which run at different angles to each other. They include the internal oblique, external oblique and transversus abdominis muscles. The thin [transversalis fascia](#) lies beneath these muscle layers.
- 2.3.3. Due to the way the muscle layers are interconnected, there are two areas of weakness within the abdominal wall in this area; the deep and superficial inguinal rings. These represent areas where the muscle fibres are less densely packed. The deep inguinal ring lies beneath the midpoint of the groin crease. The superficial inguinal ring lies close to the pubic bone.
- 2.3.4. The rings form the two ends of the inguinal canal through which, in the developing male foetus, the testis and spermatic cord descend into the scrotum. The inguinal canal runs obliquely through the abdominal wall, from the deepest muscle layer to the most superficial layer. In the male it contains the spermatic cord and in the female, the round ligament of the ovary. The importance of the inguinal canal is that it represents an inherent weakness in the abdominal wall.
- 2.3.5. As the testis descends into the scrotum in the male foetus, it is preceded by the [processus vaginalis](#). When the testis reaches the scrotum, the lumen of the processus vaginalis is normally obliterated. The mechanism leading to its closure is unknown but occasionally it does not take place, and a patent processus vaginalis persists. This may be associated with a hernia at birth, or later in life.³ This issue will be dealt with in more detail below.
- 2.3.6. An **indirect inguinal hernia** arises when a portion of the abdominal contents are pushed through the deep inguinal ring and travel into the inguinal canal. It progresses a variable distance along the canal, and may travel as far as the scrotum in males,

following the route that was originally taken by the developing testis. This process can occur at any age.

2.3.7 In adult men, 65% of inguinal hernias are indirect.⁴ Individuals with a patent processus vaginalis are at increased risk. The process can also occur in women, who may also have a patent processus vaginalis running from the deep inguinal ring to the labia majora.¹ Because indirect inguinal hernias run obliquely through the muscle layers within the inguinal canal, the contents of these hernias can be difficult to return to the abdominal cavity, and hence are at risk of becoming strangulated.

2.3.8 A **direct inguinal hernia**, by contrast, occurs when bowel contents are pushed directly out through an area of weak abdominal muscle, without following the course of the inguinal canal. This variety of hernia is seen as a swelling next to the pubic bone which does not extend into the scrotum. Due to its direct path, this hernia tends to have a wide neck. The contents usually return to the abdominal cavity when the patient lies down, and hence this hernia rarely strangulates.¹ Because a direct inguinal hernia does not follow the underlying passage of the inguinal canal, it is uncommon in children and young adults, but occurs more frequently in older people with weak abdominal musculature.

2.3.9 In practice, both forms of hernia generally present with a lump in the groin. The affected individual may also complain of a dragging sensation in the lower abdomen, or of pain, particularly when doing heavy work or during strenuous exercise. Although the two forms of hernia can be differentiated by expert clinical examination, in practice the exact nature of the hernia is only confirmed at operation.

2.4. **Epigastric hernia** occurs in adults, and arises in the linea alba. It is sometimes also referred to as 'para-umbilical' hernia. It is generally quite small and many contain only fat. Most small epigastric hernias are asymptomatic, and may be discovered incidentally as a small nodule which is more prominent on standing. Some patients, however, present with vague upper abdominal pain which must be differentiated from the pain of dyspepsia.⁴

2.4.1 Due to increases in intra-abdominal pressure, the defect may become large enough to permit abdominal contents, particularly small bowel, to pass into the hernial sac. This may cause a dragging sensation in the abdomen, and intermittent episodes of colicky pain due to intestinal obstruction.⁴ The neck of the hernial sac is often very narrow, and because the hernia grows slowly, there is a tendency for firm scar tissue adhesions to develop between the hernial sac and its contents. Because of these two factors, almost all larger para-umbilical hernias are irreducible, and hence at high risk of obstruction and strangulation.¹

2.5 **Incisional hernia** occurs through a weak scar after a surgical operation or accidental wound. The majority have a wide neck, and do not result in obstruction or strangulation.⁴ However, partial intestinal obstruction can occur in those with a narrower neck. Incisional hernia can occur as a result of open abdominal surgery, or as a consequence of a laparoscopic procedure, when the hernia arises at the site of entry of the laparoscope. The majority of incisional hernias occur within the first two years of the primary operation⁵ but they can appear many years later.

2.5.1 The first sign of an incisional hernia is usually an asymptomatic swelling over, or adjacent to, the incision site. This gradually increases in size, and may disappear on lying down. Pain is not a common early complaint⁵ although some patients do describe pain during an episode of heavy lifting or strenuous activity, followed by the appearance of

the hernia. With time, incisional hernias enlarge and tend to become more symptomatic, causing pain with movement, straining, or coughing. Once an incisional hernia is detected, repair is usually recommended, unless other co-morbid diseases pose an unacceptable risk.⁵

2.6 Femoral hernia is the form of hernia which is most prone to strangulation. It is commonly seen in women, with a female to male ratio of 4:1.¹ The age profile of patients affected by this hernia differs between males and females, and usually affects women in their 50s and 60s, particularly those who have borne children. However, male patients are more often in their 30s or 40s.⁴ The right side is twice as likely to be affected as the left, but the reason for this is unknown.^{1,6} In 20% of cases, the hernia is bilateral.⁴

