By the Name of ALLAH the Most Gracious the Most Merciful

Basic surgical skills and Anastomosis

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To be read in
Bailey & Love's Short Practice of Surgery 28th Edition.
Wounds, healing and tissue repair Ch 7.

Learning objectives

- To understand:
- The importance of safe patient positioning.
- Surgical craft and wound closure.
- The steps involved in surgical site preparation.
- Haemostasis and electrosurgery.
- The principles of surgical exposure and laparoscopic access.
- The principles of anastomosis
- The role of drains in surgery

INTRODUCTION

- Successful outcomes in surgery depend on knowledge, skills and judgement.
- While this chapter focuses on technical skills, the importance of surgical preparedness in the form of appropriate safety checks, correct positioning
- non-technical skills such as communication and teamwork cannot be overstated.

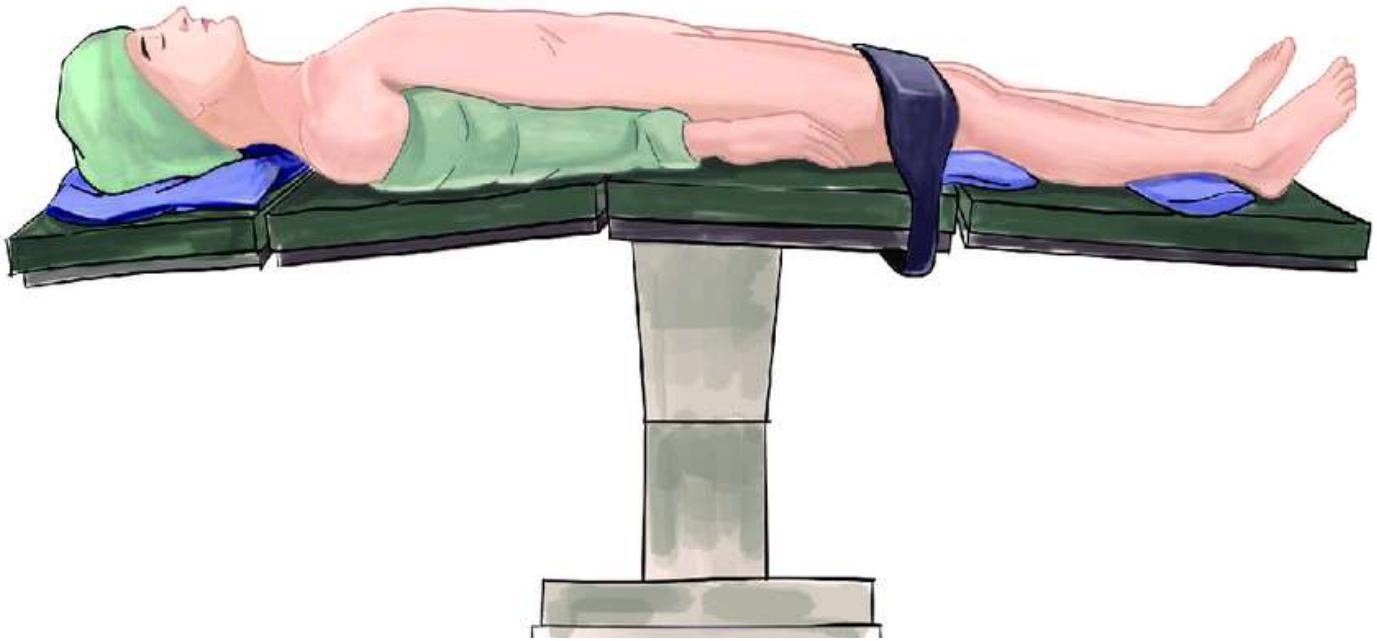
Patient safety and transfer to the operating table

- Patient safety is of paramount importance.
- It is a responsibility that is shared by the anaesthetist, surgeon, nurse and operating department practitioners.
- The anaesthetist managing the airway usually coordinates the transfer of the patient by calling the count.
- It is a critical moment during which there is a significant risk of falls and injuries, not to mention injury to operating theatre personnel.
- Additional care and specialised equipment may be required when transferring patients who are obese or emaciated and those at extremes of age.

