The Royal College of Pathologists
Pathology: the science behind the cure

# Guidelines on autopsy practice

## Autopsy examination following bariatric surgery

**July 2025**

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|---|---|
| **Unique document number** | G173 |
| **Document name** | Guidelines on autopsy practice: Autopsy examination following bariatric surgery |
| **Version number** | 2 |
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| **Date active** | July 2025 **(to be implemented within 3 months)** |
| **Date for full review** | July 2030 |
| **Comments** | This document will replace the 1st edition of the *Autopsy examination following bariatric surgery*, published in 2019.<br>In accordance with the College's pre-publications policy, this document was on the Royal College of Pathologists' website for consultation from 6 May to 3 June 2025. Responses and authors' comments are available to view at https://www.rcpath.org/profession/publications/documents-in-development.html.<br>**Dr Brian Rous**<br>**Clinical Lead for Guideline Review** |

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# Contents

# Foreword

The autopsy guidelines published by the Royal College of Pathologists (RCPath) are guidelines that enable pathologists to deal with non-forensic consent and coroner's/procurator fiscal post-mortem examinations in a consistent manner and to a high standard. The guidelines are systematically developed statements to assist the decisions of practitioners and are based on the best available evidence at the time the document was prepared. Given that much autopsy work is single observer and 1-time only in reality, it has to be recognised that there is no reviewable standard that is mandated beyond that of the FRCPath Part 2 exam or the Certificate of Higher Autopsy Training (CHAT). Nevertheless, much of this can be reviewed against ante-mortem imaging and other data. This guideline has been developed to cover most common circumstances. However, we recognise that guidelines cannot anticipate every pathological case type and clinical scenario. Occasional variation from the practice recommended in this guideline may, therefore, be required to report an autopsy in a way that maximises benefit to the pathologist, coroner/procurator fiscal and the deceased's family.

There is a general requirement from the General Medical Council (GMC) to have continuing professional development (CPD) in all practice areas; this will naturally encompass autopsy practice. Those wishing to develop expertise/specialise in pathology are encouraged to seek appropriate educational opportunities and participate in the relevant external quality assurance (EQA) scheme.

The guidelines themselves constitute the tools for implementation and dissemination of good practice.

The following stakeholders were consulted for this document:

- the Human Tissue Authority (HTA)
- the Coroners' Society of England & Wales
- the Crown Office and Procurator Fiscal Service
- the Coroners Service for Northern Ireland
- Association of Upper Gastrointestinal Surgery of Great Britain and Ireland.

The information used to develop this document was derived from current medical literature and the previous version of this guideline. Much of the content of the document represents custom and practice and is based on the substantial clinical experience of the authors. All

evidence included in this guideline has been graded using modified SIGN guidance (see Appendix C). The sections of this autopsy guideline that indicate compliance with each of the AGREE II standards are indicated in Appendix D.

No major organisational changes or cost implications have been identified that would hinder the implementation of the guidelines.

A formal revision cycle for all guidelines takes place on a 5-yearly cycle and the full revised version (incorporating the changes) will replace the existing version on the College website.

The guideline has been reviewed by the Professional Guidelines team, Death Investigation Committee and Lay Advisory Group. It was placed on the College website for consultation with the membership from 6 May to 3 June 2025. All comments received from the membership were addressed by the authors to the satisfaction of the Clinical Lead for Autopsy Guidelines.

This guideline was developed without external funding to the writing group. The College requires the authors of guidelines to provide a list of potential conflicts of interest; these are monitored by the Professional Guidelines team and are available on request. The authors have declared no conflicts of interest.

# 1 Introduction

It is a requirement to report deaths during an operation or before recovery from anaesthetic in the UK to the coroner or procurator fiscal. With increasing levels of obesity, and significant numbers of weight loss operations performed, it is important for the autopsy pathologist to understand the surgical procedures, post-operative course and the complications that can arise because of these procedures. The pathophysiology of bariatric surgery is also of importance as many deaths following this type of surgery may have a significant metabolic component. It has been reported previously that autopsies in obese patients are performed in a non-standardised manner.[1] This document was created to address the specific difficulties in performing autopsies in patients who have undergone bariatric surgery and indicates a technical approach and investigations that should prevent criticism of case analysis in medicolegal environments.

