Surgery: Anaesthetics and Perioperative care

Question: 1

A 75-year-old man comes into the orthopaedic ward for an elective hip replacement. He has been assessed for venous thromboembolism (VTE) prophylaxis. Apart from the operation and his age he does not have any additional risk factors and he does not have any risk factors for bleeding. What is the recommended VTE prophylaxis measures for this gentleman?

TED stockings	**15%**
TED stockings + dalteparin sodium started at least 6 hours post-operation	**44%**
TED stockings + dalteparin sodium started the morning of surgery	**16%**
Dalteparin sodium started at least 6 hours post-operation	**15%**
Dalteparin sodium stared the morning of surgery	**10%**

NICE recommends that patients who will undergo an elective hip replacement have both mechanical and pharmacological methods of venous thromboembolism (VTE) prophylaxis. TED stockings should be administered and the patient should wear them once they have been admitted. As long as there are not contraindications, such as bleeding risk, pharmacological VTE prophylaxis is administered after surgery. Dalteparin sodium, a low molecular weight heparin, is started 6 hours after surgery. Other pharmacological methods can also be used.

Mechanical prophylaxis, such as TEDs, while indicated for this patient is not enough of a prophylactic measure, especially as he does not have a risk of bleeding.

Pharmacological prophylaxis is not started prior to surgery because of bleeding risk during the operation. A time window is often used post-operatively in case of haematoma formation. Pharmacological prophylaxis is continued for up to 35 days post-operatively

Explanation:

Venous thromboembolism: prophylaxis in patients admitted to hospital

VTEs can cause severe morbidity and mortality, but they are preventable. Current NICE guidelines (updated for 2018) outline recommendations for assessment and management of patients at risk of VTE in hospital.

Risk factors

All patients admitted to hospital should be individually assessed to identify risk factors for VTE development and bleeding risk. For medical and surgical patients the recommended risk proforma is the department of healths VTE risk assessment tool.

The following inpatients would be deemed at increased risk of developing a VTE:

Medical patients:

- significant reduction in mobility for 3 days or more (or anticipated to have significantly reduced mobility)

Surgical/trauma patients:

- hip/knee replacement
- hip fracture
- general anaesthetic and a surgical duration of over 90 minutes
- surgery of the pelvis or lower limb with a general anaesthetic and a surgical duration of over 60 minutes
- acute surgical admission with an inflammatory/intra-abdominal condition
- surgery with a significant reduction in mobility

General risk factors:

- active cancer/chemotherapy
- aged over 60
- known blood clotting disorder (e.g. thrombophilia)
- BMI over 35
- dehydration
- one or more significant medical comorbidities (e.g. heart disease; metabolic/endocrine pathologies; respiratory disease; acute infectious disease and inflammatory conditions)
- critical care admission
- use of hormone replacement therapy (HRT)

- use of the combined oral contraceptive pill
- varicose veins
- pregnant or less than 6 weeks post-partum

After a patients VTE risk has been assessed, this should be compared to their risk of bleeding to decide whether VTE prophylaxis should be offered. If indicated VTE prophylaxis should be started as soon as possible.

Types of VTE prophylaxis

Mechanical:

- Correctly fitted anti-embolism (aka compression) stockings (thigh or knee height)
- An Intermittent pneumatic compression device

Pharmacological:

- Fondaparinux sodium (SC injection)
- Low molecular weight heparin (LMWH) - e.g. enoxaparin (brand name = Clexane)
- Unfractionated heparin (UFH) - used in patients with chronic kidney disease

Management

In general, all medical patients deemed at risk of VTE after individual assessment are started on pharmacological VTE prophylaxis. This is providing the risk of VTE outweighs the risk of bleeding (this is often a clinical judgement) and there are no contraindications. Those at very high risk may be offered anti-embolic stockings alongside the pharmacological methods.

For surgical patients at low risk of VTE first-line treatment is anti-embolism stockings. If a patient is at high risk these stockings are used in conjunction with pharmacological prophylaxis.

Advice for patients

Pre-surgical interventions:

- Advise women to stop taking their combined oral contraceptive pill/hormone replacement therapy 4 weeks before surgery.

Post-surgical interventions:

- Try to mobilise patients as soon as possible after surgery
- Ensure the patient is hydrated

Post procedure prophylaxis

For certain surgical procedures (hip and knee replacements) pharmacological VTE prophylaxis is recommended for all patients to reduce the risk of a VTE developing post-surgery. NICE make the following recommendations:

Procedure	Prophylaxis
Elective hip	LMWH for 10 days followed by aspirin (75 or 150 mg) for a further 28 days or LMWH for 28 days combined with anti-embolism stockings until discharge or Rivaroxaban

Procedure	Prophylaxis
Elective knee	Aspirin (75 or 150 mg) for 14 days or LMWH for 14 days combined with anti-embolism stockings until discharge or Rivaroxaban
Fragility fractures of the pelvis, hip and proximal femur	The NICE guidance states the following (our bolding): *Offer VTE prophylaxis for a **month** to people with fragility fractures of the pelvis, hip or proximal femur if the risk of VTE outweighs the risk of bleeding. Choose either:* • *LMWH , starting 6â€"12 hours after surgery or* • *fondaparinux sodium, starting 6 hours after surgery, providing there is low risk of bleeding.*

Question: 2

A 20-year-old African lady undergoes an open appendicectomy. She is reviewed for an unrelated problem 8 months later. On abdominal inspection the wound site is covered by shiny dark protuberant scar tissue that projects beyond the limits of the skin incision. Which of the following is the most likely underlying process?

Hypertrophic scar	16%
Keloid scar	63%
Marjolins ulcer	7%

Repeated episodes of wound sepsis	7%
Mycosis fungoides	7%

Keloid scars extend beyond the limits of the incision. Mycosis fungoides is a cutaneous T cell lymphoma.
Explanation:

Wound healing

Surgical wounds are either incisional or excisional and either clean, clean contaminated or dirty. Although the stages of wound healing are broadly similar their contributions will vary according to the wound type.

The main stages of wound healing include:

Haemostasis

- Minutes to hours following injury
- Vasospasm in adjacent vessels, platelet plug formation and generation of fibrin rich clot.

Inflammation

- Typically days 1-5
- Neutrophils migrate into wound (function impaired in diabetes).
- Growth factors released, including basic fibroblast growth factor and vascular endothelial growth factor.
- Fibroblasts replicate within the adjacent matrix and migrate into wound.
- Macrophages and fibroblasts couple matrix regeneration and clot substitution.

Regeneration

- Typically days 7 to 56
- Platelet derived growth factor and transformation growth factors stimulate fibroblasts and epithelial cells.
- Fibroblasts produce a collagen network.
- Angiogenesis occurs and wound resembles granulation tissue.

Remodeling

- From 6 weeks to 1 year
- Longest phase of the healing process and may last up to one year (or longer).
- During this phase fibroblasts become differentiated (myofibroblasts) and these facilitate wound contraction.
- Collagen fibres are remodeled.
- Microvessels regress leaving a pale scar.

The above description represents an idealised scenario. A number of diseases may distort this process. Neovascularisation is an important early process. Endothelial cells may proliferate in the wound bed and recanalise to form a vessel. Vascular disease, shock and sepsis can all compromise microvascular flow and impair healing.

Conditions such as jaundice will impair fibroblast synthetic function and immunity with a detrimental effect in most parts of the healing process.

Problems with scars:

Hypertrophic scars
Excessive amounts of collagen within a scar. Nodules may be present histologically containing randomly arranged fibrils within and parallel fibres on the surface. The tissue itself is confined to the extent of the wound itself and is usually the result of a full thickness dermal injury. They may go on to develop contractures.

Image of hypertrophic scarring. Note that it remains confined to the boundaries of the original wound:

Keloid scars

Excessive amounts of collagen within a scar. Typically a keloid scar will pass beyond the boundaries of the original injury. They do not contain nodules and may occur following even trivial injury. They do not regress over time and may recur following removal.

Image of a keloid scar. Note the extension beyond the boundaries of the original incision:

Drugs which impair wound healing:

- Non steroidal anti inflammatory drugs
- Steroids

- Immunosupressive agents
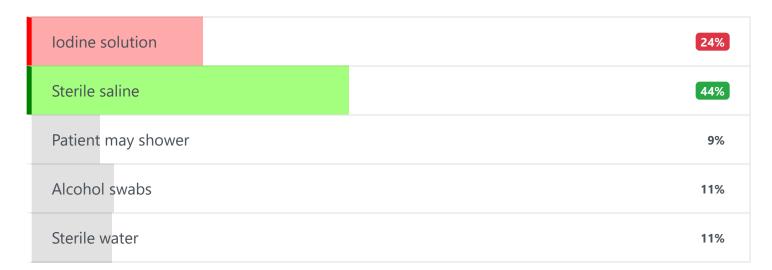- Anti neoplastic drugs

Closure

Delayed primary closure is the anatomically precise closure that is delayed for a few days but before granulation tissue becomes macroscopically evident.

Secondary closure refers to either spontaneous closure or to surgical closure after granulation tissue has formed.

Question: 3

During a surgical ward round you are asked to request a nurse cleans a patient's surgical wound when the dressing is changed. The patient is 36 hours post surgery. According to NICE guidelines, what is the most appropriate substance to use to clean the wound?

Iodine solution	24%
Sterile saline	44%
Patient may shower	9%
Alcohol swabs	11%
Sterile water	11%

NICE recommend the following regarding postoperative wound cleansing:

Use sterile saline for wound cleansing up to 48 hours after surgery.

Advise patients that they may shower safely 48 hours after surgery.

Use tap water for wound cleansing after 48 hours if the surgical wound has separated or has been surgically opened to drain pus.

Source: NICE guideline CG74 section 1.4.

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Image sourced from Wikipedia

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Question: 4

A 72-year-old male is recovering from a partial colectomy that he had 3 days ago. The patient complains of worsening pain at the wound site. On closer examination there is pink serous discharge, separation of the wound edges and bowel can be seen protruding. The patient has no other obvious symptoms. How should this patient immediately be managed?

Cover the area with dry gauze and apply pressure   14%

Pack the wound and begin intravenous fluids	12%
Start sepsis six protocol	16%
Non-urgent senior review	9%
Call for senior help urgently	**49%**

Wound dehiscence is a post-operative complication in which a wound ruptures along the surgical incision site. In this case, deep dehiscence has occurred as bowel can be seen protruding. This is an emergency and senior help should be called for immediately.

Non-urgent senior review should be considered for superficial dehiscence.

Applying pressure with dry gauze is inappropriate immediate management for this patient. However, a large sterile swab soaked in 0.9% saline can be used while waiting for senior help to arrived.

Packing the wound can be considered for superficial dehiscence but is an inappropriate immediate management for this patient.

Sepsis six protocol is a possibility and the patient's vital signs should be recorded after senior help has been called for.

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Question: 5

Whilst performing a pre-anaesthetic assessment, a young patient mentions that her mother 'had a bad reaction to some of the drugs' during an appendicectomy procedure many years ago and had to stay in intensive care on a ventilator for a short time after the operation. There were no long term complication. What condition should you be most worried about?

Merkel's diverticulum	7%
Hypersensitivity pneumonitis	17%
Stevens-Johnson syndrome	21%
Prednisolone allergy	8%
Pseudocholinesterase deficiency	47%

The clue here is the timeframe of the mother's adverse reaction.

Pseudocholinesterase deficiency (also known as suxamethonium apnoea) is a rare abnormality in the production of plasma cholinesterases. This leads to an increased duration of action of muscle relaxants used in anaesthesia, such as suxamethonium. Respiratory arrest is inevitable unless the patient can be

mechanically ventilated safely while waiting for the circulating muscle relaxants to degrade.

Pre-anaesthetic assessments are important to recognise a family history or previous episodes of complications such as this before they occur.
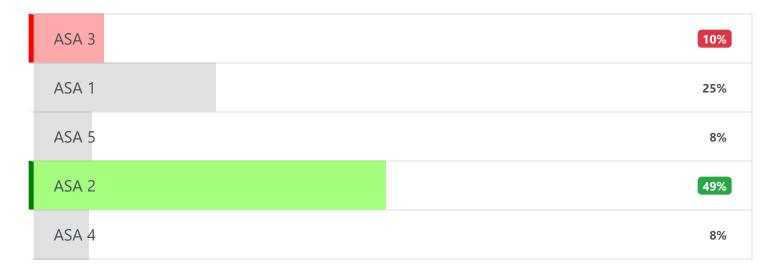**Explanation:**

Anaesthetic agents

The table below summarises some of the more commonly used IV induction agents

Agent	Specific features
Propofol	- GABA receptor agonist - Rapid onset of anaesthesia - Pain on IV injection - Rapidly metabolised with little accumulation of metabolites - Proven anti emetic properties - Moderate myocardial depression - Widely used especially for maintaining sedation on ITU, total IV anaesthesia and for daycase surgery
Sodium thiopentone	- Extremely rapid onset of action making it the agent of choice for rapid sequence of induction - Marked myocardial depression may occur - Metabolites build up quickly - Unsuitable for maintenance infusion - Little analgesic effects
Ketamine	- NMDA receptor antagonist - May be used for induction of anaesthesia - Has moderate to strong analgesic properties - Produces little myocardial depression making it a suitable agent for anaesthesia in those who are haemodynamically unstable - May induce state of dissociative anaesthesia resulting in nightmares

Agent	Specific features
Etomidate	- Has favorable cardiac safety profile with very little haemodynamic instability - No analgesic properties - Unsuitable for maintaining sedation as prolonged (and even brief) use may result in adrenal suppression - Post operative vomiting is common

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Question: 6

A 72-year-old gentleman is about to undergo an elective hernia repair. He has mild asthma which is well-controlled using a salbutamol inhaler PRN, on average about once per week. His asthma causes no limitation to his daily activity. What is his ASA (American Society of Anesthesiologists) status?