POSITIONING ON THE OPERATING TABLE

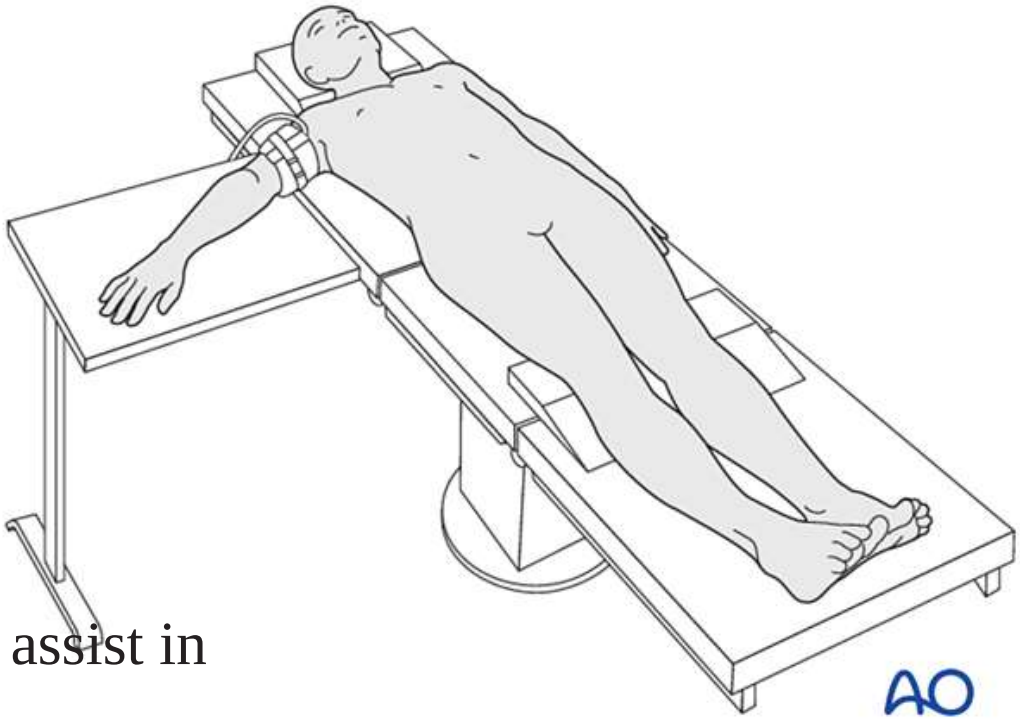
- Supine position.
- Prone position.
- Lateral position.
- Lithotomy and Lloyd-Davies position

