

# SELF ASSESSMENT QUESTIONS IN GENERAL SURGERY

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## Abstract

The advent of Modernising Medical Careers has meant that many more junior doctors are coming into contact with general surgical patients either as part of Foundation Year 2 or Core Training rotation or during the course of cross covering other specialities due to the hours constraints of the European Working Time Directive. These scenarios are all common general surgical cases that such a junior doctor may be expected to manage.

You are a general surgical SHO working in a district general hospital and are faced with the following cases.

### Case 1

A- A 48 year old male presents to your surgical clinic with a three month history of bright red rectal bleeding when he opens his bowels.

**What are the important points to elicit in the history?**

B- He tells you that he notices the blood in the toilet but is unsure of the amount or nature of the blood loss – just that the water turns red. He thinks he may have lost some weight as he has recently had to tighten his belt but is unsure of how much. He hasn't noticed any change in his bowel habit and he denies any abdominal pain or systemic symptoms.

**How will you assess this patient in clinic?**

C- The patient appears comfortable at rest and abdominal examination reveals nothing of note. You perform a digital rectal examination which reveals soft brown stool in the rectum with some traces of old blood. Rigid sigmoidoscopy gives good views of the mucosa to 12cm where there is a suspicious-looking mass (Figure 1). You ask your consultant to take a look and he biopsies the lesion in clinic.

**How will you investigate this patient further?**

Figure 1 Rectal lesion found at rigid sigmoidoscopy

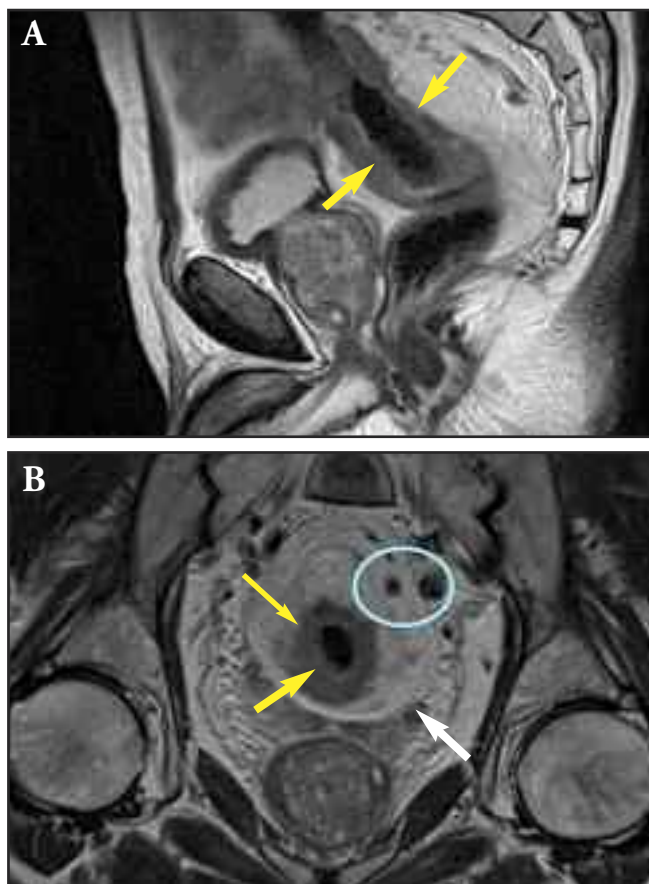


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D - The histology from your biopsy specimen confirms moderately differentiated adenocarcinoma. Staging CT scan reveals no distant metastases and colonoscopy shows no evidence of synchronous tumours. MRI shows a large tumour extending out of the muscularis propria, with several enlarged local lymph nodes one of which is threatening the CRM. It is staged as pT3N1 (Figure 2A&B).

**What are the treatment options for this patient?**

Figure 2 Sagittal (A) and axial (B) staging Magnetic Resonance Imaging (MRI) scans of a mid rectal cancer. The cancer is marked by yellow arrows, the circumferential resection margin (CRM) by the white arrow and an enlarged lymph node is circled, but this does not threaten the CRM.



E - The patient agrees with your recommendation and undergoes long course chemoradiotherapy followed by a straightforward laparoscopic anterior resection. His post-operative histology is discussed at the MDT and is classed as pT<sub>3</sub>N<sub>1</sub>, Dukes C. He proceeds to adjuvant chemotherapy

**What is his prognosis?**

### Case 2

A - You are on call over night when you are referred a 45 year old female with severe constant epigastric pain which radiates through to her back. She has vomited several times and her serum amylase is 1200 IU/L.

**What is the likely diagnosis and the differential diagnoses of hyperamylasaemia?**

**B - What are the usual aetiologies of pancreatitis in the UK and worldwide?**

**C - What scoring systems do you know that relate to acute pancreatitis and why are they useful?**

D - Your patient scores 3 on the initial scoring and you transfer her to the surgical HDU before the end of your shift.

**What imaging should be performed and when?**

E - Her ultrasound shows cholelithiasis without ductal dilatation; the pancreas is obscured by bowel gas. The next evening you are rang by the HDU nurse in charge who asks you to come and review this lady who appears to be "going off." Your assessment reveals a blood pressure of 90/60 mmHg, urine output of 10 ml/h, pH 7.33.

**What are the possible complications of Pancreatitis?**

F - She is fluid resuscitated in conjunction with the Critical Care doctors with Central Venous Monitoring in place and judicious use of inotropic support for 36 hours until her clinical course appears to be settling. 4 days after her initial admission she is returned to the ward with minimal analgesic requirements, tolerating a light diet and requiring to intravascular fluid support.

**What operation should she be offered?**

### Case 3

A - A&E refer you a 45 year old woman with a 12 hour history of severe, constant RUQ pain. She has a raised white cell count at  $16 \times 10^9/l$  and mildly deranged liver function tests, with a bilirubin of 45  $\mu\text{mol/L}$ , alkaline phosphatase of 400 IU/L and a gamma GT of 205 IU/L. She is tachycardic at 105bpm, has a temperature of 37.5°C, is tender in the right upper quadrant and is Murphy's sign positive.