ASA 3	10%
ASA 1	25%
ASA 5	8%
ASA 2	49%
ASA 4	8%

An ASA (American Society of Anesthesiologists) score is an indicator of a patient's fitness for surgery. A patient is classified as ASA 2 if they have a mild systemic disease without any functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, obesity (30 < BMI < 40), well-controlled diabetes mellitus or hypertension, and mild lung disease.

Explanation:

American Society of Anaesthesiologists (ASA) classification

ASA Classification	Definition	Examples

ASA Classification	Definition	Examples
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, obesity (30 < BMI < 40), well-controlled Diabetes Mellitus/Hypertension, mild lung disease
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled Diabetes Mellitus/Hypertension, COPD, morbid obesity (BMI 40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, End Stage Renal Disease (ESRD) undergoing regularly scheduled dialysis, history (>3 months) of Myocardial infarction, Cerebrovascular accidents
ASA IV	A patient with severe systemic disease that is a constant threat to life	Examples include (but not limited to): recent (< 3 months) of Myocardial infarction, Cerebrovascular accidents, ongoing cardiac ischaemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis

ASA Classification	Definition	Examples
ASA V	A moribund patient who is not expected to survive without the operation	Examples include (but not limited to): ruptured abdominal/thoracic aneurysm, massive trauma, intra-cranial bleed with mass effect, ischaemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

Question: 7

A 75-year-old man attends the surgical assessment unit prior to an elective Hartmann's procedure in 7 days due to bowel cancer. He has a past medical history of atrial fibrillation, hypertension and previous cerebrovascular accident. Your registrar asks you to review him prior to his procedure next week. You notice that he is currently taking warfarin and his INR today is 2.6. His remaining blood tests are normal. What is the most appropriate management for his anticoagulation peri-operatively?

Stop his warfarin	15%
Continue his warfarin at the current dose as his INR is within therapeutic range	12%
Stop his warfarin and commence treatment dose low molecular weight heparin	56%
Initiate an unfractionated heparin continuous infusion	10%

| Initiate an unfractionated heparin continuous infusion | 10% |
| Stop his warfarin and commence aspirin | 8% |

Managing anticoagulation peri-operatively is challenging and depends on the reasons for and agent used to anti-coagulate. Each patient should have a venous thromboembolic risk assessment undertaken to consider risk factors for thromboembolism versus bleeding. In this scenario the patient is at high risk of thromboembolic disease (previous CVA, known AF) but also significant bleeding due to major abdominal surgery. Therefore the best option is a shorter acting anticoagulant (e.g. low molecular weight heparin) given at treatment dose whilst withholding warfarin. This would then be withheld the evening before surgery, and mechanical prophylaxis used.

Reference:
http://www.uptodate.com/contents/perioperative-management-of-patients-receiving-anticoagulants
Explanation:

Thromboprophylaxis in surgical patients

Deep vein thrombosis may develop insidiously in many surgical patients. Untreated it may progress to result in pulmonary embolism.
The following surgical patients are at increased risk of deep vein thrombosis:

- Surgery greater than 90 minutes at any site or greater than 60 minutes if the procedure involves the lower limbs or pelvis
- Acute admissions with inflammatory process involving the abdominal cavity
- Expected significant reduction in mobility
- Age over 60 years
- Known malignancy
- Thrombophilia
- Previous thrombosis
- BMI >30
- Taking hormone replacement therapy or the contraceptive pill
- Varicose veins with phlebitis

Mechanical thromboprophylaxis

- Early ambulation after surgery is cheap and is effective
- Compression stockings (contra -indicated in peripheral arterial disease)
- Intermittent pneumatic compression devices

- Foot impulse devices

Therapeutic agents

Agent	Mode of action	Uses
Low molecular weight heparin	Binds antithrombin resulting in inhibition of factor Xa	In patients with normal renal function, low doses typically given in those with moderate to high risk of thromboembolic events. It is given as once daily subcutaneous injection
Unfractionated heparin	Binds antithrombin III with affects thrombin and factor Xa	Effective anticoagulation, administered intravenously it has a rapid onset and its therapeutic effects decline quickly on stopping and infusion. Its activity is measured using the APTT. If need be it can be reversed using protamine sulphate
Dabigatran	Orally administered direct thrombin inhibitor	Used prophylaxis in hip and knee surgery. It does not require therapeutic monitoring. It has no known antidote and should not be used in any patient in whom there is a risk of active bleeding or imminent likelihood of surgery

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Question: 8

A 25-year-old lady has developed disseminated intravascular coagulation due to an acute peripartum haemorrhage. After general resuscitation measures, what treatment should be administered first?

Vitamin K	15%
Platelets	11%
Fresh Frozen Plasma (FFP)	53%

Recombinant activated FVII	10%
Tranexamic acid	11%

The RCOG has provided guidance on management of disseminated intravascular coagulation (Green-top Guideline No.63).

It states that 'Clotting studies and a platelet count should be urgently requested and advice from a haematologist sought. Up to 4 units of FFP and 10 units of cryoprecipitate may be given whilst awaiting the results of the coagulation studies.'

Since cryoprecipitate is not an option, FFP as the first-line therapy is the correct answer.
Explanation:

Blood products - cross matching

Whole blood fractions

Fraction	Key points
Packed red cells	Used for transfusion in chronic anaemia and cases where infusion of large volumes of fluid may result in cardiovascular compromise. Product obtained by centrifugation of whole blood.
Platelet rich plasma	Usually administered to patients who are thrombocytopaenic and are bleeding or require surgery. It is obtained by low speed centrifugation.
Platelet concentrate	Prepared by high speed centrifugation and administered to patients with thrombocytopaenia.

Fraction	Key points
Fresh frozen plasma	- Prepared from single units of blood. - Contains clotting factors, albumin and immunoglobulin. - Unit is usually 200 to 250ml. - Usually used in correcting clotting deficiencies in patients with hepatic synthetic failure who are due to undergo surgery. - Usual dose is 12-15ml/Kg^{-1}. - It should not be used as first line therapy for hypovolaemia.
Cryoprecipitate	- Formed from supernatant of FFP. - Rich source of Factor VIII and fibrinogen. - Allows large concentration of factor VIII to be administered in small volume.
SAG-Mannitol Blood	Removal of all plasma from a blood unit and substitution with: - Sodium chloride - Adenine - Anhydrous glucose - Mannitol Up to 4 units of SAG M Blood may be administered. Thereafter whole blood is preferred. After 8 units, clotting factors and platelets should be considered.

Cross matching

Must be cross matched	Can be ABO incompatible in adults
Packed red cells	Platelets
Fresh frozen plasma	
Cryoprecipitate	
Whole blood	

Question: 9

A 22-year-old female is extubated following an uncomplicated laparoscopic appendicectomy. However, no respiratory effort is made and she is re-intubated and ventilated. She is monitored in the intensive care unit and all observations are normal. She is weaned from the ventilator 24 hours later successfully. What complication has occurred?

Misplacement of the endotracheal tube in intubation	9%
Suxamethonium apnoea	55%
Opioid toxicity	12%
Malignant hyperpyrexia	8%
Overdose of propofol	16%

A small subset of the population has an autosomal dominant mutation, leading to a lack of the specific acetylcholinesterase in the plasma which acts to break down suxamethonium, terminating its muscle relaxant effect. Therefore, the effects of suxamethonium are prolonged and the patient needs to be mechanically ventilated and observed in ITU until the effects of suxamethonium wear off.

Opioid toxicity causes respiratory depression but is unlikely to be extreme enough to cause no respiratory effort in the monitored conditions of an anaesthetic. Misplacement of the endotracheal tube would cause hypoxia with a respiratory acidosis soon after intubation and potentially a pneumothorax ipsilaterally with collapse contralaterally. A propofol overdose would cause a fall in blood pressure. Malignant hyperpyrexia would manifest with a rise in temperature, rise in blood pressure, muscle spasm, type II respiratory failure and metabolic acidosis and arrhythmias.
Explanation:

Muscle relaxants

Suxamethonium	- Depolarising neuromuscular blocker - Inhibits action of acetylcholine at the neuromuscular junction - Degraded by plasma cholinesterase and acetylcholinesterase

- Fastest onset and shortest duration of action of all muscle relaxants
- Produces generalised muscular contraction prior to paralysis
- Adverse effects include hyperkalaemia, malignant hyperthermia and lack of acetylcholinesterase

Atracurium	- Non depolarising neuromuscular blocking drug - Duration of action usually 30-45 minutes - Generalised histamine release on administration may produce facial flushing, tachycardia and hypotension - Not excreted by liver or kidney, broken down in tissues by hydrolysis - Reversed by neostigmine
Vecuronium	- Non depolarising neuromuscular blocking drug - Duration of action approximately 30 - 40 minutes - Degraded by liver and kidney and effects prolonged in organ dysfunction - Effects may be reversed by neostigmine
Pancuronium	- Non depolarising neuromuscular blocker - Onset of action approximately 2-3 minutes - Duration of action up to 2 hours - Effects may be partially reversed with drugs such as neostigmine

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Question: 10

A 68-year-old woman presents to the orthopaedic surgery ward one day prior to an elective knee replacement. She has osteoarthritis and hypertension and is currently being treated for an episode of giant cell arteritis that occurred three months ago with 20mg prednisolone daily. She has never had surgery before and is anxious about the anaesthetic.

What is the most important drug to prescribe prior to surgery?

Bisoprolol	16%
Diazepam	

Diazepam	27%
Hydrocortisone	**34%**
Prednisolone	**12%**
Ramipril	**11%**

Chronic glucocorticoid therapy, such as treatment of giant cell arteritis (GCA) with prednisolone can suppress the hypothalamic-pituitary-adrenal axis, meaning that in times of stress (such as surgery), the adrenal glands are not able to respond appropriately. Hydrocortisone should therefore be given preoperatively to patients taking regular prednisolone for moderate to major surgery.

As a rule of thumb:

- Minor procedure under local: no supplementation required
- Moderate procedure: 50mg hydrocortisone before induction and 25mg every 8h for 24h
- Major surgery: 100mg hydrocortisone before induction and 50mg every 8h for 24h, thereafter halving dose every 24h until maintenance dose reached.

There is no indication that this patient needs additional medications for her hypertension preoperatively and diazepam should not be given routinely to control anxiety. This patient probably just needs someone to speak to her and reassure her about the procedure.

Explanation:

Preparation for surgery

Elective and emergency patients require different preparation.

Elective cases

- Consider pre admission clinic to address medical issues.
- Blood tests including FBC, U+E, LFTs, Clotting, Group and Save
- Urine analysis
- Pregnancy test
- Sickle cell test

- ECG/ Chest x-ray

Exact tests to be performed will depend upon the proposed procedure and patient fitness.

Risk factors for development of deep vein thrombosis should be assessed and a plan for thromboprophylaxis formulated.

Diabetes

Diabetic patients have greater risk of complications.

Poorly controlled diabetes carries high risk of wound infections.

Patients with diet or tablet controlled diabetes may be managed using a policy of omitting medication and checking blood glucose levels regularly. Diabetics who are poorly controlled or who take insulin will a require variable rate intravenous insulin infusion. Potassium supplementation should also be given.

Diabetic cases should be operated on first.

Emergency cases

Stabilise and resuscitate where needed.

Consider whether antibiotics are needed and when and how they should be administered.
Inform blood bank if major procedures planned particularly where coagulopathies are present at the outset or anticipated (e.g. Ruptured AAA repair)
Don't forget to consent and inform relatives.

Special preparation

Some procedures require special preparation:

- Thyroid surgery; vocal cord check.
- Parathyroid surgery; consider methylene blue to identify gland.
- Sentinel node biopsy; radioactive marker/ patent blue dye.
- Surgery involving the thoracic duct; consider administration of cream.
- Pheochromocytoma surgery; will need alpha and beta blockade.
- Surgery for carcinoid tumours; will need covering with octreotide.
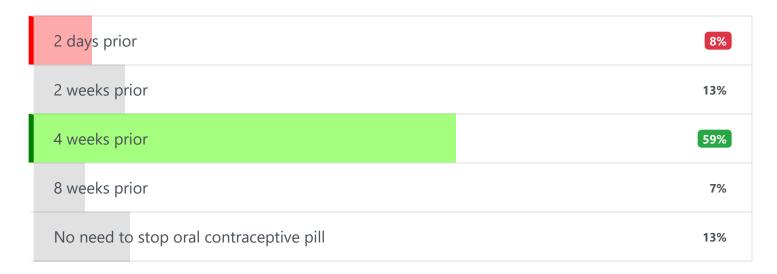- Colorectal cases; bowel preparation (especially left sided surgery)

- Thyrotoxicosis; lugols iodine/ medical therapy.