Supine position

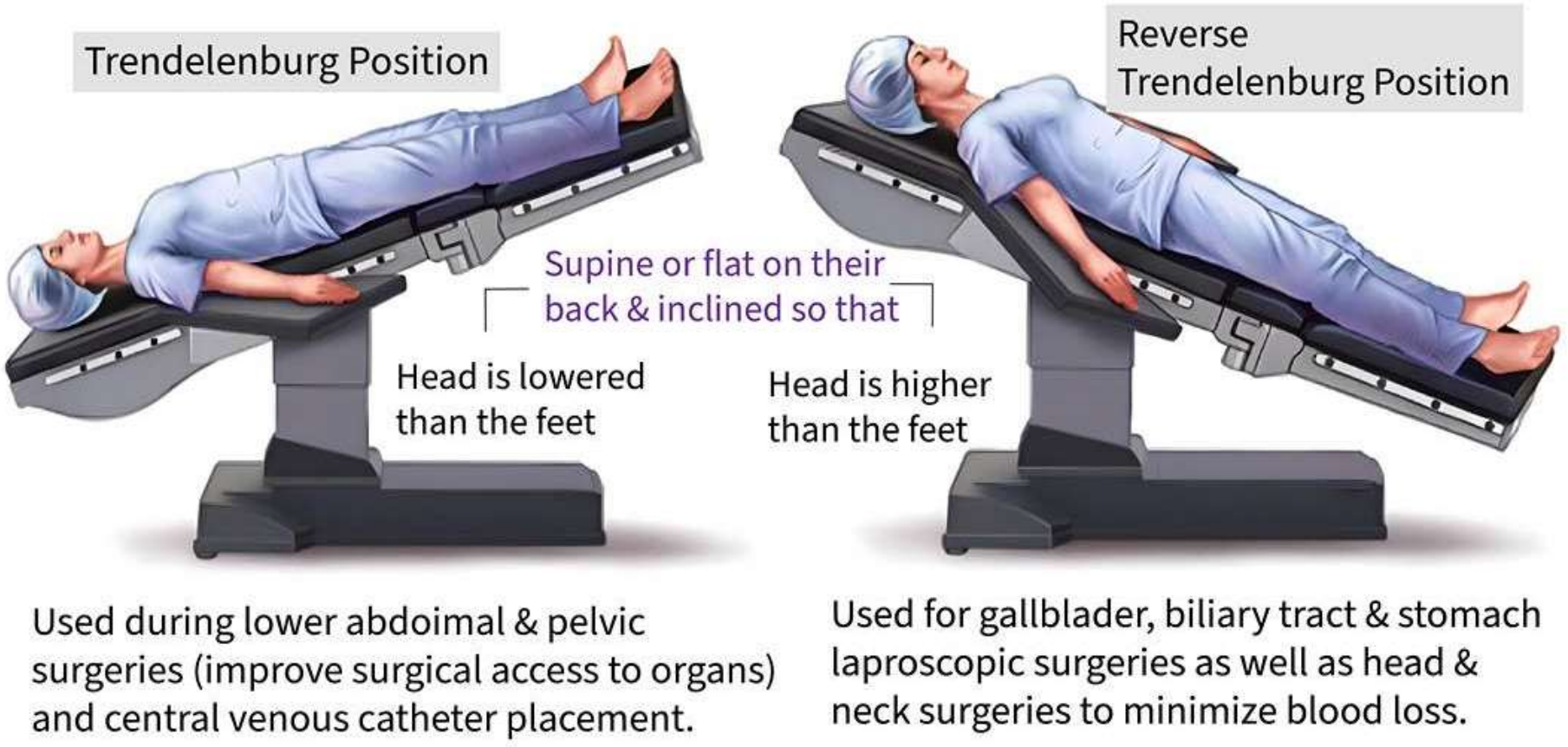


- This is the most common position for general surgical procedures. The patient's arms may be placed by their side or extended to afford access to intravenous and arterial cannulae. This is a versatile position and can be modified as follows:

Rose’s position: slight neck extension for head and neck surgery.



Shoulder and arm extended: to assist in axillary and breast surgery.



- **Trendelenburg position**: the head end of the table is tilted down on an incline with the patient's knees slightly flexed. This is often used in pelvic procedures and when resuscitating a patient in shock .
- **Reverse Trendelenburg position**: the head end of the table is tilted up, thereby placing the head higher than the feet .

- NOTE
- In advanced laparoscopic surgery, exaggerated and frequent position changes during the course of the operation are used to enhance surgical exposure.
- An excellent example would be in laparoscopic resection of the rectum, wherein the table is tilted to the right to aid in left colon mobilisation; a neutral or reverse Trendelenburg position is used to mobilise the transverse colon; and pelvic dissection is completed with a stee Trendelenburg position. This can only be achieved if the patient is well positioned and secured .

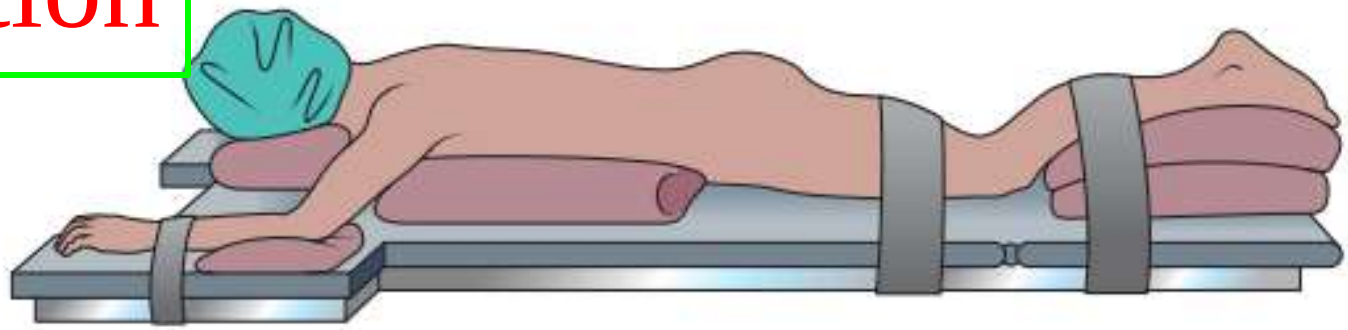
Straps and supports to secure the patient

- The safety belt to prevent the patient from sliding o the table is placed 5 cm above the knee and never over the abdomen.
- Shoulder supports are used if the Trendelenburg position is necessary.
- Side supports to prevent lateral displacement of the patient are essential if the table needs to be tilted laterally.
- Foot support is required for the reverse Trendelenburg position.
- Alternatively, vacuum-activated positioning systems that gently conform to the contours of the patient's body can be used.