There has been a significant rise in the rates of obesity in the UK population. In 2019, 27% of men and 29% of women were obese (body mass index (BMI) >30). Around 2/3 of adults were overweight or obese – more prevalent among men (68%) than women (60%).[2]

Obesity is a risk factor for significant illness including hypertension, type 2 diabetes mellitus, cardiovascular disease, and some malignancies, such as breast, oesophageal and colorectal cancers. Obstructive sleep apnoea and osteoarthritis are also associated comorbidities.[3] Obesity causes significant psychological distress and social stigmatisation. In 2019/20, there were 1,022,000 admissions in NHS hospitals in which obesity was recorded as a factor. 10,780 admissions were directly attributable to obesity.[4] There are estimated to be 30,000 deaths attributed to obesity in the UK each year, which is equivalent to 6% of all deaths.[5] As obesity is not always mentioned on death certificates, numbers may be an underestimate. The implication of these data is that the number of cases referred to the autopsy service is likely to increase.

Obesity is defined by BMI, which is calculated as the subject's weight in kilograms divided by the square of their height in metres. A BMI over 30 is classified as obese, with over 40 being classified as severe obesity. Generally, obesity is caused by calorie intake exceeding energy expenditure, although a small proportion of cases may be attributed to drug side effects, endocrine disorders or other medical conditions. Rising rates of obesity in the population are attributed to easily accessible high-calorie diets with an increase in sedentary lifestyles.

### 1.1 Target users of these guidelines

The target primary users of this guideline are established consultants performing autopsies. The recommendations will also be of value to trainee pathologists, particularly those approaching the Certificate of Higher Autopsy Training (CHAT) examination and the FRCPath Part 2 in forensic pathology. In addition, these recommendations may be of use to mortuary staff who routinely perform these cases, undertakers and hospital managers who need to provide equipment and facilities capable of delivering this type of service.

## 2 The role of the autopsy

- To determine whether the death is related to the bariatric surgical procedure.
- To consider whether death is due to an unrelated, otherwise natural, cause.
- To examine the integrity of all surgical anastomoses.

- To describe other comorbidities that may have contributed to death.

*[Level of evidence – D.]*

# 3 Specialist management of obesity

## 3.1 Surgical management of obesity

Surgical management of obesity is indicated for individuals with a BMI greater than 40 kg/m$^2$, or greater than 35 kg/m$^2$ with other significant disease (for example, type 2 diabetes or hypertension). Current recommendations also recommend using lower BMI levels for people of Asian, Middle Eastern, Black African or African-Caribbean backgrounds. The National Institute for Health and Care Excellence (NICE) recommends patients who have already tried appropriate non-surgical measures that have failed to achieve or maintain adequate weight loss for at least 6 months, and the person is fit for anaesthesia and surgery, with commitment to long-term follow-up.[6]

There are several procedures commonly carried out in the UK, as described in Appendix A. The most commonly performed procedures are gastric band surgery, Roux-en-Y gastric bypass surgery with duodenal switch, biliopancreatic diversion and duodenal bypass surgery, and sleeve gastrectomy (gastric sleeve). Gastric balloon procedure uses endoscopic techniques to inflate a balloon in the stomach to produce early satiety.

Following successful weight loss, an individual might require further procedures that address loose skin, such as abdominoplasty, ‘apronectomy’ or procedures that address loose skin across the arm and legs. While achieving certain cosmetic results, they are often performed to manage medical complications of excess skin at these sites. These might be performed in an NHS setting if strict criteria are met or performed in a private setting. These procedures may be performed alongside liposuction. Liposuction might also be performed as a standalone procedure.

## 3.2 Medical management of obesity

Pharmacological management for obesity has been available for many years in the form of Orlistat, to inhibit fat absorption. Recently, injectable medications, which are GLP-1/GIP agonists, have been developed that cause delayed gastric emptying, inhibit the release of glucagon and stimulate insulin production, the combined effect of which is to reduce blood glucose levels in people with type 2 diabetes and reduce food intake and therefore body weight. Common examples include liraglutide (Saxenda and Victoza),

semaglutide (Ozempic, Wegovy, Rybelsus) and tirzepatide (Mounjaro). These are relatively well tolerated, but important side effects described are gastroparesis, nausea and vomiting, diarrhoea, constipation and pancreatitis. NICE recommends GLP-1 agonists should be used as part of a package of care provided in a specialist weight management service, but these drugs may be accessed by individuals from online weight loss websites.[7]

# 4 Pathology encountered at the autopsy

Deaths following bariatric surgery can largely be divided into recognised complications of surgery, complications of anaesthesia, hospital-acquired infection or natural causes precipitated by the physiological insult of major surgery in an obese individual.[8] Careful inspection should be made, so as to be able to discuss the relative contributions of each component. Deaths occurring some months or years after the initial weight loss surgery may still be related to the operation and are an important part of the past medical and surgical history. For a more thorough description of the types of injury that may occur, please see Appendix B.