References

Management of adults with diabetes undergoing surgery and elective procedures. NHS Diabetes. April 2011.

Question: 11

A 35-year-old female is undergoing pre-operative assessment for an elective cholecystectomy following 2 episodes of severe biliary colic. She has no other comorbidities, but smokes 2-3 cigarettes a day. She has a body mass index of 28kg/m. She asks when she should stop her oral contraceptive pill. What is the gold-standard?

2 days prior	8%
2 weeks prior	13%
4 weeks prior	59%
8 weeks prior	7%
No need to stop oral contraceptive pill	13%

The important thing to note about this question is the type of surgery this patient is having. This patient is having an elective procedure under general anaesthesia. Although it is a day case, she is a smoker and is overweight (risk factors for clots). Thus she would need the general advice of stopping her oral contraceptive pill for the procedure which is 4 weeks.

The gold standard for stopping oral contraceptive pill prior to surgery is 4 weeks. However there are some cases (ex. If the operation is under local anaesthetic) where there would be no need to stop oral contraceptive pill.

Explanation:

Preparation for surgery

Elective and emergency patients require different preparation.

Elective cases

- Consider pre admission clinic to address medical issues.
- Blood tests including FBC, U+E, LFTs, Clotting, Group and Save
- Urine analysis
- Pregnancy test
- Sickle cell test
- ECG/ Chest x-ray

Exact tests to be performed will depend upon the proposed procedure and patient fitness.

Risk factors for development of deep vein thrombosis should be assessed and a plan for thromboprophylaxis formulated.

Diabetes

Diabetic patients have greater risk of complications.

Poorly controlled diabetes carries high risk of wound infections.

Patients with diet or tablet controlled diabetes may be managed using a policy of omitting medication and checking blood glucose levels regularly. Diabetics who are poorly controlled or who take insulin will a require variable rate intravenous insulin infusion. Potassium supplementation should also be given.

Diabetic cases should be operated on first.

Emergency cases

Stabilise and resuscitate where needed.

Consider whether antibiotics are needed and when and how they should be administered.
Inform blood bank if major procedures planned particularly where coagulopathies are present at the outset or anticipated (e.g. Ruptured AAA repair)
Don't forget to consent and inform relatives.

Special preparation

Some procedures require special preparation:

- Thyroid surgery; vocal cord check.
- Parathyroid surgery; consider methylene blue to identify gland.
- Sentinel node biopsy; radioactive marker/ patent blue dye.
- Surgery involving the thoracic duct; consider administration of cream.
- Pheochromocytoma surgery; will need alpha and beta blockade.
- Surgery for carcinoid tumours; will need covering with octreotide.
- Colorectal cases; bowel preparation (especially left sided surgery)
- Thyrotoxicosis; lugols iodine/ medical therapy.

References

Management of adults with diabetes undergoing surgery and elective procedures. NHS Diabetes. April 2011.

Question: 12

A 17-year-old man undergoes an elective right hemicolectomy. Post operatively he receives a total of 6 litres of 0.9% sodium chloride solution, over 24 hours. Which of the following complications may ensue?

Hyperchloraemiac acidosis.	**35%**
Hypochloraemic alkalosis	**15%**
Hyperchloraemic alkalosis	**26%**
Acute renal failure	**9%**
None of the above	**15%**

Excessive infusions of any intravenous fluid carry the risk of development of tissue oedema and potentially cardiac failure. Excessive administration of sodium chloride is a recognised cause of hyperchloraemic acidosis and therefore Hartmans solution may be preferred where large volumes of fluid are to be administered.

Explanation:

Post operative fluid management

Composition of commonly used intravenous fluids mmol^{-1}

	Na	**K**	**Cl**	**Bicarbonate**	**Lactate**
Plasma	137-147	4-5.5	95-105	22-25	-
0.9% Saline	153	-	153	-	-
Dextrose / saline	30.6	-	30.6	-	-
Hartmans	130	4	110	-	28

Post operative fluid management

In the UK the GIFTASUP guidelines (see reference below) were devised to try and provide some consensus guidance as to how intravenous fluids should be administered. A decade ago it was a commonly held belief that little harm would occur as a result of excessive administration of normal saline and many oliguric postoperative patients received enormous quantities of IV fluids. As a result, they developed hyperchloraemic acidosis. With a greater understanding of this potential complication, the use of electrolyte balanced solutions (Ringers lactate/ Hartmans) is now favoured over normal saline. In addition to this, solutions of 5% dextrose and dextrose/saline combinations are now generally not recommended for surgical patients. The other guidance includes:
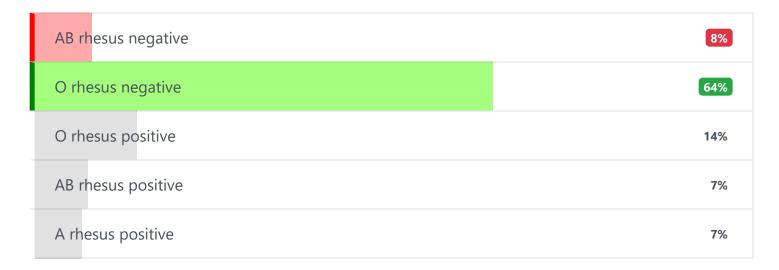
- Fluids given should be documented clearly and easily available
- Assess the patient's fluid status when they leave theatre
- If a patient is haemodynamically stable and euvolaemic, aim to restart oral fluid intake as soon as possible
- Review patients whose urinary sodium is < 20
- If a patient is oedematous, hypovolaemia if present should be treated first. This should then be followed by a negative balance of sodium and water, monitored using urine Na excretion levels.
- Solutions such as Dextran 70 should be used in caution in patients with sepsis as there is a risk of developing acute renal injury.

References

Question: 13

An 18 year old woman is admitted to the Emergency Department following a motor vehicle collision. The patient is hypotensive, blood pressure 90/40 mmHg and tachycardic, 120 beats per minute, and has oxygen saturations of 92%. Initial resuscitation is commenced using one litre of 0.9% normal saline. The consultant is concerned that the spleen has ruptured. A cross match and request of four units of blood has been sent to the haematology lab. The patient's sister overhears the conversation behind the curtain. She thinks she is blood group A because she donates blood every year. What blood product can this patient receive until the cross match result is returned?

AB rhesus negative	8%
O rhesus negative	64%
O rhesus positive	14%
AB rhesus positive	7%
A rhesus positive	7%

This patient is actively bleeding. The consultant appreciates the need to replace this individual with blood products. Over resuscitation using 0.9% saline can result in dilutional anaemia. This does not improve oxygen transport/ delivery or coagulopathy.

In patients for whom we do not know their blood group, O rhesus negative blood may be prescribed. O rhesus negative is considered the universal donor. O rhesus negative can give blood to any other blood group. However, to preserve the stocks of O negative transfusion guidelines now recommend giving male patients O positive blood in such situations (Rhesus status is relevant in pregnancy).

It is imperative to prescribe 1. The correct blood product. 2. The right product for the right patient. Transfusion reactions are serious and deadly.

Explanation:

Blood products - cross matching

Whole blood fractions

Fraction	Key points
Packed red cells	Used for transfusion in chronic anaemia and cases where infusion of large volumes of fluid may result in cardiovascular compromise. Product obtained by centrifugation of whole blood.
Platelet rich plasma	Usually administered to patients who are thrombocytopaenic and are bleeding or require surgery. It is obtained by low speed centrifugation.
Platelet concentrate	Prepared by high speed centrifugation and administered to patients with thrombocytopaenia.
Fresh frozen plasma	- Prepared from single units of blood. - Contains clotting factors, albumin and immunoglobulin. - Unit is usually 200 to 250ml. - Usually used in correcting clotting deficiencies in patients with hepatic synthetic failure who are due to undergo surgery. - Usual dose is 12-15ml/Kg^{-1}. - It should not be used as first line therapy for hypovolaemia.
Cryoprecipitate	- Formed from supernatant of FFP. - Rich source of Factor VIII and fibrinogen. - Allows large concentration of factor VIII to be administered in small volume.
SAG-Mannitol Blood	Removal of all plasma from a blood unit and substitution with: - Sodium chloride - Adenine - Anhydrous glucose - Mannitol Up to 4 units of SAG M Blood may be administered. Thereafter whole blood is preferred. After 8 units, clotting factors and platelets should be considered.

Cross matching

Must be cross matched	Can be ABO incompatible in adults
Packed red cells	Platelets
Fresh frozen plasma	
Cryoprecipitate	
Whole blood	

Question: 14

In 2010 NICE published guidelines on the prevention of venous thromboembolism (VTE) in patients admitted to hospital. Which one of the following would be classified as a risk factor for VTE?

Dehydration	**42%**
Taking a progesterone-only contraceptive pill	24%
Being 57-years-old	15%
Taking aspirin 75mg od	9%
Being of Asian ethnicity	10%

Explanation:

Venous thromboembolism: prophylaxis in patients admitted to hospital

VTEs can cause severe morbidity and mortality, but they are preventable. Current NICE guidelines (updated for 2018) outline recommendations for assessment and management of patients at risk of VTE in hospital.

Risk factors

All patients admitted to hospital should be individually assessed to identify risk factors for VTE development and bleeding risk. For medical and surgical patients the recommended risk proforma is the department of healths VTE risk assessment tool.

The following inpatients would be deemed at increased risk of developing a VTE:

Medical patients:

- significant reduction in mobility for 3 days or more (or anticipated to have significantly reduced mobility)

Surgical/trauma patients:

- hip/knee replacement
- hip fracture
- general anaesthetic and a surgical duration of over 90 minutes
- surgery of the pelvis or lower limb with a general anaesthetic and a surgical duration of over 60 minutes
- acute surgical admission with an inflammatory/intra-abdominal condition
- surgery with a significant reduction in mobility

General risk factors:

- active cancer/chemotherapy
- aged over 60
- known blood clotting disorder (e.g. thrombophilia)
- BMI over 35
- dehydration
- one or more significant medical comorbidities (e.g. heart disease; metabolic/endocrine pathologies; respiratory disease; acute infectious disease and inflammatory conditions)
- critical care admission
- use of hormone replacement therapy (HRT)
- use of the combined oral contraceptive pill
- varicose veins
- pregnant or less than 6 weeks post-partum

After a patients VTE risk has been assessed, this should be compared to their risk of bleeding to decide whether VTE prophylaxis should be offered. If indicated VTE prophylaxis should be started as soon as possible.

Types of VTE prophylaxis

Mechanical:

- Correctly fitted anti-embolism (aka compression) stockings (thigh or knee height)
- An Intermittent pneumatic compression device

Pharmacological:

- Fondaparinux sodium (SC injection)
- Low molecular weight heparin (LMWH) - e.g. enoxaparin (brand name = Clexane)
- Unfractionated heparin (UFH) - used in patients with chronic kidney disease

Management

In general, all medical patients deemed at risk of VTE after individual assessment are started on pharmacological VTE prophylaxis. This is providing the risk of VTE outweighs the risk of bleeding (this is often a clinical judgement) and there are no contraindications. Those at very high risk may be offered anti-embolic stockings alongside the pharmacological methods.

For surgical patients at low risk of VTE first-line treatment is anti-embolism stockings. If a patient is at high risk these stockings are used in conjunction with pharmacological prophylaxis.

Advice for patients

Pre-surgical interventions:

- Advise women to stop taking their combined oral contraceptive pill/hormone replacement therapy 4 weeks before surgery.

Post-surgical interventions:

- Try to mobilise patients as soon as possible after surgery
- Ensure the patient is hydrated

Post procedure prophylaxis

For certain surgical procedures (hip and knee replacements) pharmacological VTE prophylaxis is recommended for all patients to reduce the risk of a VTE developing post-surgery. NICE make the following recommendations:

Procedure	Prophylaxis
Elective hip	LMWH for 10 days followed by aspirin (75 or 150 mg) for a further 28 days or LMWH for 28 days combined with anti-embolism stockings until discharge or Rivaroxaban
Elective knee	Aspirin (75 or 150 mg) for 14 days or LMWH for 14 days combined with anti-embolism stockings until discharge or Rivaroxaban

Procedure	Prophylaxis
Fragility fractures of the pelvis, hip and proximal femur	The NICE guidance states the following (our bolding): *Offer VTE prophylaxis for a **month** to people with fragility fractures of the pelvis, hip or proximal femur if the risk of VTE outweighs the risk of bleeding. Choose either:* • *LMWH , starting 6–12 hours after surgery or* • *fondaparinux sodium, starting 6 hours after surgery, providing there is low risk of bleeding.*

Question: 15

A 49-year-old man is having an elective repair of a right-sided inguinal hernia under general anaesthetic. What is the most appropriate advice to give him about eating and drinking before the operation?