2.6.1 Femoral hernia develops through an area of weakness, the [femoral canal](#). Under normal circumstances, the canal contains only fat, lymphatic vessels and lymph nodes. The femoral canal is very inelastic, and the contents of a hernia are initially contained within its narrow diameter. Thus a small femoral hernia may not be noticed by the patient. However, as the hernia descends further, out of the femoral canal into the loose tissue of the groin, the contents are able to expand. The swelling is very unlikely to return back up the narrow femoral canal. This situation results in a high risk of strangulation. Indeed this hernia presents as strangulation in 40% of cases.⁴

2.7. The less common forms of hernia, affecting the abdominal wall and the pelvic diaphragm, are outlined below.

2.7.1 Richter's hernia refers to a hernia in which only part of the circumference of the bowel protrudes through the hernial orifice. As a result intestinal obstruction is incomplete, but the affected section of the bowel becomes inflamed, tender, and irreducible, leading to the development of gangrene. This phenomenon occurs most commonly in femoral, obturator and small incisional hernias.⁷ Richter's hernia is most common in the sixth and seventh decades, and frequently presents at the point of strangulation. It is responsible for 10% of cases of strangulated hernias.⁸

2.7.2 Obturator hernia is a herniation of abdominal contents through the [obturator canal](#). The right side is affected twice as often as the left. Obturator hernia affects women 6 times more commonly than men, and the majority of patients are aged over 60.⁴ They typically occur in elderly women who have suffered a rapid loss of weight, usually due to debilitating illness. They are also more frequently seen in people of oriental origin than in Caucasians or those of African origin.⁷ Obturator hernia is rare, and difficult to diagnose, with a high proportion of cases having undergone strangulation by the time of diagnosis. The operative mortality rate approaches 30%.⁷

2.7.3 Lumbar hernia is extremely rare, and involves protrusion of fat or bowel through the lumbar triangle, an area of weakness in the postero-lateral abdominal wall. The borders of this area are demarcated by the 12th rib, the iliac crest of the pelvis, the latissimus dorsi muscles, and the external oblique muscle anteriorly.⁹

2.7.4 Gluteal and sciatic hernia arises when abdominal contents pass through the greater sciatic foramen, and the lesser sciatic foramen, respectively. These foramina are normal anatomical spaces in the pelvic floor, which allow the passage of the sciatic nerve on its course from the spinal cord to the leg. These hernias are extremely rare, and, like obturator hernias, are usually discovered during laparotomy to investigate the cause of a bowel obstruction.⁷

2.7.5 **Spigelian hernia** is a very rare form of interstitial hernia which arises at the anterolateral aspect of the abdomen. It involves a protrusion of abdominal contents through a congenital or acquired defect in the connective tissue of the abdominal wall. Men and women are equally affected.⁴ The hernia typically presents as a soft mass lateral to the rectus abdominis muscle, with associated pain. Spigelian hernia may be congenital, resulting from weak areas in the connective tissue arising from the layered abdominal muscles. However, these hernias can also develop in later life, in which case they tend to affect overweight individuals, usually over 50 years of age. There are also reports of [iatrogenic](#) spigelian hernia arising from the use of laparoscopy trocars or drains in the region.¹⁰

2.7.6. **Umbilical hernia** is usually congenital, presenting as a swelling at the umbilicus in the newborn baby or young child. Failure of anatomical closure of the abdominal wall at this point results in a congenital weakness, through which the hernia evolves. In most cases, this hernia is symptomless and does not require treatment, as 95% resolve spontaneously.⁴ However, if the hernia remains after the age of 2 years it requires treatment, as it is then at increased risk of strangulation. Occasionally umbilical hernia can occur in adults, usually in patients with chronic liver disease and [ascites](#).

2.8 **Hernias involving the [diaphragm](#)** include true diaphragmatic hernias, and hiatus hernia. These are different in nature from the abdominal hernias outlined above. Because they involve herniation of abdominal contents into the chest cavity, they are not visible externally, and no abnormality will be seen in the abdominal wall. They manifest themselves through the symptoms they bring about.

2.8.1 **Diaphragmatic hernia** arises when there is a disruption of the diaphragm. Diaphragmatic hernia may occur as a congenital abnormality in babies. Rarely, congenital diaphragmatic hernia can present in adult life. This hernia presents with vague symptoms such as mild respiratory problems, abdominal discomfort or digestive symptoms, but occasionally also with severe symptoms of intestinal obstruction.

2.8.2 In adults, the majority of diaphragmatic hernias occur due to traumatic damage to the diaphragm.¹¹ Traumatic diaphragmatic hernia may take several months or years to become apparent.¹ Intra-abdominal contents herniate into the thorax, resulting in clinical signs such as shortness of breath due to bowel occupying the thoracic cage and compressing the lung, and occasionally acute abdominal pain will occur, due to strangulation of bowel loops as they pass through the torn diaphragm.¹¹ Diaphragmatic hernia, however small, always requires surgical repair, as without it the defect is likely to slowly enlarge, with the constant risk of bowel entering the chest cavity and compressing the lung, and the potential for strangulation.¹¹

2.9. **Hiatus hernia** is a different entity from the abdominal hernias or diaphragmatic hernia. In fact this is not a true hernia, as there is no hernial sac or abnormal weakness in muscle layers.