The following pathology may occur owing to bariatric surgery:

- anastomotic leaks, due to localised haemorrhage, infarction or technical failure
- intraluminal bleeding
- sepsis and multi-organ failure
- surgical wound infections
- visceral injury from trocar placement
- splenic injury
- hepatic injury or haemorrhage in the context of hepatomegaly due to metabolic dysfunction-associated steatotic liver disease (MASLD)
- portal vein injury and portal vein thrombosis
- bowel ischaemia and internal hernias
- misconstruction of the diverted GI tract
- venous thromboembolism (VTE) and pulmonary thromboembolism
- myocardial infarction and congestive cardiac failure

- post-operative pneumonias
- gastric remnant distension following gastric bypass causing perforation and peritonitis
- marginal ulcers at the gastro-jejunostomy site
- infection of a gastric band or erosion of the band through the stomach wall.

Obesity provides a particular anaesthetic challenge, with increased weight having a significant impact on an individual's physiology and the additional risks of anaesthetising a patient with significant comorbidities.[9] Concerns that a perioperative death resulted from anaesthesia should lead to careful consultation with an anaesthetist. Conditions encountered include:

- pneumothorax
- gas embolism
- surgical emphysema
- aspiration pneumonia/pneumonitis
- airway difficulties
- anaesthetic agent reactions, including anaphylaxis (please also see the RCPath *Guidelines on autopsy practice: Autopsy for suspected acute anaphylaxis*).

Deaths occurring in the medium to long-term following bariatric surgery may include the following pathology:

- gastric band slippage, port or tubing malfunction
- leakage at the port site tubing or band
- anastomotic breakdown
- gastric pouch or oesophageal dilatation and oesophagitis
- acute alcohol intoxication due to changes in metabolism[10]
- alcohol abuse or dependence[11]
- cholelithiasis and choledocholithiasis with cholecystitis
- metabolic and nutritional derangements
- nephrolithiasis and renal failure
- post-operative hypoglycaemia.

Deaths occurring after successful weight loss for management of excess skin or liposuction procedure might include the following pathology:

- pulmonary embolism
- fat embolism
- post-operative haemorrhage
- post-operative infection, including necrotising fasciitis
- viscus perforation
- seroma.

*[Level of evidence – C.]*

# 5 Specific health and safety implications

Deceased people with increased body weight pose a challenge for the mortuary. Equipment such as trays, trolleys and tables need to be able to tolerate extra weight and refrigeration spaces also need to have the correct dimensions to accommodate a patient. Mortuary scales need regular calibration; the mortuary should ensure it has equipment capable of weighing and transferring the growing number of patients with increased body weight. Considerations are also needed for patients to be viewed in the chapel if requested by a family. In some instances, makeshift viewing facilities have been arranged in an access-controlled corridor for patients unable to use the chapel beds, which is clearly not ideal for either family or staff. Redesigns and refitting of viewing facilities should take this into account. Contingency plans should be in place, including service-level agreements, to accommodate patients at other facilities if local storage is full or otherwise unavailable.

When performing a bariatric post mortem, a significant number of manual handling events need to occur. The transfer of the deceased from the trolley to the post-mortem table requires a lateral movement, with manual handling guidance being that at waist level each individual should be moving 15–20 kg, necessitating a large number of people for a safe transfer. This is also the case for rolling the deceased for the pathologist to view the back. Care should be taken to avoid increasing the risk of musculoskeletal problems. For future mortuary design, an element that allows trays that lock into tables to accommodate patients with increased body weight is likely to be desirable.

The evisceration procedure is technically more difficult in obese patients, owing to increased subcutaneous fat making reflection of skin more difficult. There are also

significant risks to anatomical pathology technicians and pathologists performing evisceration as the blade may not be easily visualised. Removal of the brain becomes technically more difficult to perform with a respectful incision, owing to reduced neck extension. Restoring the body is also more technically difficult as the sutured skin incision can be pulled open due to strain on it from excess soft tissue. Local practice is to stitch the deep fascia before the skin, so the strain on the suture line is dissipated.