He should be nil-by-mouth from midnight before his operation	**23%**
No food or clear fluids for 6 hours before his operation	12%
No food for 6 hours and no clear fluids for 4 hours before his operation	16%
No food for 6 hours and no clear fluids for 2 hours before his operation	**42%**
No food for 6 hours and no clear fluids for 1 hour before his operation	8%

The Royal College of Anaesthetists recommend that patients should have no food for 6 hours before the induction of general anaesthesia. Patients should be allowed to drink water or other clear fluids until 2 hours before the induction of general anaesthesia. This is to reduce the likelihood of pulmonary aspiration of gastric contents.

Explanation:

General anaesthetics

Inhaled anaesthetics

Drug	Adverse effects	Notes
Halothane	Hepatotoxicity, myocardial depression malignant hyperthermia	

Intravenous anaesthetics

Drug	Adverse effects	Notes
Thiopental	Laryngospasm	Highly lipid soluble so quickly affects the brain

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Question: 16

An 85-year-old female with multiple comorbidities is scheduled to receive a bowel resection in her local hospital. She attends a pre-operative assessment clinic with the senior anaesthetist to discuss her suitability for surgery and arrange any pre-operative investigations required. In whom do NICE recommend should receive a chest X-ray as part of their pre-operative assessment?

Patients over the age of 65	**41%**
Patients with a degree of renal impairment	9%
Patients with hypertension	14%
Not routinely recommended	**27%**
Patients with diabetes	8%

Chest x-rays are now not routinely recommended before surgery.

- Patients over the age of 65 may need an ECG before major surgery.

- Patients with renal disease may need a full blood count and an ECG depending on their ASA grade even before intermediate surgery.
- Patients with hypertension do not need any specific investigations pre-operation.
- Patients with diabetes may need an ECG before intermediate surgery.

Please see the following NICE guidelines for more information on pre-operation assessment: https:www.nice.org.uk/guidance/ng45/chapter/recommendations

Explanation:

American Society of Anaesthesiologists (ASA) classification

ASA Classification	Definition	Examples
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, obesity (30 < BMI < 40), well-controlled Diabetes Mellitus/Hypertension, mild lung disease
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled Diabetes Mellitus/Hypertension, COPD, morbid obesity (BMI 40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, End Stage Renal Disease (ESRD) undergoing regularly scheduled dialysis, history (>3 months) of Myocardial infarction, Cerebrovascular accidents

ASA Classification	Definition	Examples
ASA IV	A patient with severe systemic disease that is a constant threat to life	Examples include (but not limited to): recent (< 3 months) of Myocardial infarction, Cerebrovascular accidents, ongoing cardiac ischaemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis
ASA V	A moribund patient who is not expected to survive without the operation	Examples include (but not limited to): ruptured abdominal/thoracic aneurysm, massive trauma, intra-cranial bleed with mass effect, ischaemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

Question: 17

A 75-year-old male with diabetes type 2 is undergoing an appendectomy. He does not use insulin-based medications.

What statement is correct in regard to the management of this patient?

This patient has good control of their diabetes if their HbA1c is 77 mmol/mol	**8%**
This patient should be recommenced on oral diabetes medication 48 hours after they commence eating postoperatively	**23%**
This patient should stop taking their oral diabetes medication one week prior to the operation	**9%**
This patient should be first on the list	**53%**
This patient should be put last on the list	**7%**

Patients with diabetes should ideally be put first on the operating list to prevent complications of poor BM control.

Patients with poor control or who are taking insulin will need a sliding scale.
Explanation:

Preparation for surgery

Elective and emergency patients require different preparation.

Elective cases

- Consider pre admission clinic to address medical issues.
- Blood tests including FBC, U+E, LFTs, Clotting, Group and Save
- Urine analysis
- Pregnancy test
- Sickle cell test
- ECG/ Chest x-ray

Exact tests to be performed will depend upon the proposed procedure and patient fitness.

Risk factors for development of deep vein thrombosis should be assessed and a plan for thromboprophylaxis formulated.

Diabetes

Diabetic patients have greater risk of complications.

Poorly controlled diabetes carries high risk of wound infections.

Patients with diet or tablet controlled diabetes may be managed using a policy of omitting medication and checking blood glucose levels regularly. Diabetics who are poorly controlled or who take insulin will a require variable rate intravenous insulin infusion. Potassium supplementation should also be given.

Diabetic cases should be operated on first.

Emergency cases

Stabilise and resuscitate where needed.

Consider whether antibiotics are needed and when and how they should be administered.
Inform blood bank if major procedures planned particularly where coagulopathies are present at the outset or anticipated (e.g. Ruptured AAA repair)
Don't forget to consent and inform relatives.

Special preparation

Some procedures require special preparation:

- Thyroid surgery; vocal cord check.
- Parathyroid surgery; consider methylene blue to identify gland.
- Sentinel node biopsy; radioactive marker/ patent blue dye.
- Surgery involving the thoracic duct; consider administration of cream.
- Pheochromocytoma surgery; will need alpha and beta blockade.
- Surgery for carcinoid tumours; will need covering with octreotide.
- Colorectal cases; bowel preparation (especially left sided surgery)
- Thyrotoxicosis; lugols iodine/ medical therapy.

References

Management of adults with diabetes undergoing surgery and elective procedures. NHS Diabetes. April 2011.

A 52-year-old female underwent an orthotopic liver transplantation for chronic hepatitis C cirrhosis. She has recovered well and was transferred from ITU to your ward today, 3 days post-operative. She is eating and drinking, her pain is well managed with opiate analgesia, and her urinary catheter was removed this morning. In the afternoon you are asked by one of the nurses to review her as she is complaining of severe abdominal pain. As you are reviewing her she tells you the pain is 9/10 in severity and mainly in the lower abdomen. She is unable to find a comfortable position. On examination her heart rate is 109 bpm, blood pressure 135/79 mmHg, and temperature 37.2ÂºC. You notice that she has not opened her bowels for over 36 hours. Her abdomen is tender to palpation in the suprapubic region and right upper quadrant. What is the most likely cause of her abdominal pain?

Urinary retention	**35%**
Ovarian torsion	8%
Portal vein thrombosis	15%
Intra-abdominal haemorrhage	10%
Large bowel obstruction	31%

The most likely diagnosis is urinary retention. Risk factors for urinary retention include removal of urinary catheter, constipation, immobility, opiate analgesia, infection, haematuria and benign prostatic hyperplasia (in males). In this scenario the patient is constipated, taking opiate analgesia, and has had a urinary catheter removed earlier in the day. This is a classic surgical complication and often presents several hours after removal of catheter. Observations are normal except for a tachycardia which is likely secondary to severe pain. The right upper quadrant tenderness is a red herring. It's only present on palpation during your examination which would be expected 3 days post liver transplantation.

Intra-abdominal haemorrhage is less likely in this scenario as the patient would have generalised abdominal pain and hypotension. Whilst ovarian torsion would present with severe abdominal pain, it is normally unilateral and more acute in nature (not developing over hours). Large bowel obstruction would have greater emphasis on vomiting and portal vein thrombosis is often pain free and leads to LFT derangement and signs of portal hypertension.

Explanation:

Surgical complications

Complications occur in all branches of surgery and require vigilance in their detection. In many cases anticipating the likely complications and appropriate avoidance will minimise their occurrence. For the purposes of the exam the important principles to appreciate are:

- The anatomical principles that underpin complications
- The physiological and biochemical derangements that occur
- The most appropriate diagnostic modalities to utilise
- The principles which underpin their management

This is clearly a very broad area and impossible to cover comprehensively. There is considerable overlap with other topic areas within the website.

Avoiding complications

Some points to hopefully avert complications:

- World Health Organisation checklist- now mandatory prior to all operations
- Prophylactic antibiotics - right dose, right drug, right time.
- Assess DVT/ PE risk and ensure adequate prophylaxis
- **MARK** site of surgery
- Use tourniquets with caution and with respect for underlying structures
- Remember the danger of end arteries and in situations where they occur avoid using adrenaline containing solutions and monopolar diathermy.
- Handle tissues with care- devitalised tissue serves as a nidus for infection
- Be very wary of the potential for coupling injuries when using diathermy during laparoscopic surgery
- The inferior epigastric artery is a favorite target for laparoscopic ports and surgical drains!

Anatomical principles

Understanding the anatomy of a surgical field will allow appreciation of local and systemic complications that may occur. For example nerve injuries may occur following surgery in specific regions the table below lists some of the more important nerves to consider and mechanisms of injury

Nerve	Mechanism
Accessory	Posterior triangle lymph node biopsy
Sciatic	Posterior approach to hip
Common peroneal	Legs in Lloyd Davies position
Long thoracic	Axillary node clearance
Pelvic autonomic nerves	Pelvic cancer surgery
Recurrent laryngeal nerves	During thyroid surgery
Hypoglossal nerve	During carotid endarterectomy
Ulnar and median nerves	During upper limb fracture repairs

These are just a few. The detailed functional sequelae are particularly important and will often be tested. In addition to nerve injuries certain procedures carry risks of visceral or structural injury. Again some particular favorites are given below:

Structure	Mechanism
Thoracic duct	During thoracic surgery e.g. Pneumonectomy, oesphagectomy
Parathyroid glands	During difficult thyroid surgery
Ureters	During colonic resections/ gynaecological surgery
Bowel perforation	Use of Verres Needle to establish pneumoperitoneum
Bile duct injury	Failure to delineate Calots triangle carefully and careless use of diathermy
Facial nerve	Always at risk during Parotidectomy
Tail of pancreas	When ligating splenic hilum

Structure	Mechanism
Testicular vessels	During re-do open hernia surgery
Hepatic veins	During liver mobilisation

Again many could be predicted from the anatomy of the procedure.

Physiological derangements
A very common complication is bleeding and this is covered under the section of haemorrhagic shock. Another variant is infection either superficial or deep seated. The organisms are covered under microbiology and the features of sepsis covered under shock. Do not forget that immunocompromised and elderly patients may present will atypical physiological parameters.

Selected physiological and biochemical issues are given below:

Complication	Physiological/ Biochemical Problem
Arrhythmias following cardiac surgery	Susceptibility to hypokalaemia (K^+ <4.0 in cardiac patients)
Neurosurgical electrolyte disturbance	SIADH following cranial surgery causing hyponatraemia
Ileus following gastrointestinal surgery	Fluid sequestration and loss of electrolytes
Pulmonary oedema following pneumonectomy	Loss of lung volume makes these patients very sensitive to fluid overload
Anastamotic leak	Generalised sepsis causing mediastinitis or peritonitis depending on site of leak
Myocardial infarct	May follow any type of surgery and in addition to direct cardiac effects the decreased cardiac output may well compromise grafts etc.

Try making a short list of problems and causes specific to your own clinical area.

Diagnostic modalities
Depends largely on the suspected complication. In the acutely unwell surgical patient the following baseline investigations are often helpful:

- Full blood count, urea and electrolytes, C- reactive protein (trend rather than absolute value), serum calcium, liver function tests, clotting (don't forget to repeat if on-going bleeding)
- Arterial blood gases
- ECG (+cardiac enzymes if MI suspected)
- Chest x-ray to identify collapse/ consolidation
- Urine analysis for UTI

These will often identify the most common complications.

Special tests

- CT scanning for identification of intra-abdominal abscesses, air and if luminal contrast is used an anastamotic leak
- Gatrograffin enema- for rectal anastamotic leaks
- Doppler USS of leg veins- for identification of DVT
- CTPA for PE
- Sending peritoneal fluid for U+E (if ureteric injury suspected) or amylase (if pancreatic injury suspected)
- Echocardiogram if pericardial effusion suspected post cardiac surgery and no pleural window made.

Management of complications
The guiding principal should be safe and timely intervention. Patients should be stabilised and if an operation needs to occur in tandem with resuscitation then generally this should be of a damage limitation type procedure rather than definitive surgery (which can be more safely undertaken in a stable patient the following day).

Remember that recent surgery is a contra indication to thrombolysis and that in some patients IV heparin may be preferable to a low molecular weight heparin (easier to reverse).

As a general rule laparotomies for bleeding should follow the core principle of quadrant packing and then subsequent pack removal rather than plunging large clamps into pools of blood. The latter

approach invariable worsens the situation is often accompanied by significant visceral injury particularly when done by the inexperienced. If packing controls a situation it is entirely acceptable practice to leave packs in situ and return the patient to ITU for pack removal the subsequent day.

A 41-year-old man is assessed on the orthopaedic ward with pyrexia and shortness of breath. He had an intramedullary nail to fix a fracture of his right tibia 7 days ago. Which of the following is most likely the cause of his delayed (> 5 days) post-operative pyrexia?

Venous thromboembolism	**40%**
Pulmonary atelectasis	**19%**
Cellulitis	**18%**
Blood transfusion	**9%**
Urinary tract infection	**14%**

Venous thromboembolism normally presents within 5-10 days post-operatively. The shortness of breath makes a diagnosis of venous thromboembolism more likely than cellulitis or urinary tract infection, whilst pulmonary atelectasis is more likely to occur earlier post-operatively.