2.9.1 A hiatus hernia arises when the [gastro-oesophageal junction](#), or part of the stomach itself, passes up into the thoracic cavity through a physiological gap in the diaphragm (the oesophageal hiatus). This gap is not abnormal, and allows the anatomical communication of the oesophagus with the stomach. Hiatus hernia occurs in up to half of the population over 50,⁷ mainly in individuals who have, for any reason, developed increased intra-abdominal pressure. This includes women who have been pregnant, and individuals who are overweight.¹² There are two main forms of hiatus hernia – the sliding and rolling types.

- 2.9.2 **Sliding hiatus hernia.** This variety is 100 times more common than rolling hiatus hernia. The [gastro-oesophageal junction](#) and upper portion of the stomach 'slide' up into the chest cavity through the diaphragm¹². Due to the abnormal position of the gastro-oesophageal junction, this type of hernia is often, but not always, associated with reflux of gastric acid into the lower oesophagus. This occurs because the anatomical disruption impairs the sphincter mechanism at the lower end of the oesophagus. This sphincter is a complex valve composed of a smooth muscle element within the oesophagus, and a supporting diaphragmatic element. These two mechanisms normally supplement each other to maintain the competence of the sphincter.
- 2.9.3. When the anatomical relationship between the oesophageal smooth muscle element and the diaphragm is disrupted, the sphincter is no longer competent, and gastric acid refluxes up, causing a chemical inflammation of the lining of the oesophagus. This results in burning epigastric pain which is worse on lying flat or bending over. It may also present as angina-like chest pain, pain on swallowing, or a sense of a lump in the throat. Occasionally aspiration of acid can lead to nocturnal cough and early morning hoarseness.⁷
- 2.9.4. If the lower oesophagus is continually inflamed this can lead to ulceration, and ultimately, to scarring and stricture formation. It may also lead to alterations in the structure of the cells lining the lower oesophagus (Barrett's oesophagus) which may in turn lead to cancerous changes and oesophageal [adenocarcinoma](#).¹² The need for repair of this form of hernia depends on the degree of acid reflux experienced by the patient.
- 2.9.5 **Rolling hiatus hernia.** In this case, the gastro-oesophageal junction is in the normal position, beneath the diaphragm, therefore acid reflux symptoms are uncommon. However, in this form of hernia, a portion of the stomach pushes up into the chest cavity, lying alongside the oesophagus. The herniated portion of the stomach is at risk of incarceration and strangulation and a rolling hiatus hernia should be surgically repaired before it becomes symptomatic.
- 2.9.6 Occasionally a combination of both sliding and rolling hiatus hernia occurs. This is usually associated with a very large defect in the oesophageal hiatus, and may result in other organs, in addition to the stomach, moving into the chest cavity.¹² These cases require surgical repair.

3. Aetiology

- 3.1. For an organ to herniate it is necessary for some weakness to exist in its retaining wall. This may be congenital or acquired due to trauma, disease or poor body condition. In general however, the aetiology of hernia is multifactorial.
- 3.2. The aetiology of direct and indirect inguinal hernia arises from an interaction between inherent weaknesses in the abdominal wall and factors which place increased strain on this already vulnerable area.
- 3.3. The presence of a **patent processus vaginalis**, as described above, can predispose to the development of an indirect inguinal hernia. It is the main cause of indirect inguinal hernia in infants and children. In these cases, it is managed by simply closing the internal inguinal ring in a herniotomy procedure. However, an indirect hernia is not an inevitable consequence of a patent processus vaginalis¹ which suggests that additional causative factors must be present.
- 3.4. Because of the erect posture of the adult, the inguinal region of the groin is subjected to high levels of intra-abdominal pressure, particularly during exertion. This, together with the intrinsic weaknesses in the area, accounts for the frequency with which these hernias occur.
- 3.5. Despite the weakness of the inguinal region, activities which cause contraction of the abdominal wall muscles, such as coughing, straining or lifting heavy weights, bring about a 'physiological shutter mechanism' to protect the vulnerable areas and hence maintain the integrity of the inguinal region. This occurs even in the presence of a patent processus vaginalis.³
- 3.6. However, the ability of this mechanism to withstand high intra-abdominal pressure is reduced by factors which weaken the abdominal wall muscles and connective tissue. These are outlined below:
 - 3.6.1. The development of groin hernia is most common in men aged over 50. In these cases, the 'physiological shutter mechanism' is weakened by the ageing process and only a moderate effort may be sufficient to produce a groin hernia. It is thought that, with age, there is an increase in elastic fibres in the groin area which results in decreased resistance of the transversalis fascia to intra-abdominal pressure.³ In addition to advancing age, weakness can occur from a number of other causes including lack of physical exercise, increased [adiposity](#), and any cause of prolonged immobility such as illness, bedrest, and surgical operations.
 - 3.6.2. Interestingly, the incidence of groin hernia is similar in sedentary workers and heavy manual labourers, which indicates that heavy physical activity alone is not enough to cause hernia, despite the fact that it brings about a significant and repeated increase in intra-abdominal pressure.³
 - 3.6.3. Even in fit healthy individuals, the balance between the intra-abdominal pressure, and the protective mechanisms of the abdominal wall musculature can be upset. For example, if an individual is called upon to lift an unusually heavy weight to which he or she is not accustomed, it is possible to bring about a sudden herniation.³ Cases of 'abdominal wall rupture' such as this may often occur in the presence of an underlying patent processus vaginalis. The patient may give a history of major physical activity or