**What is the most likely diagnosis and what is your initial management plan?**

B - Your patient is more settled with your management and is seen on the ward round the next morning by the consultant.

**What imaging does this patient require?**

C - Ultrasound scan confirms the presence of a thick-walled gallbladder containing multiple calculi with a dilated CBD at 10mm but no obvious intra-ductal stone. It is now 24 hours since admission and the patient is recovering well. She is usually fit and well, although is slightly overweight with a BMI of 29. Your registrar feels she would be suitable for an index admission cholecystectomy.

**What are the benefits and disadvantages of index admission cholecystectomy?**

D - Your patient undergoes laparoscopic cholecystectomy with on-table cholangiogram. There were no ductal stones and the

gallbladder containing multiple small calculi was removed with no complications. The patient is discharged home the following day.

**What types of gallstone are there and how do they form?**

### Case 4

A - The FY2 in A&E refers you your next patient who is a 28 year old woman who has been "unwell" for several weeks. She specifically complains of feeling hot and sweaty, with weight loss and palpitations. More recently she has developed diarrhoea and vomiting. On examination you notice she has a fine tremor at rest and is sweating. She has a diffuse swelling in the midline of her neck and protuberant eyes. You perform an ECG which reveals new-onset atrial fibrillation. Clinically your diagnosis is hyperthyroidism.

**What are the commonest causes of hyperthyroidism and what results would you expect from her thyroid function tests?**

B - Her TFTs reveal a raised free T<sub>4</sub> level and a low serum TSH level.

**What is Graves' disease?**

**C - What are the treatment options available to this patient?**

D - She has a large goitre, has eye signs and is trying to get pregnant. She elects to undergo total thyroidectomy and replacement.

**What are the possible complications of thyroid surgery?**

### Case 5

A - Your Registrar and Consultant are both in theatre operating on an obstructed colon when the A & E night shift SHO asks you to attend a Trauma Call for a 25 year old male being brought in to the resuscitation room following a road traffic accident where he was the front seat passenger. He had been trapped in the car for nearly one hour by incursion of the door and door pillar on his left side.

**What are the principles of assessment of this patient?**

**B - What are the underlying mechanisms of injury after blunt abdominal trauma?**

C - Your patient is conscious, maintaining his own airway and his breathing is stable. He has remained hypotensive with a systolic blood pressure fluctuating between 80-95mmHg and tachycardic since his admission despite 2 Litres of intravenous crystalloid fluid resuscitation. He is complaining of severe abdominal pain and has a visible "seat belt" sign.

**What types of adjunctive investigation can be used to help with assessment of intra-abdominal injuries following blunt abdominal trauma?**

D - The Emergency Medicine registrar performs a FAST scan that you watch and which identifies plentiful intra-abdominal fluid and possibly free air as well. You discuss the case with the consultant on call by telephone in theatre who asks you to arrange his emergency laparotomy.

**What are the indications for laparotomy after abdominal trauma?**

E - The consultant leaves the registrar to finish off the Hartmanns procedure in theatre and comes to review the patient. He confirms his decision to proceed to laparotomy and reviews the patient's physiology. He has now received 1.5 L of Crystalloid and 1L of colloid intravenously but remains hypotensive at 95/50 with a pulse of 105bpm. His core temperature is 33.5°C. He tells the anaesthetists that he thinks a DCS approach should be adopted.

**What are the principles of Damage Control Surgery (DCS)?**

## Answers to Self Assessment Questions

### Case 1

#### A - What are the important points to elicit in the history?

It is important to note the type and nature of blood loss. Bright red blood in the pan or on the paper on wiping suggests an anal canal cause, whereas darker red blood, with or without clots, is indicative of an origin more proximally. Sticky, black offensive melaena stool suggests an upper GI cause. Is there associated mucorrhoea or slime, or is the blood mixed in with the motions? A change of bowel habit should be noted with a change to diarrhoea being more suspicious than increasing constipation. Systemic symptoms such as anorexia or weight loss may suggest a malignant cause and tenesmus – the feeling of always needing to defaecate – is typical of a rectal neoplasm. Abdominal pain may be due to the urgency cramps of colitis, the ache of diverticulitis or the tight bloated sensation of irritable bowel syndrome, whereas pain on defecation – classically described as like passing glass – occurs with fissure-in-ano. Is there associated dizziness, light-headedness or shortness of breath or symptomatic anaemia?

Identify whether he has had any symptoms similar to this in the past as well as noting his past medical history and regular medications. It is important to ask about family history related to bowel cancer in particular and other cancers in general, and if so, which members of the family were affected and how old they were at diagnosis.

#### B - How will you assess this patient in clinic?

After a full history he should be examined. Is pale or short of breath at rest? Is there supraclavicular lymphadenopathy? Examine the abdomen looking in particular for masses or hepatomegaly. Perform a digital rectal examination, noting the presence of anal fissures, rectal masses and the colour of any stool or blood on the examining finger, as well as the contours of the prostate. A rigid sigmoidoscopy and proctoscopy should be performed on all patients presenting with painless rectal bleeding.

#### C- How will you investigate this patient further?

In general the assessment of colorectal cancer consists of confirmation of diagnosis, local and distant staging, exclusion of synchronous lesions and baseline blood work in preparation for surgery. Diagnostic biopsies have already been taken so he should undergo luminal colonic evaluation, ideally this is colonoscopy to the caecal pole to identify synchronous neoplasms and remove any other polyps. If colonoscopy is not possible Barium Enema will suffice. Distant staging concentrates on the chest, abdomen and pelvis and a variety of tests may be used, depending on local resources, such as chest x-ray and liver ultrasound, but the ideal is a baseline CT scan of chest/abdomen/pelvis with intravenous contrast. Local staging for rectal cancer may be performed using endoanal USS or more commonly, MRI scanning. This will delineate the degree of penetration through the rectal wall and whether the cancer encroaches upon the mesorectal fascia which will form the Circumferential Resection Margin (CRM). The presence of potentially malignant lymph nodes within the mesorectum is also identified. (Figure 3 A&B)

Figure 3A: Endoanal Ultrasound demonstrating the normal anatomy of the mid rectum. White arrow indicates the hypoechoic

muscularis propria and the yellow arrow shows the hyperechoic submucosa. The pink arrow outlines the ultrasound probe in the rectal lumen.