Explanation:

Post-operative pyrexia

Early causes of post-op pyrexia (0-5 days) include:

- Blood transfusion
- Cellulitis
- Urinary tract infection
- Physiological systemic inflammatory reaction (usually within a day following the operation)
- Pulmonary atelectasis - this if often listed but the evidence base to support this link is limited
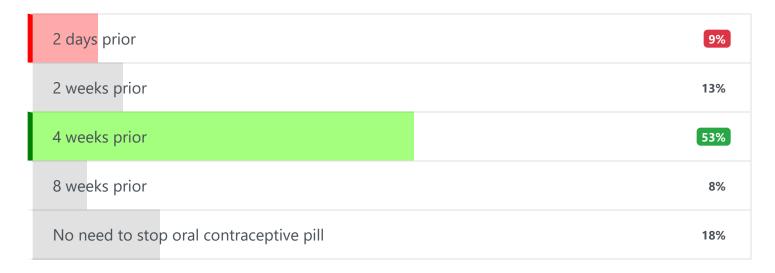
Late causes (>5 days) include:

- Venous thromboembolism
- Pneumonia
- Wound infection
- Anastomotic leak

When considering causes of post-op pyrexia, it is helpful to consider the memory aid of 'the 4 W's' (wind, water, wound, what did we do? (iatrogenic).

Source: peer-reviewed publication (http:www.ncbi.nlm.nih.gov/pubmed/16570551).

Question: 20

A 35-year-old female is undergoing pre-operative assessment for an elective laparoscopic cholecystectomy under a general anaesthetic. She asks when she should stop her combined oral contraceptive pill. What is the most appropriate advice?

2 days prior	**9%**
2 weeks prior	**13%**
4 weeks prior	**53%**
8 weeks prior	**8%**
No need to stop oral contraceptive pill	**18%**

Due to an increased risk of venous thromboembolism it is advisable to stop the combined oral contraceptive pill 4 weeks prior to her operation.
Explanation:

Preparation for surgery

Elective and emergency patients require different preparation.

Elective cases

- Consider pre admission clinic to address medical issues.

- Blood tests including FBC, U+E, LFTs, Clotting, Group and Save
- Urine analysis
- Pregnancy test
- Sickle cell test
- ECG/ Chest x-ray

Exact tests to be performed will depend upon the proposed procedure and patient fitness.

Risk factors for development of deep vein thrombosis should be assessed and a plan for thromboprophylaxis formulated.

Diabetes

Diabetic patients have greater risk of complications.

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Diabetic cases should be operated on first.

Emergency cases

Stabilise and resuscitate where needed.

Consider whether antibiotics are needed and when and how they should be administered.
Inform blood bank if major procedures planned particularly where coagulopathies are present at the outset or anticipated (e.g. Ruptured AAA repair)
Don't forget to consent and inform relatives.

Special preparation

Some procedures require special preparation:

- Thyroid surgery; vocal cord check.
- Parathyroid surgery; consider methylene blue to identify gland.
- Sentinel node biopsy; radioactive marker/ patent blue dye.

- Surgery involving the thoracic duct; consider administration of cream.
- Pheochromocytoma surgery; will need alpha and beta blockade.
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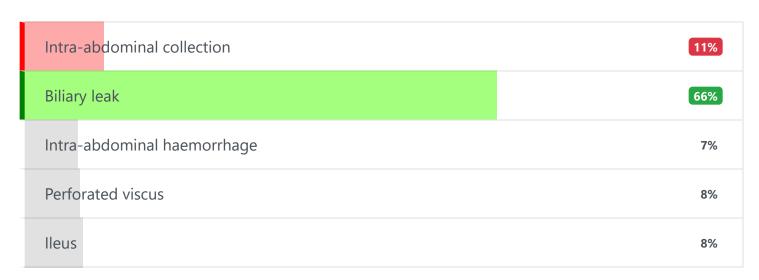- Thyrotoxicosis; lugols iodine/ medical therapy.

References

Management of adults with diabetes undergoing surgery and elective procedures. NHS Diabetes. April 2011.

Question: 21

A 39-year-old overweight female undergoes an elective laparoscopic cholecystectomy for gallstone disease. Day 1 post-operatively you are asked to review her by the nurse in charge. The patient is complaining of severe right upper quadrant pain. On examination she is tachycardic, but normotensive and apyrexial. Her right upper quadrant is tender to palpation but there is no evidence of jaundice. The intra-abdominal drain in-situ has a small volume of green liquid draining from it.

What post-operative complication is most likely?

Intra-abdominal collection	11%
Biliary leak	66%
Intra-abdominal haemorrhage	7%
Perforated viscus	8%
Ileus	8%

Right upper quadrant tenderness and bilious fluid in the intra-abdominal drain would suggest a bile leak following the cholecystectomy. As the patient is apyrexial and normotensive an intra-abdominal collection or haemorrhage would be unlikely. A perforation is a recognised complication of a laparoscopic cholecystectomy however the patient would normally develop peritonitis, as oppose to localised right upper quadrant tenderness. Finally, an ileus would not causes right upper quadrant pain or bilious fluid in the drain.

Explanation:

Surgical complications

Complications occur in all branches of surgery and require vigilance in their detection. In many cases anticipating the likely complications and appropriate avoidance will minimise their occurrence. For the purposes of the exam the important principles to appreciate are:

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Avoiding complications

Some points to hopefully avert complications:

- World Health Organisation checklist- now mandatory prior to all operations
- Prophylactic antibiotics - right dose, right drug, right time.
- Assess DVT/ PE risk and ensure adequate prophylaxis
- **MARK** site of surgery
- Use tourniquets with caution and with respect for underlying structures
- Remember the danger of end arteries and in situations where they occur avoid using adrenaline containing solutions and monopolar diathermy.
- Handle tissues with care- devitalised tissue serves as a nidus for infection
- Be very wary of the potential for coupling injuries when using diathermy during laparoscopic surgery
- The inferior epigastric artery is a favorite target for laparoscopic ports and surgical drains!

Anatomical principles

Understanding the anatomy of a surgical field will allow appreciation of local and systemic complications that may occur. For example nerve injuries may occur following surgery in specific regions the table below lists some of the more important nerves to consider and mechanisms of injury

Nerve	Mechanism
Accessory	Posterior triangle lymph node biopsy
Sciatic	Posterior approach to hip
Common peroneal	Legs in Lloyd Davies position
Long thoracic	Axillary node clearance
Pelvic autonomic nerves	Pelvic cancer surgery
Recurrent laryngeal nerves	During thyroid surgery
Hypoglossal nerve	During carotid endarterectomy
Ulnar and median nerves	During upper limb fracture repairs

These are just a few. The detailed functional sequelae are particularly important and will often be tested. In addition to nerve injuries certain procedures carry risks of visceral or structural injury. Again some particular favorites are given below:

Structure	Mechanism
Thoracic duct	During thoracic surgery e.g. Pneumonectomy, oesphagectomy
Parathyroid glands	During difficult thyroid surgery
Ureters	During colonic resections/ gynaecological surgery
Bowel perforation	Use of Verres Needle to establish pneumoperitoneum
Bile duct injury	Failure to delineate Calots triangle carefully and careless use of diathermy

Structure	Mechanism
Facial nerve	Always at risk during Parotidectomy
Tail of pancreas	When ligating splenic hilum
Testicular vessels	During re-do open hernia surgery
Hepatic veins	During liver mobilisation

Again many could be predicted from the anatomy of the procedure.

Physiological derangements
A very common complication is bleeding and this is covered under the section of haemorrhagic shock. Another variant is infection either superficial or deep seated. The organisms are covered under microbiology and the features of sepsis covered under shock. Do not forget that immunocompromised and elderly patients may present will atypical physiological parameters.

Selected physiological and biochemical issues are given below:

Complication	Physiological/ Biochemical Problem
Arrhythmias following cardiac surgery	Susceptibility to hypokalaemia (K^+ <4.0 in cardiac patients)
Neurosurgical electrolyte disturbance	SIADH following cranial surgery causing hyponatraemia
Ileus following gastrointestinal surgery	Fluid sequestration and loss of electrolytes
Pulmonary oedema following pneumonectomy	Loss of lung volume makes these patients very sensitive to fluid overload
Anastamotic leak	Generalised sepsis causing mediastinitis or peritonitis depending on site of leak

Complication	Physiological/ Biochemical Problem
Myocardial infarct	May follow any type of surgery and in addition to direct cardiac effects the decreased cardiac output may well compromise grafts etc.

Try making a short list of problems and causes specific to your own clinical area.

Diagnostic modalities
Depends largely on the suspected complication. In the acutely unwell surgical patient the following baseline investigations are often helpful:

- Full blood count, urea and electrolytes, C- reactive protein (trend rather than absolute value), serum calcium, liver function tests, clotting (don't forget to repeat if on-going bleeding)
- Arterial blood gases
- ECG (+cardiac enzymes if MI suspected)
- Chest x-ray to identify collapse/ consolidation
- Urine analysis for UTI

These will often identify the most common complications.

Special tests

- CT scanning for identification of intra-abdominal abscesses, air and if luminal contrast is used an anastamotic leak
- Gatrograffin enema- for rectal anastamotic leaks
- Doppler USS of leg veins- for identification of DVT
- CTPA for PE
- Sending peritoneal fluid for U+E (if ureteric injury suspected) or amylase (if pancreatic injury suspected)
- Echocardiogram if pericardial effusion suspected post cardiac surgery and no pleural window made.

Management of complications
The guiding principal should be safe and timely intervention. Patients should be stabilised and if an operation needs to occur in tandem with resuscitation then generally this should be of a damage limitation type procedure rather than definitive surgery (which can be more safely undertaken in a stable patient the following day).

Remember that recent surgery is a contra indication to thrombolysis and that in some patients IV heparin may be preferable to a low molecular weight heparin (easier to reverse).

As a general rule laparotomies for bleeding should follow the core principle of quadrant packing and then subsequent pack removal rather than plunging large clamps into pools of blood. The latter approach invariable worsens the situation is often accompanied by significant visceral injury particularly when done by the inexperienced. If packing controls a situation it is entirely acceptable practice to leave packs in situ and return the patient to ITU for pack removal the subsequent day.

Question: 22

A 65-year-old male undergoes a Hartmann's procedure for a sigmoid cancer. On day 2 post-op, nurses are concerned as his colostomy has not passed any wind or stool yet and he is complaining of increasing bloatedness. You review the patient and witness him vomit profusely.

How would you manage this common post-operative complication?

Prescribe regular anti-emetics	8%
Encourage light diet as tolerated	9%
Give stimulant and osmotic laxatives	11%
Place the patient nil by mouth and insert a nasogastric tube	54%
Discuss with the surgical registrar to take the patient back to theatre	19%

Post-operative ileus is a common complication in colorectal surgery due to intra-operative bowel handling. Management is conservative with nasogastric tube insertion for stomach decompression for symptom control and placing the patient nil by mouth to allow bowel rest. The recommencement of fluids/light diet should be in stages and guided by the clinical state of the patient.
Explanation:

Surgical complications

Complications occur in all branches of surgery and require vigilance in their detection. In many cases anticipating the likely complications and appropriate avoidance will minimise their occurrence. For the

purposes of the exam the important principles to appreciate are:

- The anatomical principles that underpin complications
- The physiological and biochemical derangements that occur
- The most appropriate diagnostic modalities to utilise
- The principles which underpin their management

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Question: 23

Which of the following anaesthetic agents has the strongest analgesic effect?

Sodium thiopentone	**18%**
Ketamine	**46%**
Midazolam	**13%**
Etomidate	**11%**
None of the above	**12%**

Ketamine has a moderate to strong analgesic effect. It may be used for emergency procedures outside the hospital environment to induce anaesthesia for procedures such as emergency amputation.

Explanation:

Anaesthetic agents

The table below summarises some of the more commonly used IV induction agents

Agent	Specific features
Propofol	- GABA receptor agonist - Rapid onset of anaesthesia - Pain on IV injection - Rapidly metabolised with little accumulation of metabolites - Proven anti emetic properties - Moderate myocardial depression - Widely used especially for maintaining sedation on ITU, total IV anaesthesia and for daycase surgery

Agent	Specific features
Sodium thiopentone	- Extremely rapid onset of action making it the agent of choice for rapid sequence of induction - Marked myocardial depression may occur - Metabolites build up quickly - Unsuitable for maintenance infusion - Little analgesic effects
Ketamine	- NMDA receptor antagonist - May be used for induction of anaesthesia - Has moderate to strong analgesic properties - Produces little myocardial depression making it a suitable agent for anaesthesia in those who are haemodynamically unstable - May induce state of dissociative anaesthesia resulting in nightmares
Etomidate	- Has favorable cardiac safety profile with very little haemodynamic instability - No analgesic properties - Unsuitable for maintaining sedation as prolonged (and even brief) use may result in adrenal suppression - Post operative vomiting is common

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Question: 24

Which of the following checks is not a part of the WHO (World Health Organisation) Surgical Safety Checklist before the induction of anaesthesia?

Does the patient have any allergies? — 12%

Is the pulse oximeter on the patient and functioning? — 14%

Does the patient have 12-lead ECG monitoring in place? — 36%

Is the site marked? — 27%

Checklists have been identified as a hugely effective tool to reduce mistakes in medicine and also in other fields, such as the aviation industry. A Surgical Safety Checklist has been developed by the World Health Organisation (WHO) to reduce the occurrence of the most common surgical mistakes.

The checklist identifies three phases of an operation:

1) Before the induction of anaesthesia (sign in)
2) Before the incision of the skin (time out)
3) Before the patient leaves the operating room (sign out).