heavy physical work prior to the presentation of the hernia. This is thought to be a reflection of the fact that such activity increases intra-abdominal pressure to the point where the margins of the deep inguinal ring are stretched.¹

3.6.4. The 'physiological shutter mechanism' described above is usually sufficient to resist the increased pressure and a hernia does not, therefore, appear. However, in situations where the intra-abdominal pressure increases passively, with no associated contraction of the abdominal wall muscles, the protective mechanisms are not brought into play. Causes of passively raised intra-abdominal pressure include pregnancy, peritoneal dialysis fluid, and ascites.³

3.6.5. The strength and integrity of the **transversalis fascia** is essential for the prevention of hernia. The transversalis fascia is a relatively weak component of the abdominal wall, and wherever it is inadequately supported by muscle or connective tissue, there is a tendency for a hernia to arise. It is made up mainly of collagen fibres, and the condition of these fibres is responsible for the strength of the fascia. Collagen is in a constant process of re-absorption and production. When the balance of this process is disrupted by factors reducing collagen production or increasing its destruction, the strength of the transversalis fascia may be attenuated.

3.6.5 (1) **Factors resulting in weaker collagen** include connective tissue disorders such as Marfan's syndrome, Ehlers-Danlos syndrome and Hurler-Hunter syndrome. The fact that groin hernia often shows a familial tendency indicates that heredity also plays a part. The collagen framework of the transversalis fascia in patients with groin hernia has been found to be disorganised, with increased vascularity and cellularity. This is particularly the case in direct inguinal hernia.³ Metabolic abnormalities resulting in an excess of type III collagen in the abdominal wall have been found in some patients with direct inguinal hernia but this has not been associated with indirect inguinal hernia.¹

3.6.5 (2) **Smoking** is associated with weak collagen. Cigarette smoke contains substances which increase the levels of [proteases](#) which break down collagen fibres in the body. These circulating enzymes upset the normal balance of protease/antiprotease activity and bring about the destruction of elastin and collagen fibres in the transversalis fascia and rectus sheath. This predisposes to groin hernia, particularly the direct variety, due to weakening of the transversalis fascia.³ The sequelae of long-term smoking can also increase the risks of hernia, through chronic cough and recurrent respiratory infections.

3.6.5 (3) **Physical illness** The effect of physical illness on collagen is rather similar to that of smoking. Systemic illness results in the release of proteases from white blood cells, leading to an increase in collagen breakdown.³

3.6.5 (4) **Surgical operations** can weaken the musculature of the inguinal region, specifically long low abdominal incisions which may be carried out for gynaecological or urological procedures. These may significantly affect the internal oblique and transversus abdominis muscles, and may also cut across the motor and sensory nerves of the groin, leading to further [atrophy](#) of the muscles.³ There is evidence for increased rates of right-sided inguinal hernia following appendicectomy, due to damage to the nerve fibres supplying the right transversus abdominis muscle.¹

3.7 **Epigastric hernia** occurs 5 times more commonly in women than in men, and particularly affects patients between the ages of 35 and 50. The patient is usually overweight or obese. The

herniation occurs through a defect in the linea alba. It is not yet clear how such defects arise, although the most strongly held hypothesis is that they arise in a region associated with an embryological remnant, the ligamentum teres.¹³