Some mortuaries may lack the facilities to accommodate a referral for post mortem in a patient with increased body weight and need to refer the case to another local hospital. This creates transportation issues and increases the time the deceased's body is not able to be released to the family.

*[Level of evidence – GPP.]*

# 6 Clinical information relevant to the autopsy

- Circumstances of death will assist in the assessment of the cause of death and the contribution, if any, of the surgical procedure.
- Past medical history will assist in the assessment of the cause of death and the contribution, if any, of the surgical procedure. Confounding factors, such as tobacco smoking history or alcohol use, can impact on the pathology assessment of obesity-related disease.
- It is important to assess the contribution of therapeutic drugs to the death. During surgery, drugs may have been withheld or incorrectly continued. Immediately following surgery, there may be issues with altered absorption; in the longer term, weight loss may lead to increased plasma levels. Where appropriate, it should be assessed whether drugs had been adequately dose adjusted.
- The medical records, and often the witness statements, are required to detail the operative and post-operative course. Identify from these the exact procedure and modifications performed and if there were any operative complications.
- Pre- and post-operative investigation results looking for evidence of potential metabolic abnormalities including diabetes, ketoacidosis, renal failure and pancreatitis. Look at temperature charts and electrocardiogram traces for evidence of sepsis or electrolyte imbalance.

- Review any imaging studies that may assist in determining the anatomy of the surgical procedure and the presence of any leaks.

*[Level of evidence – GPP.]*

# 7 The autopsy procedure

A complete post-mortem examination including the central nervous system should be performed. A limited post mortem confined to examination of surgical site is considered suboptimal.

*[Level of evidence – GPP.]*

# 8 Post-mortem imaging

Post-mortem imaging is an emerging technique and may be requested for cultural or religious reasons.

There are often local arrangements for imaging, which may be off-site. To facilitate this, the HTA has confirmed that non-invasive post-mortem examinations that do not include sampling do not need to be performed on HTA-licensed premises.[12] Considerations for imaging obese patients include weight limitations on the scanner and trolleys necessary for transporting and the dimensions of the scanner aperture. CT scanning in live, obese patients can suffer from reductions in image quality owing to beam hardening and limited field of view; however, patients who have predominantly intraperitoneal fat may have improved visualisation of organs owing to delineation of internal organ structures by fat.[13]

Unfortunately, for application in bariatric surgery, imaging autopsies cannot reliably recognise some of the common causes of death following this type of surgery, including coronary artery disease (unless combined with angiography), pulmonary embolism and pneumonia. The presence of a pneumoperitoneum on post-mortem CT imaging does not necessarily demonstrate viscus perforation, since this can also be seen as secondary to decomposition, or trocar placement, but might alert the pathologist to a more detailed limited inspection of potential viscus perforation.

Local policies for post-mortem imaging need to include the maximum weight and dimensions of the scanner. Families may require counselling before imaging that there is an increased risk of an uncertain outcome, which could lead to proceeding with a conventional autopsy.

# 9 Specific significant organ systems

Table 1 summarises common conditions that may be encountered in the context of a post mortem after bariatric surgery, although this is not an exhaustive list.

**Table 1: Significant organ systems.**

| **Organ/system and pathology** |
|---|
| **Lungs** |
| • Pneumonia or aspiration pneumonia<br>• Chronic obstructive pulmonary disease<br>• Pulmonary hypertension<br>• Pulmonary thromboembolism<br>• Air embolism |
| **Heart** |
| • Myocardial infarction<br>• Hypertensive heart disease<br>• Obesity-related cardiomyopathy |
| **Central nervous system** |
| • Cerebral haemorrhage<br>• Cerebral infarction |
| **Hepato-pancreatic biliary** |
| • Cholelithiasis<br>• Pancreatitis<br>• MASLD<br>• Cirrhosis |
| **GI tract** |
| • Perforation of a viscus<br>• Anastomotic leak<br>• Bowel infarction<br>• Superior/inferior mesenteric artery occlusion<br>• Occlusion of the coeliac axis<br>• Faecal peritonitis<br>• Paralytic ileus<br>• Incisional and internal hernias<br>• Failure of gastric band or medical device |
| **Haematoreticular system** |
| • Splenic haemorrhage |
| **Metabolic** |

- Hyper/hypoglycaemia
- Drug toxicity

*[Level of evidence – GPP.]*

# 10 Organ retention

Organ and tissue sampling will largely depend on clinical suspicion and the need to exclude a particular pathology. It is not essential to retain whole organs or sagittal slices when adequately sampled tissue will suffice for purposes of diagnosis and causation. Where a death might result in a medicolegal claim, judicious sampling is encouraged. It is recommended that the time for tissue retention be at least 5 years to allow for the slow passage of medicolegal cases, with the appropriate consent from the family as per the Human Tissue Act 2004.[14]

*[Level of evidence – GPP.]*

# 11 Histological examination

Clinical judgement must be used to assess the need for histology in each individual case in compliance with the *Coroners (Investigations) Regulations 2013* and procurator fiscal policy.