In each phase, a checklist coordinator must confirm that the surgery team has completed the listed tasks before proceeding with the operation.

Before the induction of anaesthesia, the following must have been checked:

- Patient has confirmed: Site, identity, procedure, consent
- Site is marked
- Anaesthesia safety check completed
- Pulse oximeter is on patient and functioning
- Does the patient have a known allergy?
- Is there a difficult airway/aspiration risk?
- Is there a risk of > 500ml blood loss (7ml/kg in children)?

You can see the full checklist here:

http://www.who.int/patientsafety/safesurgery/toolsresources/SSSLChecklistfinalJun08.pdf?ua=1

Explanation:

Surgical safety checklist

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Question: 25

A 65-year-old female is admitted for an elective total hip replacement of the right hip. On admission she is given thigh-length anti-embolism stockings to wear before surgery and until she regains mobility. It is hospital policy to also use a low molecular weight heparin for postoperative thromboprophylaxis. According to NICE guidelines, when should this be initiated?

6-12 hours before surgery	18%
1-4 hours after surgery	12%
Immediately after surgery	19%

6-12 hours after surgery	41%
30 minutes - 1 hour after surgery	10%

For elective total hip replacement surgery NICE recommend commencing a low molecular weight heparin 6-12 hours after surgery.

Explanation:

Venous thromboembolism: prophylaxis in patients admitted to hospital

VTEs can cause severe morbidity and mortality, but they are preventable. Current NICE guidelines (updated for 2018) outline recommendations for assessment and management of patients at risk of VTE in hospital.

Risk factors

All patients admitted to hospital should be individually assessed to identify risk factors for VTE development and bleeding risk. For medical and surgical patients the recommended risk proforma is the department of healths VTE risk assessment tool.

The following inpatients would be deemed at increased risk of developing a VTE:

Medical patients:

- significant reduction in mobility for 3 days or more (or anticipated to have significantly reduced mobility)

Surgical/trauma patients:

- hip/knee replacement
- hip fracture
- general anaesthetic and a surgical duration of over 90 minutes
- surgery of the pelvis or lower limb with a general anaesthetic and a surgical duration of over 60 minutes
- acute surgical admission with an inflammatory/intra-abdominal condition
- surgery with a significant reduction in mobility

General risk factors:

- active cancer/chemotherapy
- aged over 60
- known blood clotting disorder (e.g. thrombophilia)
- BMI over 35
- dehydration
- one or more significant medical comorbidities (e.g. heart disease; metabolic/endocrine pathologies; respiratory disease; acute infectious disease and inflammatory conditions)
- critical care admission
- use of hormone replacement therapy (HRT)
- use of the combined oral contraceptive pill
- varicose veins
- pregnant or less than 6 weeks post-partum

After a patients VTE risk has been assessed, this should be compared to their risk of bleeding to decide whether VTE prophylaxis should be offered. If indicated VTE prophylaxis should be started as soon as possible.

Types of VTE prophylaxis

Mechanical:

- Correctly fitted anti-embolism (aka compression) stockings (thigh or knee height)
- An Intermittent pneumatic compression device

Pharmacological:

- Fondaparinux sodium (SC injection)
- Low molecular weight heparin (LMWH) - e.g. enoxaparin (brand name = Clexane)
- Unfractionated heparin (UFH) - used in patients with chronic kidney disease

Management

In general, all medical patients deemed at risk of VTE after individual assessment are started on pharmacological VTE prophylaxis. This is providing the risk of VTE outweighs the risk of bleeding (this

is often a clinical judgement) and there are no contraindications. Those at very high risk may be offered anti-embolic stockings alongside the pharmacological methods.

For surgical patients at low risk of VTE first-line treatment is anti-embolism stockings. If a patient is at high risk these stockings are used in conjunction with pharmacological prophylaxis.

Advice for patients

Pre-surgical interventions:

- Advise women to stop taking their combined oral contraceptive pill/hormone replacement therapy 4 weeks before surgery.

Post-surgical interventions:

- Try to mobilise patients as soon as possible after surgery
- Ensure the patient is hydrated

Post procedure prophylaxis

For certain surgical procedures (hip and knee replacements) pharmacological VTE prophylaxis is recommended for all patients to reduce the risk of a VTE developing post-surgery. NICE make the following recommendations:

Procedure	Prophylaxis
Elective hip	LMWH for 10 days followed by aspirin (75 or 150 mg) for a further 28 days or LMWH for 28 days combined with anti-embolism stockings until discharge or Rivaroxaban

Procedure	Prophylaxis
Elective knee	Aspirin (75 or 150 mg) for 14 days or LMWH for 14 days combined with anti-embolism stockings until discharge or Rivaroxaban
Fragility fractures of the pelvis, hip and proximal femur	The NICE guidance states the following (our bolding): *Offer VTE prophylaxis for a **month** to people with fragility fractures of the pelvis, hip or proximal femur if the risk of VTE outweighs the risk of bleeding. Choose either:* • *LMWH , starting 6â€"12 hours after surgery or* • *fondaparinux sodium, starting 6 hours after surgery, providing there is low risk of bleeding.*

Question: 26

A 55-year-old lady is to undergo an elective hysterectomy tomorrow morning. What is the correct advice regarding oral intake before her operation?

Food/solids > 6 hours beforehand and clear fluids > 2 hours beforehand	**52%**
Food/solids > 12 hours beforehand and clear fluids > 2 hours beforehand	**21%**
Food/solids > 2 hours beforehand and clear fluids > 6 hours beforehand	**8%**
Food/solids/clear fluids > 2 hours beforehand	**7%**

The key recommendations are that adults and children should be encouraged to drink clear fluids up to 2 hours before elective surgery and should consume no solid food for 6 hours before elective surgery. These recommendations also apply to patients with diabetes and pregnant women not in labour. Breast milk is safe up to 4 hours before and other milk 6 hours before.

For emergency surgery in an adult, non-pregnant patient (who has not fasted), an anaesthetic technique known as Rapid Sequence Induction (RSI) can be used to reduce the risk of gastro-oesophageal reflux. In simple terms, this involves optimal preoxygenation, the use of an induction agent and suxamethonium, with the application of cricoid force at the onset of unconsciousness. As there has been no preoperative airway assessment, anaesthetists must be prepared for a difficult airway and any potential problems with laryngoscopy and intubation.

http://www.aagbi.org/sites/default/files/Perioperativefastinginadultsandchildren.4.pdf

Explanation:

Preparation for surgery

Elective and emergency patients require different preparation.

Elective cases

- Consider pre admission clinic to address medical issues.
- Blood tests including FBC, U+E, LFTs, Clotting, Group and Save
- Urine analysis
- Pregnancy test
- Sickle cell test
- ECG/ Chest x-ray

Exact tests to be performed will depend upon the proposed procedure and patient fitness.

Risk factors for development of deep vein thrombosis should be assessed and a plan for thromboprophylaxis formulated.

Diabetes

Diabetic patients have greater risk of complications.

Poorly controlled diabetes carries high risk of wound infections.

Patients with diet or tablet controlled diabetes may be managed using a policy of omitting medication and checking blood glucose levels regularly. Diabetics who are poorly controlled or who take insulin will a require variable rate intravenous insulin infusion. Potassium supplementation should also be given.

Diabetic cases should be operated on first.

Emergency cases

Stabilise and resuscitate where needed.

Consider whether antibiotics are needed and when and how they should be administered.
Inform blood bank if major procedures planned particularly where coagulopathies are present at the outset or anticipated (e.g. Ruptured AAA repair)
Don't forget to consent and inform relatives.

Special preparation

Some procedures require special preparation:

- Thyroid surgery; vocal cord check.
- Parathyroid surgery; consider methylene blue to identify gland.
- Sentinel node biopsy; radioactive marker/ patent blue dye.
- Surgery involving the thoracic duct; consider administration of cream.
- Pheochromocytoma surgery; will need alpha and beta blockade.
- Surgery for carcinoid tumours; will need covering with octreotide.
- Colorectal cases; bowel preparation (especially left sided surgery)
- Thyrotoxicosis; lugols iodine/ medical therapy.

References

Management of adults with diabetes undergoing surgery and elective procedures. NHS Diabetes. April 2011.

Question: 27

You are the surgical F1 on call and are bleeped to go and review Mr Jones, a 62-year-old who underwent a right sided total hip replacement 6 hours previously. He has type 2 diabetes mellitus but is otherwise healthy. The nursing staff are concerned as his catheter output has steadily declined and has been 40ml over the last two hours. He has also been drowsy since returning to the ward. The urine is very concentrated but is draining slowly.

Examination reveals: heart rate 131/min, blood pressure 92/71mmHg, temperature 36.8C, BM 8.7 and a central cap refill of 2/3 seconds. His abdomen is soft, non-tender and you see no obvious signs of acute bleeding. He had a spinal anaesthetic during the procedure and is written up for PRN oramorph (5mg 2-4 Hourly). A 1L bag of Hartmann's is running over 8 hours. What is the most appropriate course of action?

Flush the catheter	**21%**
Hold the oramorph until the urine output picks up	**10%**
500ml of 5% dextrose fluid challenge	**8%**
500ml 0.9% normal saline fluid challenge	**44%**
Urgent bloods to check renal function	**16%**

The patients symptoms are likely to be caused by hypovolaemia, potentially from intra-operative blood loss or dehydration. Normal saline will provide better intra-vascular filling that dextrose and is therefore more appropriate. The catheter appears to be draining and there is no sign of bladder distension which likely rules out a blocked catheter. Opiates may cause urinary retention, but as there is no bladder distension and a catheter is in situ, this is unlikely to be the cause. Bloods to check renal function are important, but do not provide immediate treatment for the problem and a patients reaction to a fluid challenge is likely to be a quicker means of identifying whether hypovolaemia is to blame. Other factors to have in mind with low blood pressure or tachycardia would include sepsis or the effect of the anaesthetic.

Explanation:

Post operative fluid management

Composition of commonly used intravenous fluids mmol^{-1}

	Na	K	Cl	Bicarbonate	Lactate
Plasma	137-147	4-5.5	95-105	22-25	-
0.9% Saline	153	-	153	-	-
Dextrose / saline	30.6	-	30.6	-	-
Hartmans	130	4	110	-	28

Post operative fluid management

In the UK the GIFTASUP guidelines (see reference below) were devised to try and provide some consensus guidance as to how intravenous fluids should be administered. A decade ago it was a commonly held belief that little harm would occur as a result of excessive administration of normal saline and many oliguric postoperative patients received enormous quantities of IV fluids. As a result, they developed hyperchloraemic acidosis. With a greater understanding of this potential complication, the use of electrolyte balanced solutions (Ringers lactate/ Hartmans) is now favoured over normal saline. In addition to this, solutions of 5% dextrose and dextrose/saline combinations are now generally not recommended for surgical patients. The other guidance includes:

- Fluids given should be documented clearly and easily available
- Assess the patient's fluid status when they leave theatre
- If a patient is haemodynamically stable and euvolaemic, aim to restart oral fluid intake as soon as possible
- Review patients whose urinary sodium is < 20
- If a patient is oedematous, hypovolaemia if present should be treated first. This should then be followed by a negative balance of sodium and water, monitored using urine Na excretion levels.
- Solutions such as Dextran 70 should be used in caution in patients with sepsis as there is a risk of developing acute renal injury.

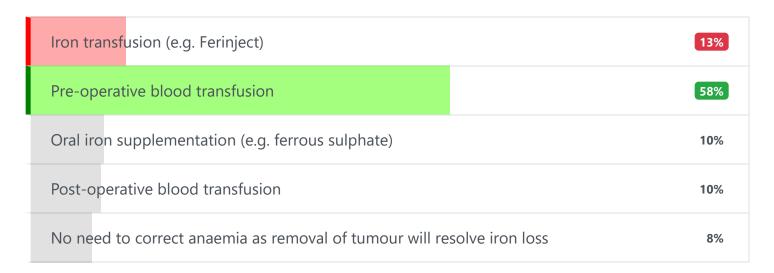**References**
British Consensus Guidelines on Intravenous Fluid Therapy for Adult Surgical Patients
GIFTASUP (2009)

Question: 28

A 65-year-old female is admitted to your surgical ward for an elective hemicolectomy tomorrow due to Duke's B colonic cancer. You are carrying out her admission assessment and notice her full blood count (FBC) demonstrates a microcytic anaemia with haemoglobin of 58 g/L. Her previous FBC 3 months earlier showed Hb 88 g/L. Haematinic blood tests show that the cause of the microcytosis is iron deficiency.

What is the most appropriate management of her anaemia?