- 3.8 **Femoral hernia** is most common in elderly women who have borne several children. Femoral hernia is more common in females than in males because the femoral canal region forms a wider angle in the female pelvis than in the male. Intra-abdominal pressure during pregnancy increases the size of the femoral vein which in turn stretches the femoral canal. In obese middle-aged females, fatty tissue insinuates itself into the femoral canal and enlarges it further.^{6,7} With the weight loss associated with old age, the fatty tissue within the canal disappears, and a femoral hernia may develop within the remaining space.
- 3.9 **Incisional hernia** is a common problem. Patients followed up after abdominal surgery have a rate of incisional hernia of 6% at 5 years, and 12% at 10 years.⁷ The continued increase in incidence over the years following the primary operation suggests that this complication is due to weakening of the collagen in the healed wounds.⁷ Repair of these hernias is unfortunately followed by a high recurrence rate of 10-50%.⁵
- 3.10 Risk factors for incisional hernia can be categorised as those relating to the patient's condition, and those that relate to operative technique and any peri-operative complications. Those which relate to the patient include:⁵
- **Older age** (over 65) at the time of the primary operation
 - **Concurrent disease** Patients with concurrent disease, particularly immunosuppression, diabetes, jaundice, renal failure, malignant disease, and chronic obstructive airways disease, show an increased tendency for wound breakdown⁷
 - **Obesity**, particularly morbid obesity (body mass index of over 35)
 - **Significant abdominal distension** due to bowel obstruction or ascites
- 3.11 Technical factors relating to the operation and the peri-operative period include the following:
- **Post-operative wound infection** is a highly significant independent risk factor for the subsequent development of an incisional hernia. Infection delays and inhibits the healing process.¹ This is a particular problem, for example, in abdominal operations for peritonitis as it is difficult to avoid contamination of the surgical incision. The risk of wound infection can be reduced by giving prophylactic antibiotics at the time of the initial operation¹
 - **Post-operative haematoma and tissue breakdown**⁷
 - **Unskilled closure of the wound** – particularly the use of absorbable sutures, inadequate stitch size and insecure knots⁷
 - **Placement of drains or stomas** directly through wounds⁷
 - **Inappropriate/badly made incisions**⁷
 - **Other factors** which stress the abdominal wound closure post-operatively, such as coughing, vomiting and repeated urinary catheterisation, have also been implicated.

- Use of unabsorbable suture like silk can cause a persistent discharge
- 3.12 The choice of abdominal incision is important, with hernia occurring more frequently following vertical incisions as compared with transverse incisions. Midline lower abdominal incisions produce the highest risk of a subsequent incisional hernia. Other incisions which commonly result in herniation include upper midline incisions, lateral muscle-splitting incisions (McBurney's incisions), subcostal, parastomal and transverse incisions.⁷ Despite the high frequency of herniation following a midline incision, these remain the most versatile, and are used frequently for emergency procedures in cases of haemorrhage, trauma and peritonitis.
 - 3.13 In addition to these risk factors, the multiple causes of a weakened abdominal wall, outlined above, also apply to the aetiology of incisional hernia.
 - 3.14 Incisional hernia can also arise as a result of **laparoscopic surgery** through the port of entry of the laparoscope. The risk of herniation is increased if the size of the port is greater than 10mm, if the patient is obese, and if the closure of the abdominal fascia was inadequate at the time of operation.¹ The commonest location for this type of hernia is at the umbilicus, which is often quite a large port site.¹⁴
 - 3.15 The formation of a surgical stoma increases the risk of hernia, which in this case is termed a parastomal hernia. The underlying process here is that the initial surgical opening is gradually enlarged due to tangential abdominal forces pulling on the circumference of the opening.¹ Examples include paracolostomy hernia, ileostomy hernia and urinary conduit hernia. These parastomal hernias are common, and difficult to manage. For example after colostomies of the sigmoid colon, the estimated risk of a paracolostomy hernia is 35–40% during ten years of follow-up.¹
 - 3.16 **Diaphragmatic hernia** results from blunt injury to the diaphragm. A forceful blow to the abdomen or chest causes a sudden pressure differential to arise between the thoracic and abdominal cavities, resulting in a burst type injury to the diaphragm. The most common cause of such injury is motor vehicle accidents, and in particular side impact collisions. These are three times more likely to produce diaphragmatic injuries than frontal collisions. The left side of the diaphragm is more prone to herniation following blunt trauma than the right side, probably due to the force being dispersed by the dome of the liver on the right.¹¹ Iatrogenic diaphragmatic hernia can also occasionally arise following surgery to the diaphragm, particularly operations for the treatment of acid reflux.
 - 3.17 **Lumbar hernia** rarely arises spontaneously. In the majority of cases the condition is due to weakening of the muscle layers due to operations on the kidneys.⁴ They may also arise following surgical drainage of lumbar abscesses, surgery to the iliac crest of the pelvis (for example during bone graft donation)¹⁵ or due to paralysis of the lumbar musculature caused by conditions such as poliomyelitis or spina bifida.⁷ Rarely, lumbar hernia can occur as a result of acute blunt abdominal trauma.⁹ Lumbar hernia may also arise spontaneously through two anatomically weak points in the lumbar region. This is a very rare phenomenon, with only 45 cases reported in the English language literature.
 - 3.18 **Richter's hernia** This hernia occurs when only the [antimesenteric](#) border of the bowel herniates through the fascial defect. Since only a portion of the circumference of the bowel is involved there may be incarceration or strangulation without clinical evidence of obstruction. There is a risk that the portion of strangulated bowel may be inadvertently reduced into the abdominal cavity, with ensuing perforation and peritonitis. These small

hernias arise in a number of the sites of potential weakness described above, the commonest being the femoral ring, deep inguinal ring, and at previous incision sites. There have also been cases of Richter's hernia arising at the sites of trochar insertion following laparoscopic procedures.¹⁶