Histological sections may be considered from:

- all sites of anastomosis
- gastric mucosa for *Helicobacter pylori*
- any region of bowel suggestive of infarction
- the heart, to exclude myocardial infarction, obesity cardiomyopathy or other cardiac causes of death
- the lungs, to confirm or refute aspiration pneumonia/pneumonia
- the liver, which should always be sampled, to assess for microscopic changes related to obesity and metabolic factors
- the kidneys, to assess changes relating to hypertension or diabetic nephropathy
- other pathology as indicated.

# 12 Toxicology

Toxicology samples of blood, urine and vitreous fluid should be taken if any of the following are suspected:

- hypoglycaemia
- diabetic ketoacidosis
- pancreatitis
- drug reactions/overdose
- alcohol.

In addition, it is important to assess the contribution of therapeutic drugs to the death. During surgery, drugs may have been withheld or incorrectly continued. Immediately following surgery, there may be issues with altered absorption; in the longer term, weight loss may lead to increased plasma levels. Where appropriate, whether drugs had been adequately dose adjusted for body weight or ideal body weight should be assessed.

*[Level of evidence – GPP.]*

# 13 Clinicopathological correlation

With the permission of the coroner or procurator fiscal, it may be advisable to discuss perioperative deaths with the surgeon or invite them to the mortuary at the time of the examination. The case notes should be examined and any pathological abnormalities should be considered in the context of the clinical findings. In the context of bariatric surgery, metabolic abnormalities should be considered, especially if there have been anaesthetic complications. Permission should always be sought to discuss anaesthetic deaths with the anaesthetist.

*[Level of evidence – GPP.]*

# 14 Examples of cause of death opinions/statements

1a. Peritonitis

1b. Breakdown of surgical anastomosis

1c. Roux-en-Y gastric bypass surgery with duodenal switch (date) for morbid obesity

1a. Multiple organ failure

1b. Post-operative haemorrhage and sepsis

1c. Sleeve gastrectomy (date) for morbid obesity

2. Type 2 diabetes mellitus

1a. Pulmonary thromboembolism

1b. Deep venous thrombosis

1c. Morbid obesity

2. Gastric band surgery (date)

1a. Renal failure

1b. Nephrolithiasis

1c. Hyperoxaluria

1d. Roux-en-Y gastric bypass surgery with duodenal switch (date) for morbid obesity

1a. Acute necrotising pancreatitis

1b. Choledocholithiasis

1c. Gastric band surgery (date) for previous morbid obesity

1a. Sepsis and multi-organ failure

1b. Perforated stomach (repaired)

1c. Morbid obesity (date of surgery)

2. Cirrhosis of the liver

*[Level of evidence – GPP.]*

# 15 Criteria for audit

The following standards are suggested criteria that might be used in periodic reviews to ensure a post-mortem report for coronial autopsies conducted at an institution comply with the national recommendations provided by the 2006 NCEPOD study:[15]

- supporting documentations:
  - standards: 95% of supporting documentation was available at the time of the autopsy
  - standards: 95% of autopsy reports documented are satisfactory, good or excellent
- reporting internal examination:
  - standards: 100% of autopsy reports include a description of internal appearance
  - standards: 100% of autopsy reports documented are satisfactory, good or excellent
- reporting external examination:
  - standards: 100% of autopsy reports include a description of external appearance
  - standards: 100% of autopsy reports documented are satisfactory, good or excellent.