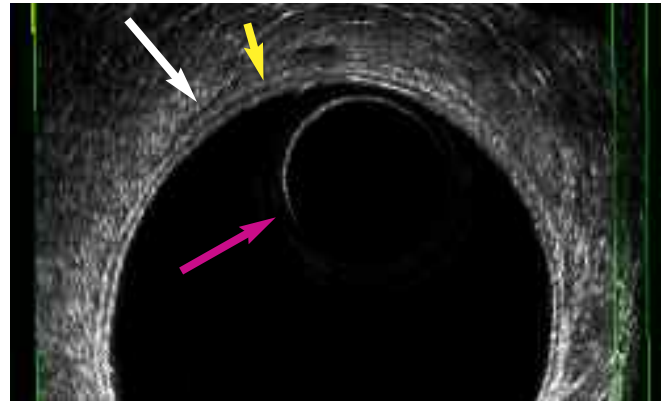
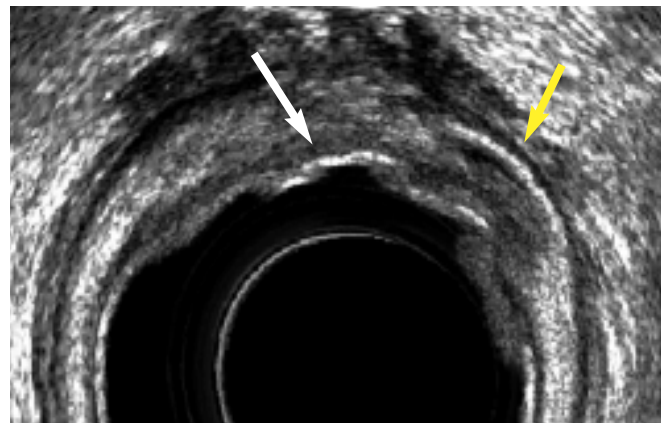


Figure 3B: Endoanal ultrasound of a rectal cancer (white arrow) which has breached the muscularis propria (yellow arrow) and is invading into perirectal fat or serosa and is therefore staged as uT3.



#### D-What are the treatment options for this patient?

The only reliably curative treatment for colorectal cancer is surgical excision – this may be achieved by colonic resection or by transanal endoscopic microsurgery which is suitable for T1 or very early T2 rectal cancers or those unfit for major resection [1]. Colorectal resection is now increasingly performed laparoscopically with oncological results comparable to open surgery [2] and short term health gains for the patients.

The surgery of rectal cancer has been revolutionised by the concept of Total Mesorectal Excision which acknowledges that craniocaudal spread (and therefore resection margins) are of less importance than ensuring adequate circumferential clearance [3] which is achieved by dissecting in a plane outside of the mesorectal fascia that encloses the fat of the mesorectum. Cases in whom the CRM is threatened by tumour or probably malignant lymph nodes within 1mm on pre-operative staging benefit from downstaging by pre-operative “long course” chemoradiotherapy – 45 Grays in 25 fractions, accompanied by weekly 5-fluorouracil [4]. This may require a prophylactic defunctioning loop stoma prior to commencing treatment. Recent data also supports the use of “short course” radiotherapy (25 Grays in 5 fractions followed by surgery within the week) for all other rectal cancers [5]. Thereafter, patients at high risk of local recurrence post-operatively – ie those with involved CRMs, nodal involvement or locally advanced tumours may be recommended for adjuvant chemotherapy and/or radiotherapy if not already given.

This gentleman should undergo long course chemoradiotherapy after provision of a defunctioning loop

ileostomy. Six to eight weeks after the end of radiotherapy he should have a further staging MRI pelvis scan to identify the effect of the treatment before proceeding to laparoscopic anterior resection.

**E-What is his prognosis?**

Colorectal cancer is usually staged by either the TNM system or the Dukes system originally developed originally by Cuthbert Duke at St Mark's Hospital, in 1932 for rectal cancers (Table 1).

Table 1 The Duke's Classification for Colorectal Cancer

Classification	Description	5 year survival [6]
Duke's A	Tumour confined to the mucosa	>93%
Duke's B	Tumour infiltrating through the muscle	77%
Duke's C	Lymph node involvement	47%
C1	No apical node involvement	
C2	Apical lymph node involvement	
Duke's D (added later)	Distant metastases	6.6%

The TNM staging system (Tumour, Node, Metastasis) is more complicated (Table 2). Once a person's T, N, and M categories have been determined, usually after surgery, this information is combined in a process called stage grouping, expressed as a Roman numeral, it gives an indication of prognosis.

Table 2 The TNM Staging of colorectal cancer

Descriptor	Classification	Description
<b>Tumour</b>	T1	Tumour invades submucosa
	T2	Tumour invades muscularis propria
	T3	Tumour invades through the muscularis propria into the subserosa, or into the pericolic or perirectal tissues.
	T4	Tumour directly invades other organs or structures, and/or perforates.
<b>Nodes</b>	N0	No regional lymph node metastasis
	N1	Metastasis in 1 to 3 regional lymph nodes
	N2	Metastasis in 4 or more regional lymph nodes
<b>Metastasis</b>	M0	Distant metastasis present
	M1	Distant metastasis present
<b>TNM Stage</b>		<b>Prognosis (5 Year Survival Rates %) [7]</b>
Stage I	T1, N0, M0 or T2, N0, M0	93%
Stage IIa	T3, N0, M0	85%
Stage IIb	T4, N0, M0	72%
Stage IIIa	T1, N1, M0 or T2, N1, M0	83%
Stage IIIb	T3, N1, M0 or T4, N1, M0	64%
Stage IIIc	Any T, N2, M0	44%
Stage IV:	Any T, Any N, M1	8%

Whilst being more unwieldy to use in practice, TNM does avoid the potential for understaging that can occur with Dukes. A locally advanced cancer without lymph node involvement will still be classified as a Dukes B and generally would not be considered for post-operative chemotherapy – this has led to the concept of a “bad B” and is a potential explanation why IIIa cancers have a better outcome than IIB, given that node negative tumours will rarely be considered for chemotherapy, whereas locally smaller tumours that are node positive (IIIa) will usually receive chemotherapy. This gentleman has a 47% 5 year survival rate according to the Dukes and 64% according to TNM.