Iron transfusion (e.g. Ferinject)	13%
Pre-operative blood transfusion	58%
Oral iron supplementation (e.g. ferrous sulphate)	10%
Post-operative blood transfusion	10%
No need to correct anaemia as removal of tumour will resolve iron loss	8%

A haemoglobin of 58 g/L will need to be corrected prior to surgery and this will only be achieved in such a short time frame by arranging a blood transfusion. Iron transfusions or oral iron supplements would be recommended over a longer time frame of weeks to months had this been detected earlier.
Explanation:

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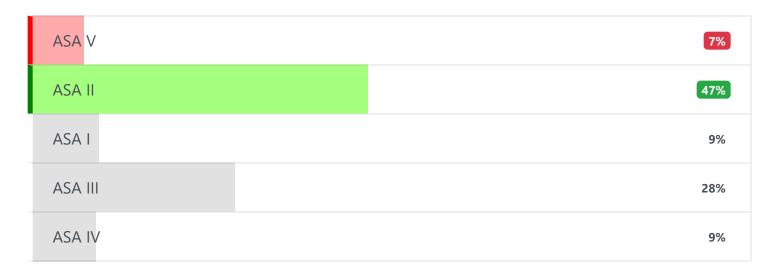Some procedures require special preparation:

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Question: 29

A 45-year-old lady presents to the pre-operative clinic for assessment before a cholecystectomy. She smokes 20 cigarettes per day for the past 10 years and eats a high fat diet despite advice from her GP. She takes metformin 1g b.d. for type 2 diabetes and amlodipine 10mg once a day for hypertension. She states she monitors her blood sugar and pressure at least three times a day. Her blood sugar and blood pressure are well controlled on her current medication. Based on this information alone, what American Society of Anaesthesiologists Classification (ASA) class does this lady fall into?

ASA V	7%
ASA II	47%
ASA I	9%
ASA III	28%
ASA IV	9%

This lady belongs to ASA II due to her smoking history, well controlled diabetes and blood pressure. A high BMI is likely due to her high fat diet but this needs to be confirmed.

Explanation:

American Society of Anaesthesiologists (ASA) classification

ASA Classification	Definition	Examples
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use

ASA Classification	Definition	Examples
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, obesity (30 < BMI < 40), well-controlled Diabetes Mellitus/Hypertension, mild lung disease
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled Diabetes Mellitus/Hypertension, COPD, morbid obesity (BMI 40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, End Stage Renal Disease (ESRD) undergoing regularly scheduled dialysis, history (>3 months) of Myocardial infarction, Cerebrovascular accidents
ASA IV	A patient with severe systemic disease that is a constant threat to life	Examples include (but not limited to): recent (< 3 months) of Myocardial infarction, Cerebrovascular accidents, ongoing cardiac ischaemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis
ASA V	A moribund patient who is not expected to survive without the operation	Examples include (but not limited to): ruptured abdominal/thoracic aneurysm, massive trauma, intra-cranial bleed with mass effect, ischaemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction

ASA Classification	Definition	Examples
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

Question: 30

A 60-year-old suffers a trauma and burn injury and is due to undergo an emergency surgery. His urea and electrolytes are shown below:

Na^+	131 mmol/l
K^+	5.9 mmol/l
Urea	8.1 mmol/l
Creatinine	78 Âµmol/l

He is being prepared for anaesthesia.

Which of the following neuromuscular blockers is contraindicated in this patient?

Atracurium	11%
Vecuronium	11%
Suxamethonium (succinylcholine)	61%
Rocuronium	9%
Pancuronium	9%

Depolarising neuromuscular blockers (e.g. suxamethonium) increase the risk of hyperkalaemia in burns/trauma patients and therefore are contraindicated.

Other neuromuscular blockers in the question are non-depolarising and do not increase the risk of hyperkalaemia.

Explanation:

Neuromuscular blocking drugs

Neuromuscular blocking drugs are mainly in surgery as an adjunct to anaesthetic agents. They cause muscle paralysis which is necessary prerequisite for mechanical ventilation.

Types of neuromuscular blocking drugs

	Depolarizing	**Non-depolarizing**
Mechanism of action	Binds to nicotinic acetylcholine receptors resulting in persistent depolarization of the motor end plate	Competitive antagonist of nicotinic acetylcholine receptors
Examples	Succinylcholine (also known as suxamethonium)	Tubcurarine, atracurium, vecuronium, pancuronium
Adverse effects	Malignant hyperthermia Hyperkalaemia (normally transient)	Hypotension
Reversal		Acetylcholinesterase inhibitors (e.g. neostigmine)

	Depolarizing	Non-depolarizing
Notes	The muscle relaxant of choice for rapid sequence induction for intubation May cause fasciculations	
Contraindications	Suxamethonium is contraindicated for patients with penetrating eye injuries or acute narrow angle glaucoma, as suxamethonium increases intra-ocular pressure	

Question: 31

Which anaesthetic agent has inherent anti-emetic properties?

Ketamine	25%
Propofol	38%
Atracurium	11%
Sevoflurane	12%
Suxamethonium	14%

The precise mechanism behind the anti-emetic effects of propofol is unclear, but may involve direct suppression of the chemoreceptor trigger zone (CTZ), which is involved in initiating vomiting.
Explanation:

Anaesthetic agents

The table below summarises some of the more commonly used IV induction agents

Agent	Specific features

Agent	Specific features
Propofol	- GABA receptor agonist - Rapid onset of anaesthesia - Pain on IV injection - Rapidly metabolised with little accumulation of metabolites - Proven anti emetic properties - Moderate myocardial depression - Widely used especially for maintaining sedation on ITU, total IV anaesthesia and for daycase surgery
Sodium thiopentone	- Extremely rapid onset of action making it the agent of choice for rapid sequence of induction - Marked myocardial depression may occur - Metabolites build up quickly - Unsuitable for maintenance infusion - Little analgesic effects
Ketamine	- NMDA receptor antagonist - May be used for induction of anaesthesia - Has moderate to strong analgesic properties - Produces little myocardial depression making it a suitable agent for anaesthesia in those who are haemodynamically unstable - May induce state of dissociative anaesthesia resulting in nightmares
Etomidate	- Has favorable cardiac safety profile with very little haemodynamic instability - No analgesic properties - Unsuitable for maintaining sedation as prolonged (and even brief) use may result in adrenal suppression - Post operative vomiting is common

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Question: 32

A patient is brought into resus following a seizure, he has a nasopharyngeal airway (NPA) in situ. A nasopharyngeal airway would be contraindicated in?

A patient with a low Glasgow coma score (GCS)	10%
Seizures	12%
A patient with small nostrils	9%
Base of skull fractures	48%
A patient with an obstructed airway	20%

Explanation:

Nasopharyngeal airway

Nasopharyngeal airways are lubricated and inserted into the nostril to provide a patent airway in patients with decreased Glasgow coma score (GCS). They are ideal for patients having seizures, as you may not be able to insert an oropharyngeal airway (OPA). They come in a variety of sizes. They are well tolerated in patients with low GCS and are relatively contraindicated in base of skull fractures as they can cause further damage.

Question: 33

A 37-year-old woman with a history of gallstones is listed to have a laparoscopic cholecystectomy in three months time. She is currently prescribed Microgynon 30 (combined oral contraceptive pill). The patient asks for advice as she is aware that her contraceptive pill may increase the risk of blood clots. What is the most appropriate advice in this situation?

She is safe to continue taking Microgynon	15%
She should halve the dose of Microgynon prior to the procedure	7%
She should stop Microgynon 48 hours before the procedure	17%

She should stop Microgynon 28 days before the procedure	50%
She should stop Microgynon 3 months before the procedure	11%

Clinical Knowledge Summaries advise the following:

No precautions are necessary for minor surgery where the duration of anaesthesia and immobilization is short (such as varicose vein surgery, and tooth extraction).

The COC should be stopped:

- *Four weeks before any major surgery (which includes operations lasting more than 30 minute), all surgery to the legs, or surgery that involves prolonged immobilization of a lower limb.*
- *If emergency surgery or immobilization (such as for a leg fracture) is necessary.*

Explanation:

Venous thromboembolism: prophylaxis in patients admitted to hospital

VTEs can cause severe morbidity and mortality, but they are preventable. Current NICE guidelines (updated for 2018) outline recommendations for assessment and management of patients at risk of VTE in hospital.

Risk factors

All patients admitted to hospital should be individually assessed to identify risk factors for VTE development and bleeding risk. For medical and surgical patients the recommended risk proforma is the department of healths VTE risk assessment tool.

The following inpatients would be deemed at increased risk of developing a VTE:

Medical patients:

- significant reduction in mobility for 3 days or more (or anticipated to have significantly reduced mobility)

Surgical/trauma patients:

- hip/knee replacement
- hip fracture
- general anaesthetic and a surgical duration of over 90 minutes
- surgery of the pelvis or lower limb with a general anaesthetic and a surgical duration of over 60 minutes
- acute surgical admission with an inflammatory/intra-abdominal condition
- surgery with a significant reduction in mobility

General risk factors:

- active cancer/chemotherapy
- aged over 60
- known blood clotting disorder (e.g. thrombophilia)
- BMI over 35
- dehydration
- one or more significant medical comorbidities (e.g. heart disease; metabolic/endocrine pathologies; respiratory disease; acute infectious disease and inflammatory conditions)
- critical care admission
- use of hormone replacement therapy (HRT)
- use of the combined oral contraceptive pill
- varicose veins
- pregnant or less than 6 weeks post-partum

After a patients VTE risk has been assessed, this should be compared to their risk of bleeding to decide whether VTE prophylaxis should be offered. If indicated VTE prophylaxis should be started as soon as possible.

Types of VTE prophylaxis

Mechanical:

- Correctly fitted anti-embolism (aka compression) stockings (thigh or knee height)
- An Intermittent pneumatic compression device

Pharmacological:

- Fondaparinux sodium (SC injection)
- Low molecular weight heparin (LMWH) - e.g. enoxaparin (brand name = Clexane)
- Unfractionated heparin (UFH) - used in patients with chronic kidney disease

Management

In general, all medical patients deemed at risk of VTE after individual assessment are started on pharmacological VTE prophylaxis. This is providing the risk of VTE outweighs the risk of bleeding (this is often a clinical judgement) and there are no contraindications. Those at very high risk may be offered anti-embolic stockings alongside the pharmacological methods.

For surgical patients at low risk of VTE first-line treatment is anti-embolism stockings. If a patient is at high risk these stockings are used in conjunction with pharmacological prophylaxis.

Advice for patients

Pre-surgical interventions:

- Advise women to stop taking their combined oral contraceptive pill/hormone replacement therapy 4 weeks before surgery.

Post-surgical interventions:

- Try to mobilise patients as soon as possible after surgery
- Ensure the patient is hydrated

Post procedure prophylaxis

For certain surgical procedures (hip and knee replacements) pharmacological VTE prophylaxis is recommended for all patients to reduce the risk of a VTE developing post-surgery. NICE make the following recommendations:

Procedure	Prophylaxis

Procedure	Prophylaxis
Elective hip	LMWH for 10 days followed by aspirin (75 or 150 mg) for a further 28 days or LMWH for 28 days combined with anti-embolism stockings until discharge or Rivaroxaban
Elective knee	Aspirin (75 or 150 mg) for 14 days or LMWH for 14 days combined with anti-embolism stockings until discharge or Rivaroxaban
Fragility fractures of the pelvis, hip and proximal femur	The NICE guidance states the following (our bolding): *Offer VTE prophylaxis for a **month** to people with fragility fractures of the pelvis, hip or proximal femur if the risk of VTE outweighs the risk of bleeding. Choose either:* • *LMWH , starting 6–12 hours after surgery or* • *fondaparinux sodium, starting 6 hours after surgery, providing there is low risk of bleeding.*

Question: 34

Which of the following interventions is most likely to reduce the incidence of intra abdominal adhesions?

Peritoneal lavage with cetrimide following elective right hemicolectomy	**17%**
Use of a laparoscopic approach over open surgery	**58%**
Use of talc to coat surgical gloves	**7%**
Performing a Nobles plication of the small bowel	**8%**
Using stapled rather than a hand sewn anastamosis	**10%**

Laparoscopy results in fewer adhesions. When talc was used to coat surgical gloves it was a major cause of adhesion formation and withdrawn for that reason. A Nobles plication is an old fashioned operation which has no place in the prevention of adhesion formation. Use of an anastamotic stapling device will not influence the development of adhesions per se although clearly an anastamotic leak will result in more adhesion formation

Explanation:

Surgical complications

Complications occur in all branches of surgery and require vigilance in their detection. In many cases anticipating the likely complications and appropriate avoidance will minimise their occurrence. For the purposes of the exam the important principles to appreciate are:

- The anatomical principles that underpin complications
- The physiological and biochemical derangements that occur
- The most appropriate diagnostic modalities to utilise
- The principles which underpin their management

This is clearly a very broad area and impossible to cover comprehensively. There is considerable overlap with other topic areas within the website.

Avoiding complications

Some points to hopefully avert complications:

- World Health Organisation checklist- now mandatory prior to all operations
- Prophylactic antibiotics - right dose, right drug, right time.
- Assess DVT/ PE risk and ensure adequate prophylaxis
- **MARK** site of surgery
- Use tourniquets with caution and with respect for underlying structures
- Remember the danger of end arteries and in situations where they occur avoid using adrenaline containing solutions and monopolar diathermy.
- Handle tissues with care- devitalised tissue serves as a nidus for infection
- Be very wary of the potential for coupling injuries when using diathermy during laparoscopic surgery
- The inferior epigastric artery is a favorite target for laparoscopic ports and surgical drains!