A template for coronial autopsy audit can be found on the RCPath website.[16]

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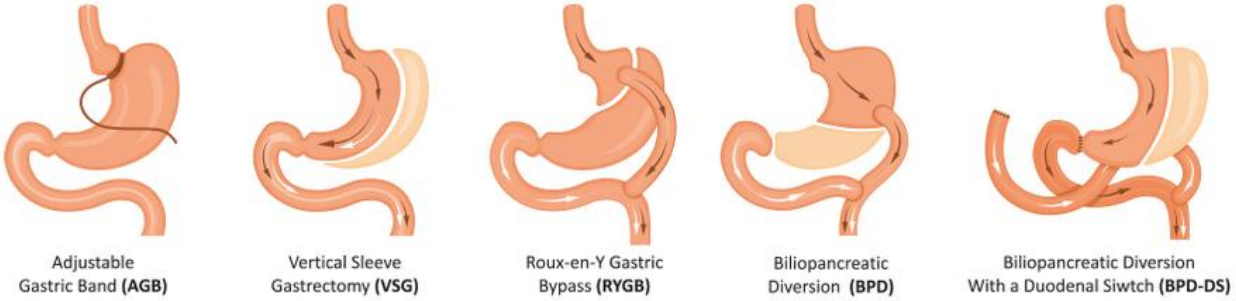
# Appendix A Surgical management of obesity

There are several procedures commonly carried out in the UK for surgical management of obesity, which can be divided into those causing malabsorption (biliopancreatic diversion, jejunoileal bypass and endoluminal sleeve surgery), restrictive processes (vertical banded gastroplasty, adjustable gastric band surgery, sleeve gastrectomy, gastric balloon insertion and gastric plication) and mixed procedures (including Roux-en-Y gastric bypass surgery with duodenal switch) (Figure A1).

**Figure A1: Types of bariatric surgery.**




The 2 most commonly performed procedures in the UK are gastric band surgery and Roux-en-Y gastric bypass surgery with duodenal switch. Gastric banding is usually performed laparoscopically under general anaesthesia. A band is placed around the stomach, dividing the stomach into 2 compartments, with the proximal pouch at the top of the stomach being small so as to induce satiety. The band can be inflated with sterile saline through an access port to allow adjustment. Gastric bypass is also performed laparoscopically under general anaesthesia; in this procedure, a small pouch is created at the top of the stomach that is anastomosed to the small intestine. This operation induces early satiety and causes malabsorption.

A sleeve gastrectomy may be used to treat people with a BMI greater than 60. In this procedure, a section of the stomach is surgically removed, reducing the size of the stomach to a quarter of the normal volume. A biliopancreatic diversion uses the same principles as a gastric bypass; however, by bypassing a larger section of the small intestine, it can result in a high rate of complications and side effects. An intra-gastric balloon – made from silicone – is surgically implanted into the stomach endoscopically and filled with air or saline, effectively reducing the available space and inducing early satiety. This is often a temporary procedure and used when an individual is unsuitable for permanent surgery.

In 2008–2009, 4,200 bariatric operations were carried out in England; this increased to 8,600 in 2010–2011.[1] In 2019–2020, there were 6,740 hospital admissions with a primary diagnosis of obesity and a main or secondary procedure of bariatric surgery.[2] 80% of admissions were for females. The decrease may be related to increased use of injectable anti-obesity drugs.

Increasing numbers of operations are being performed abroad, where costs are lower, and surgeons may operate on those with a BMI greater than or equal to 30.

Surgery leads to a stabilised weight loss of between 14% and 25% at 10 years depending on the operation type.[3] A meta-analysis identified a complication rate of 17% and reoperation rate of 7%.[4]

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# Appendix B Risks associated with surgical management of obesity

Deaths following bariatric surgery may be due to recognised complications of surgery, complications of anaesthesia, hospital-acquired infection or natural causes precipitated by the physiological insult of major surgery in an obese individual. Careful inspection should be made to allow discussion of the relative contributions of each component. Deaths occurring some months or years after the initial weight loss surgery may still be related to the operation, therefore it should be considered an important part of the past medical and surgical history.

There are a number of risks specific to bariatric surgery itself.

- Injury to viscera may occur from trocar placement (a procedure that is more difficult in obese individuals).
- The spleen may be injured, requiring haemostasis measures.
- The portal vein can be injured with consequent portal vein thrombosis.
- Hepatomegaly, due to steatohepatitis, is frequently seen in obese patients and can cause difficulties in viewing the abdomen, as well as risk of bleeding during laparoscopic surgery.
- Bowel ischaemia may occur if the root of the mesentery is compromised during transection of the small bowel, or if the mesentery is under tension during anastomosis formation.
- Bowel ischaemia may result from internal hernias; it is important to look for these in a post-mortem case.
- There is a risk of misconstruction of the diverted GI tract, which leads to the biliopancreatic secretions returning to the stomach pouch, inversion of sections of the GI tract or the distal jejunum becoming disconnected from the proximal GI tract.
- Leaks following bariatric surgery have been seen in up to 6% of patients; most occur within a week, but they are much more likely to occur after revisional surgery.[1] Leaks can be caused by technical failure or follow localised bleeding at the anastomosis, which causes failure. Obese patients are at increased risk of anastomotic leaks

compared with non-obese patients undergoing GI surgery owing to their poor nutritional state.