**Case 2**

**A-What is the likely diagnosis and the differential diagnoses of hyperamylasaemia?**

She is likely to have acute pancreatitis. There are numerous causes of hyperamylasaemia but a serum amylase level greater than 3-5 times (varying between institutions) the upper limit of normal for your hospital is usually considered diagnostic of pancreatitis. Most gastrointestinal pathology will result in a raised serum amylase although rarely to that level for example, a ruptured abdominal aortic aneurysm may also cause hyperamylasaemia. Other causes include cholecystitis, perforated peptic ulcer, generalised peritonitis, intestinal obstruction and mesenteric ischaemia. It is worth remembering that the pancreas is not the only source of amylase and mumps parotiditis will also raise serum amylase – differential assay may identify salivary amylasaemia. Finally, a normal amylase does not exclude the diagnosis of pancreatitis as the sample may have been taken early in the course of the disease before the serum levels have had time to rise, or later on after they have peaked and then fallen. In such circumstances urinary amylase, or trypsinogen or serum lipase may be used as alternative specific and sensitive markers of pancreatic inflammation

**B-What are the usual aetiologies of pancreatitis in the UK and worldwide?**

Eighty percent of cases of acute pancreatitis in the UK are caused by either gallstones or alcohol excess, with a slight preponderance of biliary disease. Smaller (<5mm) gallstones are more likely to cause pancreatitis as they are small enough to enter the duct; however less than 5% of all patients with gallstones will develop pancreatitis. Features which suggest a gallstone pancreatitis include: female gender, older than 50 years, hyperbilirubinaemia (bilirubin > 25 umol/L) and obstructive liver function test (LFT) picture (ALP >300 IU/L, AST > 100 IU/L)

- The other less common aetiologies are:
- Idiopathic – the British Society of Gastroenterology guidelines from 2005 [8] suggest that less than 20% of all cases should be labelled as idiopathic.
  - Obstructive (choledocolithiasis; ampullary or pancreatic tumours)
  - Pancreatic structural anomalies such as pancreas divisum
  - Vascular anomalies - for example vascular endothelial injury resulting in ischaemia
  - Toxins including alcohol and drugs including steroids, salicylates, azathioprine, cimetidine, and thiazide diuretics
  - Trauma - resulting in disruption of parenchyma or ducts
  - Iatrogenic after ERCP, resulting in ductal disruption and enzyme extravasation
  - Metabolic abnormalities – such as hyperlipidaemia and hypercalcaemia
  - Infection – typically mumps or coxsackie viral infection

### C -What scoring systems do you know that relate to acute pancreatitis and why are they useful?

Numerous scoring systems have been validated and all aim to identify those attacks of acute pancreatitis which are severe, as mortality and morbidity increases with severity. Ranson's Criteria and the Acute Physiology and Chronic Health Evaluation (APACHE) II systems are both widely used in the USA but not in the UK. The commonest in use in the UK is the Modified Glasgow (or Imrie) criteria (Table 3).

Table 3: Modified Glasgow (Imrie) Criteria for Acute Pancreatitis

Parameter	Score 1 for the following:
Age	>55 years
White blood cell count	>15 x 10 <sup>9</sup> /L
Blood glucose (in non-diabetics)	>10 mmol/L
Serum urea (no response to intravenous fluids)	>16 mmol/L
Arterial oxygen saturation (PaO <sub>2</sub> )	<60 mmHg / <8 kPa
Serum calcium	<2.0 mmol/L
Serum albumin	<32 g/L
LDH (lactate dehydrogenase)	>600 units

Patients should be fully scored on admission and daily for 48 hours. One or two positive criteria are associated with a mortality of <1%, three or four positive have a mortality of ~15%, and for six or more positive criteria the mortality rate is ~ 100%. Greater than 3 positive criteria equates to acute severe pancreatitis and these patients should be managed in a critical care environment. A single CRP (C-Reactive Protein) of >150 U/L within 72 hours of admission is also an independent predictor of severity.

### D-What imaging should be performed and when?

All patients with acute pancreatitis should undergo abdominal ultrasound to look for gallstones and to assess common bile duct dilatation, ideally within 24 hours of admission. In most patients the gallstone responsible for the pancreatitis has already passed by the time imaging is performed. Non-resolving acute pancreatitis should be assessed by contrast abdominal CT scanning between days 3 and 10 to identify the complications of pancreatitis, particularly pancreatic necrosis [8]; CT scanning may also be used to confirm the diagnosis if enzymatic means are equivocal (Figure 4). If there is concern about common bile duct stones in the face of settling symptoms then Magnetic Resonance Cholangiopancreatography (MRCP) will delineate the relevant anatomy; if symptoms persist with evidence of CBD stones then this is an indication for prompt therapeutic ERCP to clear the duct and lessen the severity of the attack.

Figure 4: CT scan through the abdomen showing diffuse peripancreatic inflammation and fluid especially around the pancreatic head (white arrow).



### E-What are the possible complications of Pancreatitis?

These may be considered as local or systemic, early or late. The local complications are as a result of the local liberation of digestive enzymes and include pancreatic necrosis with or without superadded infection, phlegmon formation and collections of pancreatic fluid which may become encapsulated as pseudocysts occurring adjacent or distant to the gland. Ongoing autodigestion may result in erosion and necrosis of the adjacent transverse colon with perforation, or erosion into the gastroduodenal or gastroepiploic vessels, resulting in significant haemorrhage either internally or into the gastrointestinal tract. Much of the early morbidity from pancreatitis arises as a systemic complication because of initiation of the Systemic Inflammatory Response Syndrome (SIRS) which results in fluid sequestration and relative hypovolaemia. This may lead onto Multi-Organ Dysfunction Syndrome (MODS) which is responsible for much of the mortality associated with the disease. Adult Respiratory Distress Syndrome (ARDS) (Figure 5) and hypoxaemia are common, as is intestinal ileus and ascites formation. Metabolic derangement such as hypocalcaemia, hypomagnesaemia and hypoalbuminaemia also occur. The two most significant complications of acute pancreatitis are death and in a minority of cases, especially alcohol related ones, chronicity.