- 3.19 **Recurrence of a hernia** following its initial surgical repair is a common problem. The incidence of recurrence varies from 2.3-20.0% for inguinal hernia, and from 11.8%-75% for femoral hernia.³ The majority of recurrences evolve within 2 to 3 years of the initial repair, and these are largely due to deficiencies in surgical technique or post-operative infection. However, as with primary hernias, some of the risk factors for recurrence depend on the general condition of the patient. The principal causes of recurrent hernia are outlined below:
- 3.19.1 **Surgeons' experience** in carrying out the repair significantly influences the degree of tissue damage, haematoma formation and infection. Recurrence rates decrease as a surgeon's experience with the procedure develops.³
 - 3.19.2 **Tissues under tension** As a result of suturing under tension tissue [necrosis](#) may follow, causing breakdown and failure of the scar and recurrence of the hernia. For this reason, current methods of hernia repair avoid the use of tension. In particular, the use of synthetic mesh to strengthen the abdominal wall has eliminated the need for tension. These new methods have contributed to a rapid return to full activity, and a reduced recurrence rate.³
 - 3.19.3 **Infection** has been identified as a cause in around 50% of recurrent hernias. Wound infection may occur at the time of operation, or post-operatively when the patient has left hospital. A very mild infection at the skin edges is unlikely to increase the risk of hernia recurrence, but an established tissue infection in and around the wound can progress to cause tissue necrosis and deep abscess formation.³ Although the acute infection may settle with adequate treatment, and the wounds may heal, this process may be followed by a low-grade chronic inflammatory process. The process of inflammation attracts large numbers of white blood cells which release proteases and oxidants which destroy elastin, collagen and other supporting structures in the tissues.
 - 3.19.4 **The general condition of the patient** affects the process of wound healing and collagen production. Conditions such as malnutrition, low protein levels, vitamin deficiencies, jaundice, prolonged infections, chronic debilitating diseases, malignancies and long term steroid therapy can have a negative impact. Metabolic defects affecting the production of collagen, as described above, result in a high incidence of recurrent hernia.
 - 3.19.5 Although **body weight** affects the ease with which a hernia can be repaired, being overweight does not, in fact, appear to affect rates of recurrence. Markedly underweight patients are probably at greater risk of recurrent hernia.³ Patients with recurrence tend to be near or below ideal body weight.¹⁷
 - 3.19.6 **Smoking** As explained above, smoking increases levels of proteases, and hence interferes with laying down collagen and wound healing. For this reason, recurrence rates are higher in smokers than non-smokers.³

- 3.19.7 **Ascites** results in increased intra-abdominal pressure. Just as this increases rates of primary hernia, it also increases rates of recurrence. Recurrent inguinal and umbilical hernias are extremely common in patients with liver cirrhosis and ascites.
- 3.19.8 **Repeated repairs** to a hernia increase the technical difficulty of the procedure, due to repeated tissue destruction and scarring. The defect increases in size with each attempt at repair and the tissues become increasingly unyielding. Large hernias typically recur more frequently than small ones.³
- 3.19.9 **‘Missed’ hernia** In the process of repairing an initial hernia, failure to adequately explore the inguinal and femoral canals to ensure there are no other hernial sacs present, can result in the later presentation of a hernia which appears as a ‘recurrence’.³
- 3.19.10 **Type of repair procedure** This is a complex and controversial area, which is beyond the scope of this synopsis. There are several ‘standard’ methods of hernia repair, and the choice of these is usually dependent on the familiarity of the surgeon with the technique. However, experienced surgeons with expertise in the area of hernia repair generally obtain good results with recurrence rates of 1% or less whatever their preferred method.³
- 3.19.11 The current trend in hernia repair involves the use of tension-free mesh-based techniques, which may be carried out either laparoscopically or as an open operation. Mesh repair appears to reduce the rate of recurrences in groin hernia and incisional hernia.¹⁸ For the repair of incisional hernia, open tension-based suture repair results in a recurrence rate as high as 31-49 %, whereas for open mesh repair, the rate is between 0-10%. Laparoscopic mesh repair results in a slightly improved rate at 0-9%.¹⁹
- 3.19.12 **Late recurrence.** After the first five years post-operatively, the incidence of groin hernia recurrence generally tapers off. However, very late recurrences can occur, largely due to ageing of the tissues, weakened muscles and general loss of body condition, with an associated breakdown of the metabolic system responsible for maintaining the integrity of collagen.³