- Patients may present with signs of sepsis. Surgical wound infection rates vary with the operation used and whether it is performed laparoscopically or open. The incidence can be decreased by judicious use of perioperative antibiotics. The wound should be inspected in all post-operative deaths and culture considered where sepsis is thought to have had a role.
- Bleeding after gastric bypass has been described in up to 4% of patients and is usually intraluminal and from the anastomotic site.[2] The presence of free blood in the thoracic cavity, abdominal cavity or GI tract should be quantified and commented on. A bleeding source should be identified.
- VTE and pulmonary thromboembolism account for a high proportion of deaths following bariatric surgery, with data from the BOLD database showing that the incidence of VTE was 0.29% for laparoscopic procedures and 1.2% for open procedures.[3,4] Risk factors for VTE include severe venous stasis disease, BMI >60, truncal obesity and obesity-hypoventilation syndrome.[4] Pulmonary thromboembolism can present in a very similar way to a post-operative leak causing sepsis. In a bariatric post mortem, it is important to look directly for each entity regardless of the presumed diagnosis.
- Myocardial infarction and congestive cardiac failure occur in 0.2% of patients within 30 days of bariatric surgery.[5] Routine weighing and inspection of the organs at post mortem, with judicious histological sampling, will identify such cases.
- Post-operative pneumonias associated with increased length of stay, ventilator use and atelectasis may occur. Predictors for post-operative pneumonia include past medical history of heart failure, chronic obstructive pulmonary disorder, bleeding disorder, smoking, increasing age and the type of procedure performed.[6]

There are also less-common complications specific to particular bariatric operations.

- After Roux-en-Y gastric bypass, gastric remnant distension may rarely occur if there is a paralytic ileus secondary to vagal injury, or distal mechanical obstruction occurs post-operatively. Continued distension can lead to perforation and peritonitis from the gastric contents.
- Marginal ulcers may be seen at the gastro-jejunostomy site due to acid entering the jejunum, poor tissue perfusion, the presence of suture or staple material, non-steroidal

anti-inflammatory drug use, smoking or *Helicobacter* infection; the latter is high in patients undergoing bariatric surgery. Patients are at risk of bleeding and perforation of marginal ulcers.

- Roux-en-Y surgery places patients at risk of ventral incisional hernia and internal hernias with the additional risk of developing subsequent bowel obstruction, infarction and perforation.
- Gastric banding has been associated with several complications, such as causing an infection of the band or gastric perforation due to over distension of the pouch because of overeating or erosion of the band through the stomach wall.
- Post-operative changes in oesophageal peristalsis and sphincter relaxation increases the risk of regurgitation and resultant aspiration, particularly during general anaesthetic, and the post-mortem pathologist should assess potential aspiration in post-operative pneumonia.[7,8]

## Anaesthetic complications

Obesity provides a particular anaesthetic challenge, with excess weight having a significant impact on an individual's physiology and the additional risks of anaesthetising a patient with significant comorbidities. An obese patient's respiratory system has reductions in functional reserve capacity and total lung capacity, increased risk of intrapulmonary shunting, increased oxygen consumption and carbon dioxide production, decreased lung compliance and increased mechanical pressure from the abdomen that leads to decreased respiratory efficiency.[9] High pressures may be needed to insufflate the abdomen during laparoscopic bariatric surgery with further increased intra-thoracic pressures and decreased functional capacity, and an increased risk of pneumothorax, gas embolism and surgical emphysema.[10]

When an obese patient undergoes anaesthesia, airway difficulties and desaturation at the time of induction may be encountered owing to restricted cervical spine movement and redundant oral tissue. The pharmacokinetics of anaesthetic agents are altered in morbid obesity. Concerns that a perioperative death is due to anaesthesia should lead to careful consultation with an anaesthetist.

## Metabolic complications

Gastric bypass surgery changes the way alcohol is metabolised so that patients are more susceptible to the effects of alcohol, experiencing longer, more intense acute intoxication

and needing more time to become sober. Gastric bypass patients experience higher peak blood alcohol levels than they did before gastric bypass surgery.[11] There is evidence that a small percentage of patients undergoing weight loss surgery appear to develop alcohol abuse or dependence.[12] These combined factors might make taking samples for toxicology analysis important at a post-mortem examination of an individual with an appropriate history.