Figure 5: Plain Chest Radiograph demonstrating the typical bilateral hilar shadowing or ARDS



### F-What operation should she be offered?

In order to reduce the risks of recurrent pancreatitis she should be offered laparoscopic cholecystectomy, and BSG guidelines suggest that this should be done on the index admission wherever possible and definitely within 2 weeks if not.

### Case 3

#### A- What is the most likely diagnosis and what is your initial management plan?

This lady has acute cholecystitis, 90% of which result from obstruction to the cystic duct by gallstones. This leads to increased pressure within the gallbladder, resulting in an acute inflammatory response. There may be secondary bacterial infection, common organisms include E.coli, Klebsiella and Strep. Faecalis. Clinical features include constant right upper quadrant pain with an associated fever and tachycardia. There will be right upper quadrant tenderness and a positive Murphy's sign – arrest of inspiration on deep palpation – is

pathognomonic. Initial management is conservative with the patient fasted and given intravenous fluids and antibiotics such as a second generation cephalosporin. Patients usually require opiate analgesia and regular paracetamol. Most will settle with this type of conservative management.

#### B-What imaging does this patient require?

Although only 10% of gallstones are radio-opaque, most patients will have had plain radiographs to exclude other pathology as part of their initial work up. The gold standard imaging for any biliary disease, including cholecystitis, is an ultrasound scan which may reveal the presence of gallstones, a thick-walled distended gallbladder (Figure 6), dilatation of the common bile or intrahepatic ducts, or pericholecystic fluid. Hepatobiliary Imino-Diacetic Acid (HIDA) scan, also known as cholescintigraphy, is a useful but rarely used nuclear imaging procedure that evaluates the health and function of the gallbladder. A radioactive tracer is introduced intravenously and allowed to circulate to liver, where it is excreted into the biliary system and stored by the gallbladder. In the absence of disease the gallbladder can be visualised within an hour of the injection. If the gallbladder is not visualised within 4 hours of the injection either cholecystitis or cystic duct obstruction is indicated.

Figure 6: Thick walled gallbladder on ultrasound. The wall is measured at 6.6mm thickness; wall thickness greater than 3.5mm is highly correlated with the presence of gall bladder disease [9]

If the common bile duct is not adequately visualised on USS in patients with deranged liver function in association with acute cholecystitis, then further ductal imaging is required. The



choice of ductal imaging depends on the plan for definitive management of the gallstones. ERCP has therapeutic potential to unblock the CBD but is invasive and is associated with a 3% risk of pancreatitis. MRCP is an excellent non-invasive modality for imaging the CBD (Figure 7) but has no therapeutic capability and many patients are too claustrophobic for scanning. The final option is to perform on-table cholangiography during the course of cholecystectomy – if positive this can then be extended to include exploration of the common bile duct. The choice is dependent on the local availability of facilities and skills.

Figure 7: Magnetic Resonance Cholangiopancreatography (MRCP) image showing a filling defect in the lower end of the otherwise opacified common bile duct (CBD) representing a CBD stone



#### C-What are the benefits and disadvantages of index admission cholecystectomy?

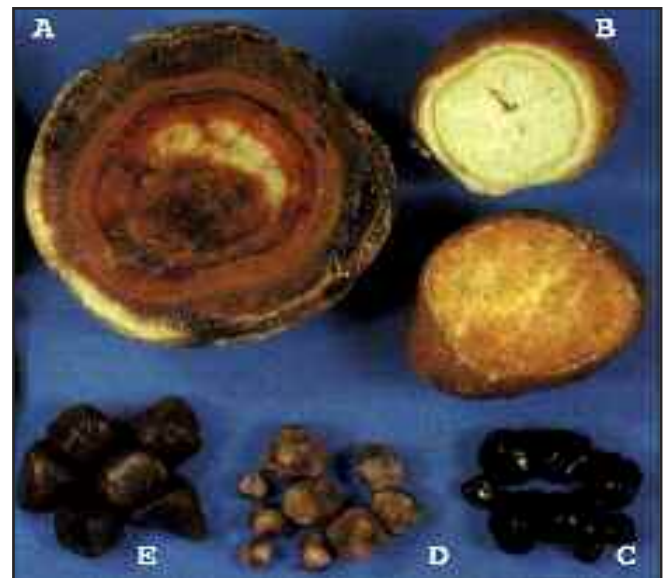
Laparoscopic cholecystectomy was introduced into the UK in 1990. In the past, it has been deferred until at least 6-8 weeks following the acute admission to allow the inflammation to settle. The main reason for this was fear of higher morbidity and conversion rates during acute cholecystitis. However, many patients get re-admitted with a further episode of calculi-related symptoms while they are on the waiting list, increasing hospital costs and bed usage [10]. Recently, there has been a trend towards laparoscopic cholecystectomy on the index hospital admission. There have been many recent trials comparing the complication rates, length of hospital stay, conversion rates, etc, between acute and interval cholecystectomy by experienced surgeons, showing no difference in complications or overall outcome, and with overall decreased hospital stay, hospital costs and increased tariff income [11-13]. A recent Cochrane review [14] looking at five systematic reviews on the subject showed early laparoscopic cholecystectomy during acute cholecystitis to be safe and shorten overall hospital stay. In this patient, the dilated CBD mandates ductal imaging and on-table cholangiogram should be performed.