Anatomical principles

Understanding the anatomy of a surgical field will allow appreciation of local and systemic complications that may occur. For example nerve injuries may occur following surgery in specific regions the table below lists some of the more important nerves to consider and mechanisms of injury

Nerve	Mechanism
Accessory	Posterior triangle lymph node biopsy
Sciatic	Posterior approach to hip
Common peroneal	Legs in Lloyd Davies position
Long thoracic	Axillary node clearance
Pelvic autonomic nerves	Pelvic cancer surgery
Recurrent laryngeal nerves	During thyroid surgery
Hypoglossal nerve	During carotid endarterectomy
Ulnar and median nerves	During upper limb fracture repairs

These are just a few. The detailed functional sequelae are particularly important and will often be tested. In addition to nerve injuries certain procedures carry risks of visceral or structural injury. Again some particular favorites are given below:

Structure	Mechanism
Thoracic duct	During thoracic surgery e.g. Pneumonectomy, oesphagectomy
Parathyroid glands	During difficult thyroid surgery
Ureters	During colonic resections/ gynaecological surgery
Bowel perforation	Use of Verres Needle to establish pneumoperitoneum
Bile duct injury	Failure to delineate Calots triangle carefully and careless use of diathermy
Facial nerve	Always at risk during Parotidectomy
Tail of pancreas	When ligating splenic hilum
Testicular vessels	During re-do open hernia surgery
Hepatic veins	During liver mobilisation

Again many could be predicted from the anatomy of the procedure.

Physiological derangements
A very common complication is bleeding and this is covered under the section of haemorrhagic shock. Another variant is infection either superficial or deep seated. The organisms are covered under microbiology and the features of sepsis covered under shock. Do not forget that immunocompromised and elderly patients may present will atypical physiological parameters.

Selected physiological and biochemical issues are given below:

Complication	Physiological/ Biochemical Problem

Complication	Physiological/ Biochemical Problem
Arrhythmias following cardiac surgery	Susceptibility to hypokalaemia (K^+ <4.0 in cardiac patients)
Neurosurgical electrolyte disturbance	SIADH following cranial surgery causing hyponatraemia
Ileus following gastrointestinal surgery	Fluid sequestration and loss of electrolytes
Pulmonary oedema following pneumonectomy	Loss of lung volume makes these patients very sensitive to fluid overload
Anastamotic leak	Generalised sepsis causing mediastinitis or peritonitis depending on site of leak
Myocardial infarct	May follow any type of surgery and in addition to direct cardiac effects the decreased cardiac output may well compromise grafts etc.

Try making a short list of problems and causes specific to your own clinical area.

Diagnostic modalities
Depends largely on the suspected complication. In the acutely unwell surgical patient the following baseline investigations are often helpful:

- Full blood count, urea and electrolytes, C- reactive protein (trend rather than absolute value), serum calcium, liver function tests, clotting (don't forget to repeat if on-going bleeding)
- Arterial blood gases
- ECG (+cardiac enzymes if MI suspected)
- Chest x-ray to identify collapse/ consolidation
- Urine analysis for UTI

These will often identify the most common complications.

Special tests

- CT scanning for identification of intra-abdominal abscesses, air and if luminal contrast is used an anastamotic leak
- Gatrograffin enema- for rectal anastamotic leaks
- Doppler USS of leg veins- for identification of DVT
- CTPA for PE
- Sending peritoneal fluid for U+E (if ureteric injury suspected) or amylase (if pancreatic injury suspected)
- Echocardiogram if pericardial effusion suspected post cardiac surgery and no pleural window made.

Management of complications

The guiding principal should be safe and timely intervention. Patients should be stabilised and if an operation needs to occur in tandem with resuscitation then generally this should be of a damage limitation type procedure rather than definitive surgery (which can be more safely undertaken in a stable patient the following day).

Remember that recent surgery is a contra indication to thrombolysis and that in some patients IV heparin may be preferable to a low molecular weight heparin (easier to reverse).

As a general rule laparotomies for bleeding should follow the core principle of quadrant packing and then subsequent pack removal rather than plunging large clamps into pools of blood. The latter approach invariable worsens the situation is often accompanied by significant visceral injury particularly when done by the inexperienced. If packing controls a situation it is entirely acceptable practice to leave packs in situ and return the patient to ITU for pack removal the subsequent day.

Question: 35

A 30-year-old obese nulliparous lady has just delivered a live singleton and the placenta, but continues to bleed profusely; the registrar estimates she has lost approximately 600 ml of blood. She has been given both crystalloid and colloids, but is still haemodynamically unstable. Assuming crossmatched blood is not yet available and her blood group is unknown, which blood group should be administered in order to avoid a mismatched transfusion?

O negative	66%
O positive	14%
AB negative	7%

AB positive	7%
A negative	6%

This question tests your ability to work out which blood group is the 'universal donor', i.e. can give blood regardless of the recipient's blood type.

Blood group categorisation is broken down into two areas, i.e. ABO and Rhesus. Therefore, someone with the blood group 'O negative' has the O antigen and is Rhesus negative. Since the O group blood has no anti-A or anti-B antibodies, and Rhesus negative blood has no antigen that the recipient antibodies can react to, it is the safest blood group to give in such scenarios.

Note: This question talks about blood, not plasma. The situation with plasma is the opposite i.e. Type O plasma can only be given to Type O recipients, since it contains both anti-A and anti-B antibodies, whereas Type AB plasma can be given to any ABO recipient as it does not contain any antibodies.
Explanation:

Blood products - cross matching

Whole blood fractions

Fraction	Key points
Packed red cells	Used for transfusion in chronic anaemia and cases where infusion of large volumes of fluid may result in cardiovascular compromise. Product obtained by centrifugation of whole blood.
Platelet rich plasma	Usually administered to patients who are thrombocytopaenic and are bleeding or require surgery. It is obtained by low speed centrifugation.
Platelet concentrate	Prepared by high speed centrifugation and administered to patients with thrombocytopaenia.

Fraction	Key points
Fresh frozen plasma	- Prepared from single units of blood. - Contains clotting factors, albumin and immunoglobulin. - Unit is usually 200 to 250ml. - Usually used in correcting clotting deficiencies in patients with hepatic synthetic failure who are due to undergo surgery. - Usual dose is 12-15ml/Kg^{-1}. - It should not be used as first line therapy for hypovolaemia.
Cryoprecipitate	- Formed from supernatant of FFP. - Rich source of Factor VIII and fibrinogen. - Allows large concentration of factor VIII to be administered in small volume.
SAG-Mannitol Blood	Removal of all plasma from a blood unit and substitution with: - Sodium chloride - Adenine - Anhydrous glucose - Mannitol Up to 4 units of SAG M Blood may be administered. Thereafter whole blood is preferred. After 8 units, clotting factors and platelets should be considered.

Cross matching

Must be cross matched	Can be ABO incompatible in adults
Packed red cells	Platelets
Fresh frozen plasma	
Cryoprecipitate	
Whole blood	

Question: 36

Four days after undergoing a right hemicolectomy for colon cancer, a 67-year-old woman develops vomiting. On examination she has a distended abdomen and no bowel sounds. Her temperature is 36.8 °C, her blood results show the following:

CRP	124 mg/l
WBC	$5.2 * 10^9/l$

The nursing notes indicate she has not opened her bowels since undergoing surgery. What is the most likely cause of all her symptoms and signs?

Constipation	7%
Hirschsprung's disease	7%
Peritonitis	9%
Caecal volvulus	9%
Paralytic ileus	69%

In this patient:

- The vomiting and absent bowel sounds makes simple constipation less likely than paralytic ileus, especially this soon after surgery. Constipation would not account for all of her symptoms and signs.
- The caecum will have been removed as part of the right hemicolectomy so it could not be a caecal volvulus.
- The raised CRP is a normal response after surgery.
- Peritonitis would more commonly be associated with severe abdominal pain, tenderness and guarding as well as more severely raised inflammatory markers and fever.
- Hirschsprung's disease is a congenital condition and would be very unlikely to present for the first time in a 67-year-old lady.

Explanation:

Paralytic ileus

Paralytic ileus is a common complication after surgery involving the bowel, especially surgeries involving handling of the bowel. There is no peristalsis resulting in pseudo-obstruction.

Paralytic ileus can also occur in association with chest infections, myocardial infarction, stroke and acute kidney injury.

Deranged electrolytes can contribute to the development of paralytic ileus, so it is important to check potassium, magnesium and phosphate. As the bowel is not functioning as normal it is better to replace electrolytes intravenously.

Question: 37

A 22-year-old fit and well male undergoes an emergency appendicectomy. He is given suxamethonium. An inflamed appendix is removed and the patient is returned to recovery. One hour post operatively the patient develops a tachycardia of 120 bpm and a temperature of 40 ÂºC. He has generalised muscular rigidity. What is the most likely diagnosis?

Acute dystonic reaction	14%
Malignant hyperthermia	55%
Pelvic abscess	9%
Epilepsy	8%
Serotonin syndrome	13%

Anaesthetic agents, such as suxamethonium, can cause malignant hyperthermia in patients with a genetic defect. Acute dystonic reaction normally is associated with antipsychotics (haloperidol) and metoclopramide. These lead to marked extrapyramidal effects. Serotonin syndrome is associated with the antidepressants selective serotonin reuptake inhibitors (SSRIs) and selective serotonin/norepinephrine reuptake inhibitors (SSNRIs). This causes a syndrome of agitation, tachycardia, hallucinations and hyper-reflexia.

Malignant hyperthermia

Overview

- condition often seen following administration of anaesthetic agents
- characterised by hyperpyrexia and muscle rigidity
- cause by excessive release of Ca2+ from the sarcoplasmic reticulum of skeletal muscle
- associated with defects in a gene on chromosome 19 encoding the ryanodine receptor, which controls Ca2+ release from the sarcoplasmic reticulum
- susceptibility to malignant hyperthermia is inherited in an autosomal dominant fashion
- neuroleptic malignant syndrome may have a similar aetiology

Causative agents

- halothane
- suxamethonium
- other drugs: antipsychotics (neuroleptic malignant syndrome)

Investigations

- CK raised
- contracture tests with halothane and caffeine

Management

- dantrolene - prevents Ca2+ release from the sarcoplasmic reticulum

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Question: 38

You are reviewing the medications of a 38-year-old woman in the surgical ward admitted for an elective open cholecystectomy. You notice the patient is currently prescribed the combined oral contraceptive pill (COCP) and she tells you she had not been instructed to stop taking this prior to the planned operation.

Which of the following is the most appropriate next action?

No action required	11%
Reschedule operation until combined oral contraceptive pill has been omitted for 4 weeks	46%
Prescribe compression hosiery only	8%
Prescribe thromboprophylaxis	27%
Switch to a progestogen only contraceptive	9%

Oestrogen-containing contraceptives should preferably be discontinued (and adequate alternative contraceptive arrangements made) 4 weeks before major elective surgery and all surgery to the legs or surgery which involves prolonged immobilisation of a lower limb; they should normally be recommenced at the first menses occurring at least 2 weeks after full mobilisation. A progestogen-only contraceptive may be offered as an alternative and the oestrogen-containing contraceptive restarted after mobilisation, as above.

When discontinuation of an oestrogen-containing contraceptive is not possible, e.g. after trauma or if a patient admitted for an elective procedure is still on an oestrogen-containing contraceptive (as in this case), thromboprophylaxis (with unfractionated or low molecular weight heparin and graduated compression hosiery) is advised.

These recommendations do not apply to minor surgery with short duration of anaesthesia, e.g. laparoscopic sterilisation or tooth extraction, or to women using oestrogen-free hormonal contraceptives.
Explanation:

Thromboprophylaxis in surgical patients

Deep vein thrombosis may develop insidiously in many surgical patients. Untreated it may progress to result in pulmonary embolism.
The following surgical patients are at increased risk of deep vein thrombosis:

- Surgery greater than 90 minutes at any site or greater than 60 minutes if the procedure involves the lower limbs or pelvis
- Acute admissions with inflammatory process involving the abdominal cavity

- Expected significant reduction in mobility
- Age over 60 years
- Known malignancy
- Thrombophilia
- Previous thrombosis
- BMI >30
- Taking hormone replacement therapy or the contraceptive pill
- Varicose veins with phlebitis

Mechanical thromboprophylaxis

- Early ambulation after surgery is cheap and is effective
- Compression stockings (contra -indicated in peripheral arterial disease)
- Intermittent pneumatic compression devices
- Foot impulse devices

Therapeutic agents

Agent	Mode of action	Uses
Low molecular weight heparin	Binds antithrombin resulting in inhibition of factor Xa	In patients with normal renal function, low doses typically given in those with moderate to high risk of thromboembolic events. It is given as once daily subcutaneous injection
Unfractionated heparin	Binds antithrombin III with affects thrombin and factor Xa	Effective anticoagulation, administered intravenously it has a rapid onset and its therapeutic effects decline quickly on stopping and infusion. Its activity is measured using the APTT. If need be it can be reversed using protamine sulphate
Dabigatran	Orally administered direct thrombin inhibitor	Used prophylaxis in hip and knee surgery. It does not require therapeutic monitoring. It has no known antidote and should not be used in any patient in whom there is a risk of active bleeding or imminent likelihood of surgery