4. Prognosis

- 4.1 The majority of patients with a groin hernia should undergo operative repair, unless they are too unfit to undergo the risks of operation. Where non-operative management is preferable, the patient can be treated conservatively.
- 4.2 Small indirect inguinal hernias may be controlled by a truss device to support the region. Larger indirect and direct hernias need a large pad and firm belt device. These conservative approaches should only be used when the hernia is easily reducible, and when the patient has other medical conditions which would complicate operative repair.¹ The prolonged use of trusses can be associated with complications such as [atrophy](#) of the spermatic cord and deterioration of the tissue margins of the hernial sac, and their use can make subsequent surgical repair more difficult.²⁰
- 4.3 The surgical risks of elective hernia repair are low, therefore few patients should be considered unfit for the procedure.²⁰ However, the mortality associated with strangulated inguinal and femoral hernias is high in patients who have co-existent cardiovascular or respiratory disease.¹ One study²¹ found that in adult patients undergoing emergency surgery for incarcerated groin hernia, 12.9% of patients required bowel resection, and the mortality rate was 3.4%. Unfavourable outcomes were particularly associated with late presentation, late hospitalisation, concomitant illnesses and anaesthetic difficulties.
- 4.4 Surgical repair may be effected either by an open operation or by a laparoscopic technique. The laparoscopic approach to inguinal hernia repair is advantageous in that it results in less post-operative pain, reduced rates of persistent groin pain after a year of follow-up, and an earlier return to normal activities and work, as compared with the open operation.^{1,22} The laparoscopic approach also gives the best results where the hernia is bilateral, and in recurrent hernias. The recurrence rate after a first laparoscopic repair at 3 years is less than 1%.¹
- 4.5 **Complications of groin hernia repair** are unfortunately relatively common. The potential sequelae of an inguinal or femoral hernia repair are outlined below:
- 4.5.1. **Testicular ischaemia** due to disruption of the testicular blood supply. This can cause severe pain. One review estimates the frequency of this complication as 1-6% of male patients undergoing groin hernia repair. If prolonged, this can result in testicular atrophy, which may itself cause chronic testicular pain.²³ Rarely, intra-operative damage to the [vas deferens](#) during inguinal hernia repair can result in pain on ejaculation.
- 4.5.2 **Seromas** – collections of lymphatic fluid – may develop post-operatively. The majority of these will be spontaneously re-absorbed. However, if this fails to occur they may require drainage. The incidence of seromas has increased since the widespread use of prosthetic mesh, with an incidence of 0-17.6%.²⁴
- 4.5.3 **Vascular injuries** can occur with both open and laparoscopic procedures. Whilst a minor vessel injury can be easily controlled, damage to larger vessels can represent a life-threatening event.
- 4.5.4 **Neuralgia** – residual nerve pain – is a problematic complication of groin hernia repair. It has been reported in 15-20% of patients following open groin hernia repair. Chronic groin pain occurs in approximately 10% of patients.²³ In some cases the pain can be 5%¹

extremely debilitating, and may require re-exploration of the wound and division of the affected nerves. Certain patient factors are known to be predictive for the risk of developing chronic post-operative pain. These include the presence of pain pre-operatively, repeat surgery, psychological vulnerability, an ongoing worker's compensation claim, a surgical approach which increases nerve damage, severe immediate post-operative pain, radiation therapy and chemotherapy, depression, neuroticism and anxiety. Mesh repair appears to result in less chronic pain than non-mesh repair, presumably due to an easier suture technique and thus less risk of nerve damage.^{23,25}

4.5.5 Chronic groin pain secondary to hernia repair has been associated with resulting restrictions during work, sport, other leisure activities and sexual activity. A study of patients one year after inguinal herniorrhaphy found that 22.1% suffered from pain during sexual activity. Genital or ejaculatory pain was found in 12.3% and 2.8% reported that pain impaired their sexual activity to a moderate or severe degree.²⁶

4.5.6 **Bladder and bowel damage.** Trauma to the urinary bladder can occur in both open and laparoscopic hernia repair. Laparoscopic surgery is associated with urinary complications in 1.5-5% of cases, including urinary retention, infection and bleeding.²⁴ Damage to the small and large bowel can occur when freeing an incarcerated or strangulated segment of bowel, or due to inadvertent laceration of the bowel. Bowel damage is a particular risk with femoral hernias which have become strangulated.

4.5.7 **Wound infection.** Factors which have been found to increase the risk of wound infection include patients aged over 70 and the presence of a post-operative drain (which increases infection incidence by a factor of 9). Other factors include incarcerated and recurrent hernias, and longer duration of surgery. Where infection occurs in the presence of a prosthetic mesh, this can present a challenge post-operatively, requiring aggressive management with systemic antibiotics, exposure of the prosthesis, irrigation and partial resection of the mesh.²³ Rarely does an infected mesh require total removal.

4.6 **Incisional hernia.** Depending on the degree of symptoms, these may or may not require surgical repair. Even when repaired, there is a risk of recurrence.

4.6.1 Factors associated with recurrence following mesh repair of incisional hernia are older age (over 70 years), initial hernia size greater than 6cm, no prophylactic antibiotic given at the time of the repair operation, wound infection, obesity, and the hernia being a recurrent one.¹ However, the most important prognostic factor following mesh repair is the surgeon's level of experience with the technique.²⁷ Best results are obtained by experienced surgeons with a particular interest in incisional hernia repair. Unfortunately, each time a hernia requires further repair, the defect tends to be larger. When the hernia becomes greater than 10cm in diameter, the repair may require not only the use of a mesh but also reconstruction of the abdominal wall using muscle flaps taken from elsewhere in the body.¹

4.6.2 Sometimes incisional hernias, particularly those in the central abdomen, can become very large indeed (up to 24cm long). Repair of these massive defects is a specialist procedure which requires plastic surgical intervention to carry out the appropriate muscle transfer procedures. Despite the complexity of the repair process, most heal well and only about 10% recur, with few complications – mainly seroma formation and infection of the superficial tissues. However, the associated mortality is estimated at 4-5%.¹