#### D- What types of gallstone are there and how do they form?

Gallstones are classified according to composition, and there are three types:

Cholesterol stones account for about 15% of all stones and are usually large and solitary, pigment stones (5%) are uncommon with the majority (80%) being of mixed type (Figure 8). Bile acid acts as a detergent to keep cholesterol in solution, with bile acids, lecithin and cholesterol forming micelles. Cholesterol stones result from a change in the solubility of these bile constituents when bile is supersaturated with cholesterol and cholesterol microcrystals form. Pigment stone is the name used for stones containing less than 30% cholesterol and there are two types – black and brown. Black stones are largely composed of an insoluble bilirubin pigment which occurs in excess because of increased haemolysis, for example in spherocytosis, sickle cell disease and with mechanical heart valves and are responsible for the occasional case of cholecystitis in the very young patient with hereditary erythrocyte abnormalities. Other factors which favour stone formation include alterations in gallbladder function, biliary stasis and infection.

Figure 8: Gallstones of various types: A – Laminated (alternate layers of cholesterol and bile pigment); B- Cholesterol stone; C- Pure bile pigment stones; D – Brown mixed stones; E – faceted mixed pigment black stones



## Case 4

### A-What are the commonest causes of hyperthyroidism and what results would you expect from her thyroid function tests?

Hyperthyroidism affects approximately 2% of women and 0.2% of men. The causes are Grave's disease (75%), toxic nodular goitre (24%), toxic solitary nodule (1%) and thyroiditis (<1%). Thyrotoxicosis is diagnosed by performing thyroid function tests which measure free T3 and T4 levels, and Thyroid Stimulating Hormone (TSH). Thyrotoxicosis is an excess of circulating thyroid hormone and is diagnosed on a raised T4 (the active hormone) and consequent suppression and therefore low TSH. Total serum T4 may be variable according to the level of thyroid-binding globulin and free T4 levels are useful. T3 toxicosis is uncommon.

### B-What is Graves' disease?

Graves' disease is an autoimmune disorder resulting from the production of thyroid-stimulating IgG antibodies which bind to TSH receptors, stimulating thyroid hormone production. It usually occurs in women aged 20-40 years and presents with a diffuse goitre, features of thyrotoxicosis and eye signs. The signs and symptoms of hyperthyroidism are multiple and manifest across most body systems. There is sweating, heat intolerance and weight loss from the increase in basal metabolic rate which also causes palpitations and may be sufficient to cause exertional chest pain. Neurologically there is tremor, anxiety and mood swings that tend towards mania. There is associated diarrhoea and gut cramps, and menstrual irregularity is common. When examined, the hyperthyroid patient is generally anxious, fidgety and sweaty. They are tachycardic with a propensity to atrial fibrillation and a fine resting tremor. In Graves' disease the hands may demonstrate thyroid acropathy, which resembles clubbing, onycholysis (nail destruction) and vitiligo. The classical "Eye Signs" of thyroid disease are specific to Graves' disease and are described in Table 4.

The neck must be examined for the presence of a goitre or thyroid nodule. The goitre of Graves' disease is typically a diffuse, symmetrically enlarged gland with audible bruit due to hypervascularity. Toxic multinodular goitre or a solitary overactive nodule will give solitary or multiple palpable nodules and the gland may feel irregular. A hard, irregular goitre raises the possibility of an anaplastic carcinoma or a thyroiditis. Rare signs of hyperthyroidism include pretibial myxoedema, proximal myopathy, brisk reflexes and hepatomegaly.

Table 4: Eye Signs of Graves' Disease.

Signs	Cause
Loss of outer 1/3 of eyebrow	Unknown
Exophthalmosis	Retraction and spasm of the upper eyelid caused by involvement of sympathetic fibres innervating levator palpebrae superioris muscle
Proptosis	Infiltration of the retrobulbar tissues with fluid and round cells
Lid retraction	Increased sympathetic response
Lid lag	CN III palsy
Ophthalmoplegia	CN III,IV & VI palsies
Chemosis	Due to lid retraction and proptosis

### C- What are the treatment options available to this patient?

These are usually considered to be medical, radioactive iodine or surgery.

### Medical Treatment

Beta-blockers are used in the first instance to provide rapid relief from symptoms. Specific anti-thyroid drugs, such as carbimazole and propylthiouracil, can be used in the short term prior to definitive treatment or in the longer term to induce remission. They work by inhibiting the synthesis of thyroxine by reducing the amount of iodine incorporated into tyrosine residues. Carbimazole is effective in 40% of patients with Graves' disease. They have the advantage that no surgery or radiation is required but do have significant disadvantages including the need for prolonged treatment and approximately 50% fail or relapse over time. Some goitres will actually enlarge during treatment and there is a small (1%) risk of agranulocytosis and aplastic anaemia.

### Radioactive Iodine

Treatment with I<sup>131</sup> achieves hypothyroid status in 50% of patients but about 20% remain hyperthyroid. It is contraindicated in children, pregnancy and breast feeding and pregnancy should be avoided for 6 months. It avoids surgery or prolonged medical drug treatment, unfortunately isotope facilities may not be readily available and most (80%) patients will have become hypothyroid by 10 years, hence prolonged follow-up is required.

### Surgery

Surgery for hyperthyroidism involves subtotal thyroidectomy, preserving about 10% of the thyroid tissue, or total thyroidectomy and replacement therapy which avoids the possibility of recurrent hyperthyroidism in the remnants and the need for redo surgery. The primary advantage of surgery is a high cure rate although 20% of those treated by subtotal thyroidectomy will go on to suffer recurrent thyrotoxicosis. Surgery is associated with well recognised complications. Patients must be euthyroid prior to surgery and this is usually achieved using antithyroid drugs and beta-blockers. Surgery is indicated in those who have failed, cannot tolerate or do not want medical therapy. Large goitres with compressive symptoms, high levels of T4 at presentation (>75pmol/L) and female patients who are considering starting a family are best treated surgically.