Rapid weight loss following gastric bypass can lead to cholelithiasis and choledocholithiasis, with patients at risk of cholecystitis. A number of metabolic and nutritional derangements are described after bariatric surgery that might contribute to morbidity and mortality, including hyperoxaluria causing nephrolithiasis and renal failure, and post-operative hypoglycaemia causing seizures.[13]

## Long-term complications

Long-term complications include band slippage, port or tubing malfunction, leakage at the port site tubing or band, pouch or oesophageal dilatation, and oesophagitis.

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# Appendix C Summary table – Explanation of grades of evidence

(modified from Palmer K *et al. BMJ* 2008;337:1832)

| Grade (level) of evidence | Nature of evidence |
|---|---|
| Grade A | At least 1 high-quality meta-analysis, systematic review of randomised controlled trials or a randomised controlled trial with a very low risk of bias and directly attributable to the target population<br>or<br>A body of evidence demonstrating consistency of results and comprising mainly well-conducted meta-analyses, systematic reviews of randomised controlled trials or randomised controlled trials with a low risk of bias, directly applicable to the target cancer type. |
| Grade B | A body of evidence demonstrating consistency of results and comprising mainly high-quality systematic reviews of case-control or cohort studies and high-quality case-control or cohort studies with a very low risk of confounding or bias and a high probability that the relation is causal and which are directly applicable to the target population<br>or<br>Extrapolation evidence from studies described in A. |
| Grade C | A body of evidence demonstrating consistency of results and including well-conducted case-control or cohort studies and high- quality case-control or cohort studies with a low risk of confounding or bias and a moderate probability that the relation is causal and which are directly applicable to the target population<br>or<br>Extrapolation evidence from studies described in B. |
| Grade D | Non-analytic studies such as case reports, case series or expert opinion<br>or<br>Extrapolation evidence from studies described in C. |
| Good practice point (GPP) | Recommended best practice based on the clinical experience of the authors of the writing group. |

# Appendix D AGREE II compliance monitoring sheet

The autopsy guidelines of The Royal College of Pathologists comply with the AGREE II standards for good quality clinical guidelines. The sections of this autopsy guideline that indicate compliance with each of the AGREE II standards are indicated in the table.

| AGREE standard | | Section of guideline |
|---|---|---|
| **Scope and purpose** | | |
| 1 | The overall objective(s) of the guideline is (are) specifically described | Introduction |
| 2 | The health question(s) covered by the guideline is (are) specifically described | Introduction |
| 3 | The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described | Foreword |
| **Stakeholder involvement** | | |
| 4 | The guideline development group includes individuals from all the relevant professional groups | Foreword |
| 5 | The views and preferences of the target population (patients, public, etc.) have been sought | Foreword |
| 6 | The target users of the guideline are clearly defined | Introduction |
| **Rigour of development** | | |
| 7 | Systematic methods were used to search for evidence | Foreword |
| 8 | The criteria for selecting the evidence are clearly described | Foreword |
| 9 | The strengths and limitations of the body of evidence are clearly described | Foreword |
| 10 | The methods for formulating the recommendations are clearly described | Foreword |
| 11 | The health benefits, side effects and risks have been considered in formulating the recommendations | Foreword and Introduction |
| 12 | There is an explicit link between the recommendations and the supporting evidence | 2–14 |
| 13 | The guideline has been externally reviewed by experts prior to its publication | Foreword |
| 14 | A procedure for updating the guideline is provided | Foreword |
| **Clarity of presentation** | | |
| 15 | The recommendations are specific and unambiguous | 2–14 |
| 16 | The different options for management of the condition or health issue are clearly presented | 2–14 |
| 17 | Key recommendations are easily identifiable | 2–14 |

| | |
|---|---|
| **Applicability** | |
| 18 The guideline describes facilitators and barriers to its application | Foreword |
| 19 The guideline provides advice and/or tools on how the recommendations can be put into practice | 2–14 |
| 20 The potential resource implications of applying the recommendations have been considered | Foreword |
| 21 The guideline presents monitoring and/or auditing criteria | 15 |
| **Editorial independence** | |
| 22 The views of the funding body have not influenced the content of the guideline | Foreword |
| 23 Competing interest of guideline development group members have been recorded and addressed | Foreword |