- 4.7 **Para-stomal hernia** presents a particular challenge, and no one technique has been found to be reliably effective. There are four different repair techniques which are used, but irrespective of the choice of technique, the repair is often unsuccessful with a recurrence rate of 30% after 5 years of follow-up.¹
- 4.8 While the majority of **epigastric hernias** are small, asymptomatic, and do not require surgical intervention, the larger and symptomatic ones require attention. The surgical repair involves excision of the hernial sac and repair of the abdominal wall connective tissues. These operations are generally very successful, other than in obese patients.¹
- 4.9 **Early post-operative recovery and mobilisation.** Healing following repair of a groin hernia is complete in approximately one year. The process involves the production of collagen and its remodelling into fibres which lie according to the lines of stress. Six months after repair the wound will have gained approximately 80% of its final strength.
- 4.9.1 Early return to normal unrestricted activities, including heavy work, does not increase rates of recurrence. In fact, people with more sedentary occupations have a recurrence rate which is twice that of heavy manual labourers.³ The time taken to return to work is generally dependent on psychosocial and economic factors such as the patient's motivation, social class and type of work. The post-operative convalescence time has not been shown to influence the recurrence rate.³
- 4.9.2 However, despite the fact that the recurrence of an inguinal hernia is independent of the rate of return to normal activities and the type of work done, studies show that the average time off work recommended by GPs and surgeons is nearly always influenced by the patient's occupation.¹⁷ For individuals in sedentary work, the mean time advised by surgeons to stay off work is 2.8 weeks, whereas GPs advise a mean of 5.1 weeks. Patients have been found to take a mean of 3.1 weeks off.²⁰
- 4.10 **Return to driving post-operatively.** One small study has researched this issue, and demonstrated that the reaction time in an emergency stop situation took on average 10 days to return to pre-operative levels.²⁰

5 Summary

- 5.1 Hernia, in its various forms, represents a common, and potentially very serious surgical condition. Hernia can cause abdominal pain and discomfort, and may lead to irreversible damage to abdominal organs through the process of strangulation. In the majority of cases, the condition will require surgical repair in order to avoid this outcome.
- 5.2 Men and women are affected to differing degrees by the various forms of hernia. In particular, femoral hernia is more common in women, and men are more prone to indirect inguinal hernia.
- 5.3 Hernia should be regarded as having a multi-factorial aetiology. Longstanding weaknesses in the abdominal wall, which may have been present from childhood, are often exacerbated by other risks, many of which are related to lifestyle factors such as smoking.
 - 5.3.1 The impact of heavy physical work on hernia formation is not as great as might be expected. However, this can represent a risk factor when the individual is unaccustomed to exercise which places great strain on the abdominal muscles.
- 5.4 Although surgical repair of hernia is a common procedure, it is associated with a number of potential complications including organ damage and chronic pain. One of the most challenging problems remains the relatively high risk of recurrence. However, in the majority of cases, patients are able to return to work and normal activities a few weeks after the operation.

6 Related synopses

7 Glossary

adenocarcinoma	A tumour arising from glandular tissue.
adiposity	Obesity; excessive accumulation of lipids in a site or organ.
anterior superior iliac spine	The anterior extremity of the iliac crest, which provides attachment for the inguinal ligament.
antimesenteric	Pertaining to the part of the intestine that lies opposite the mesenteric attachment.
ascites	Free fluid in the abdomen which may be due to a variety of conditions, including chronic liver disease or malignancy, or the use of peritoneal dialysis fluid.
atrophy	Wasting, diminution in size.
diaphragm	The strong muscular sheet dividing the abdominal cavity from the chest cavity.
fascia	A sheet of connective tissue. See <i>transversalis fascia</i> .
femoral canal	The most medial component of the femoral sheath, which contains the femoral artery and vein as they pass from the abdomen to the leg.
gastro-oesophageal junction	The anatomical connection between the oesophagus and the stomach.
haematoma	A collection of blood in the tissues following damage to blood vessels (a “bruise”).
iatrogenic	Induced inadvertently by medical treatment or procedures.
linea alba	A midline fibrous band which extends from the lowest part of the sternum (qv) to the pubis.
necrosis	Tissue changes indicative of cell death.
obturator canal	A 3cm long fibrous channel running

	between the lower surface of the pubic bone and the border of the obturator membrane, which lies at the outlet of the pelvis.
peritoneum	A fine layer of tissue covering the abdominal organs.
peritonitis	An area of inflammation of part or all of the abdominal lining tissue.
processus vaginalis	A thin pouch of peritoneum that is carried into the scrotum by the descent of the testicle.
prophylactic	Preventative.
protease/antiprotease	Relating to enzymes which break down proteins, and those which block protein breakdown, respectively.
pubic tubercle	A small projection at the anterior extremity of the crest of the pubic bone.
sternum	The breastbone.
transversalis fascia	The deep layer of connective tissue which lies beneath the abdominal wall muscles.
vas deferens	Duct which transports sperm from the epididymis to the urethra.

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