### D-What are the possible complications of thyroid surgery?

Early complications include:

- Thyrotoxic storm – This is an uncommon, potentially fatal exacerbation of thyrotoxicosis with a mortality rate of 50%. Precipitating factors include thyroid surgery, radioiodine, withdrawal of anti-thyroid medication, iodinated contrast agents and acute illness. Clinical features include those of severe hyperthyroidism with fever, jaundice, delirium, seizures or coma. The treatment is with an initial loading dose of propylthiouracil, followed by Lugol's iodine one hour later. Other management involves beta-blockers, supportive measures and treating the underlying cause.
- Haemorrhage – Bleeding inside the fascial layers of the neck is usually venous ooze and increases in size due to hygroscopic expansion. It presents as respiratory distress and decompression is an emergency and should be undertaken wherever the patient happens to be. Every patient undergoing thyroid surgery should have a clip-remover by their bedside in case of this.
- Respiratory compromise secondary to laryngeal oedema and blood.
- Recurrent laryngeal nerve damage, which may be temporary (3%) or permanent (0.5-1%).
- Parathyroid damage, which also may be temporary (3%) or permanent (<1%).

**Late complications include:**

- Hypothyroidism
- Hypocalcaemia
- Wound complications – such as infection and keloid scarring

*Case 5***A- What are the principles of assessment of this patient?**

Assessment begins at the scene of injury with information gathered from witnesses, others involved in the accident and the paramedics. Specifically in this case, answers should be sought to the following questions:

- Speed of vehicle at the time of collision and what it collided with
- Extent of damage to the vehicle
- Was the person ejected from the vehicle?
- Was there a prolonged extraction time?
- Other passenger injuries including fatalities
- Did anything penetrate the vehicle?
- Were seatbelts worn/airbags deployed?
- Presence of intoxicating substances

On admission to the casualty department, trauma patients should undergo systematic assessment according to Advanced Trauma Life Support (ATLS®) or similar principles. This starts with the primary survey, the goal of which is to identify and initiate treatment of life-threatening injuries. The primary survey follows the well known ABCDE structure:

- Airway (with cervical spine protection)
- Breathing
- Circulation
- Disability
- Exposure

Those exposed to significant amounts of high energy transfer trauma such as the Defence Medical Services advocate a revised treatment paradigm of <C>ABCDE where <C> represents the primary control of catastrophic external haemorrhage before turning attention to the Airway. This may involve the use of tourniquets for extremity injury or novel topical haemostatics in junctional injury. Resuscitation is performed in conjunction with the primary survey. An AMPLE history (Allergies, Medications, Past illnesses, Last meal, Events & Environment of injury) is useful at this stage. After completion of the primary survey, which should result in a stabilised patient, the secondary survey is performed which involves the identification of all injuries via a head-to-toe examination.

When evaluating blunt abdominal trauma it is important to maintain this systematic approach as other injuries involving the head or respiratory system may take precedence over abdominal injury; but it is also important to remember that stabilisation of the circulatory system may be impossible in the face of uncontrolled intra-abdominal haemorrhage.

A systematic abdominal examination starts with inspection of the whole abdomen, flanks and back for abrasions or bruising, especially in the pattern and distribution of a seatbelt which is associated with a one in six chance of significant intra-abdominal injury [15] and an even higher rate in children [16]. Abdominal distension may be due to pneumoperitoneum, gastric dilatation or ileus. Tenderness over the lower ribs with or without the presence of rib fractures is associated with splenic or hepatic injury [17,18]. Palpate for signs of peritonism; auscultation for the presence or absence of bowel sounds usually adds little in a busy resuscitation room. A rectal examination

should be performed in all patients to rule out penetrating bony injuries from pelvic fractures, sphincter tone relating to neurological status, and the presence of a high-riding prostate which suggests urethral injury.

**B- What are the underlying mechanisms of injury after blunt abdominal trauma?**

There are 4 mechanisms by which blunt abdominal trauma cause injury.

**Compression**

Direct compression by a blunt force in either the anteroposterior or lateral directions will crush those viscera that are relatively fixed against the unyielding restraints of the abdominal cavity. Typically the strong peritoneal attachments of the liver and spleen, as well as the fixity of the duodenojejunal (DJ) flexure, make these organs prone to this form of injury as are all the retroperitoneal viscera. Direct rupture may be accompanied by massive haemorrhage.

**Shearing**

Rotational or acceleration/deceleration forces applied across the abdomen make the organs within move at different rates dependent upon their inertia and fixity and the points of fixity such as the insertion points of blood vessels act as stress risers and these are commonly avulsed, leading to significant haemorrhage as well as potential devitalisation of distal parenchyma.

**Bursting**

Acute compression of the abdominal cavity generates a sudden rise in intra-abdominal pressure and also within the lumen of hollow organs, which if sufficient will cause them to burst. The oesophago-gastric junction is particularly prone to this mechanism of injury and most diaphragmatic ruptures occur in this manner as the increased abdominal pressure decompresses into the thorax.

**Penetration**

Blunt injury to the bony pelvis, lumbosacral spine or ribs may generate bone spicules that penetrate both hollow and solid organs – the pelvic organs are particularly vulnerable.

**C- What types of adjunctive investigation can be used to help with assessment of intra-abdominal injuries following blunt abdominal trauma?**

A variety of techniques are available but none are perfect, thus the choice of modality or combination of modality depends in part on local experience and availability.

**Diagnostic Peritoneal Lavage (DPL)**

DPL is currently out of favour with most trauma clinicians who have access to other tests such as FAST or computed tomographic (CT) scanning, but it can in certain circumstances be a valuable, rapid, bedside investigation. Urinary catheterisation and a nasogastric tube are mandatory. A sub-umbilical incision is made under local anaesthetic and the linea alba divided under vision, the peritoneum beneath incised between clips and a peritoneal dialysis catheter inserted. Egress of frank blood, bile, faecal or vegetable matter constitutes a positive test. If no such aspirate occurs, 1 Litre of warmed saline is infused and the fluid drained back out after 3-5 minutes and a sample analysed in the laboratory. The DPL is then also considered positive if there is >100,000 red cells or >500 white cells per mm<sup>3</sup>. DPL precludes later FAST or CT scanning as the procedure introduces fluid and air into the abdominal cavity

### **Focused Assessment for the Sonographic Assessment of Trauma (FAST)**

This focussed ultrasound assessment aims to identify free intraperitoneal fluid in subphrenic, subhepatic spaces or the pelvis. It also examines for pericardial fluid. It may be reliably used by non-radiologists who have been suitably trained, is non-invasive, rapid and repeatable at the bedside and does not involve ionising radiation. It is not intended to identify the source of free fluid nor examine individual solid viscera for signs of injury. As with all ultrasound, results are operator dependent and are adversely affected by patient obesity and gastrointestinal gas. Small volumes of fluid (<500ml) can be difficult to detect [19] and the interpretation of a negative FAST scan is still controversial. For the assessment of blunt abdominal trauma in experienced hands FAST is reported to have sensitivity and specificity of 73-88% and 98-100% [20].

### **CT Scanning**

CT scanning is the single most useful adjunctive investigation in abdominal trauma and its utility is increasing as rapid thin slice scanners become more common. CT allows identification of free intraperitoneal fluid and air and allows assessment of the degree of solid organ injury, including the retroperitoneum which forms the basis of the American Association for the Surgery of Trauma (AAST) injury scaling scores [21]. It will also identify bony injury, especially in the pelvis where 60% of significant pelvic fractures are associated with visceral injury, but is relatively poor at identifying diaphragmatic and hollow visceral injury. The biggest drawback of CT is the necessity in most UK Emergency Departments to move the patient out of the relative safety of the resuscitation room to Radiology.

### **Laparoscopy**

Laparoscopy in trauma is still uncommon and most indications for its use are in the realms of penetrating injury to identify peritoneal violation or diaphragmatic injury. Laparoscopic examination of the small bowel after blunt trauma is time consuming and technically demanding; laparoscopy also requires a general anaesthetic and transport out of the resuscitation room

### **Laparotomy**

This remains the ultimate abdominal investigation and in the haemodynamically unstable patient with suspicion of intra-abdominal injury should be performed without delay.

### **D- What are the indications for laparotomy in abdominal trauma?**

As mentioned previously the trauma laparotomy should be remembered as part investigation/part therapy and thus persistent, unexplained shock unresponsive to fluid resuscitation after blunt trauma should prompt thoughts of laparotomy. Frank peritonitis, evisceration or obvious pneumoperitoneum on imaging should also prompt laparotomy. Previously any penetrating abdominal wound, be it stabbing or gunshot, was an absolute indication for laparotomy but increasing experience of selective non-operative management (SNOM) of first abdominal stabblings and latterly gunshot wounds in high trauma volume centres in the USA and South Africa have shown that this approach is safe and cost effective, thus these no longer mandate laparotomy. Such penetrating injuries deemed unsuitable for SNOM after appropriate assessment and imaging should undergo laparotomy. Positive investigations (DPL, FAST or CT) should be interpreted in the clinical context and with reference to the haemodynamic stability of the patient. A frankly positive DPL where no other investigation is available should be followed by

laparotomy although there is at least a 15% non-therapeutic laparotomy rate.

### **E- What are the principles of Damage Control Surgery (DCS)?**

DCS is an attempt to limit mortality when operating on critically ill trauma patients who historically have succumbed to the physiological, rather than anatomical, insults inflicted by trauma and prolonged surgery. It consists of an abbreviated laparotomy to halt haemorrhage and limit contamination followed by physiological restitution on the Intensive Care Unit (ICU) and subsequent definitive surgery and rehabilitation. Ideally the need for a damage control approach should be identified before laparotomy begins and Table 5 describes both the physiological and surgical triggers that should initiate a DCS approach.

Table 5 Physiological and surgical triggers for DCS

Physiological Triggers	Surgical Triggers
pH < 7.2	Inability to achieve haemostasis
Core temp < 34°C	Combined vascular hollow and solid organ injury
Coagulopathy (prothrombin time >16sec or Activated Partial Thromboplastin Time >60 sec)	Inaccessible vascular injury
Systolic BP < 90mmHg for greater than 1 hour	Lengthy operative procedures
Serum lactate >5mmol/L	Need for surgical treatment of other injuries ie craniotomy for intra-cranial haematoma
> 10 unit blood transfusion	Need for non-surgical control of other injuries ie embolisation of pelvic haemorrhage
Probable operation time >60minutes	Inability to close the abdomen or surgical reason for re-look laparotomy

The technique of DCS avoids definitive treatment of injuries at first look and thus haemorrhage may be controlled by packing or a vascular shunt; splenic bleeding is probably best controlled by a swift splenectomy. Gastrointestinal contamination can be controlled by isolating damaged segments of gut by nylon tapes, soft clamps or stapler/cutting devices. Pancreaticobiliary leakage is best controlled by drainage only initially or a T-tube if easily placed. Frankly necrotic tissue is removed. The abdomen should not be closed definitively as these patients are at extremely high risk of abdominal compartment syndrome and temporary abdominal closure may be achieved using a sterile fluid bag sutured to the fascial edges (Figure 9), temporary placement of an absorbable mesh or simply using an adhesive abdominal drape (Opsite® sandwich).

Figure 9: Opened out sterile saline bag sutured to the abdominal wall fascia as a Bogota Bag temporary abdominal closure of grossly oedematous and dilated gut.



Physiological restitution and warming on ICU takes 24-48 hours at which point the patient is returned to theatre for the 'second look' and definitive management of individual injuries. Decompensation before the planned return time should prompt an early return to theatre for further damage control. After definitive surgery abdominal closure may still not be possible and the need for ongoing temporary abdominal closure accepted.

This patient is found to have transected his jejunum just distal to the DJ flexure as well as tearing the small bowel mesentery and rupturing his spleen. There is 3 litres of blood and small bowel content in the peritoneal cavity. The spleen is removed expeditiously and the DJ flexure stapled off; small bowel mesentery vessels are ligated and the resulting ischaemic small bowel segment resected between staplers. The abdomen is thoroughly lavaged with warm saline and closed by application of a Bogata Bag before the patient is returned to ICU for warming and correction of his physiology. He subsequently returns to theatre for restoration of intestinal continuity.

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