Potential complications specific to supine positioning

- Ulnar, axillary, peroneal and brachial neuropraxia.
  - To reduce the risk of brachial plexus injury, the arm should not be hyperextended (abducted by greater than 90°). Pronation of the extended arm causes traction of the brachial plexus and also causes pressure on the ulnar nerve.
- Pressure necrosis of the heels, shoulder, sacral region and scalp.
- Steep Trendelenburg position can cause respiratory compromise and raise intracranial and intraocular pressure.

Prone position

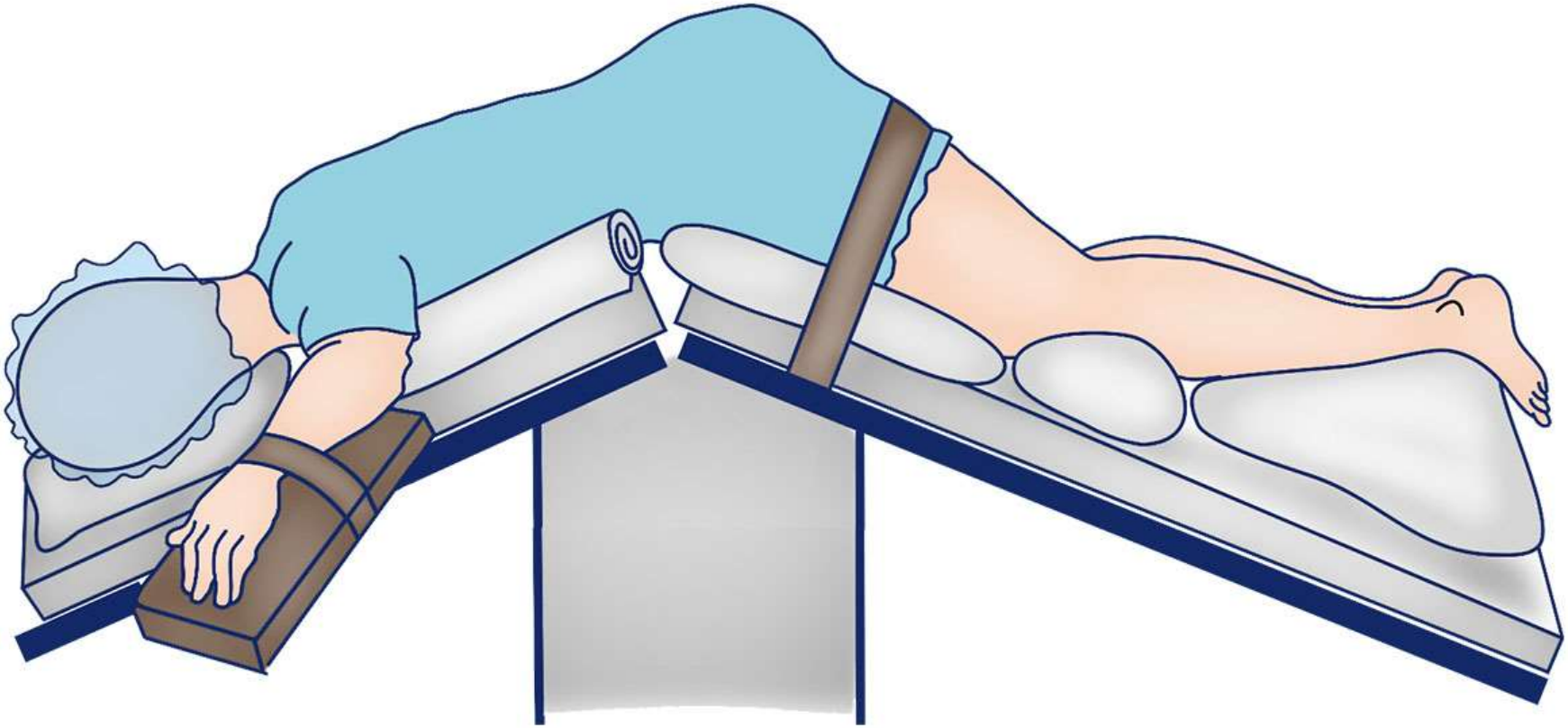


- ●Axillary and lateral chest rolls are essential to aid in the movement of the chest, abdomen and diaphragm.
- ●Female breasts and male genitalia have to be carefully positioned.
- ●Arms may be placed by the side of the head by reversing the arm boards with care taken to avoid shoulder dislocation.
- ●Toes should be elevated o the bed by placing pads under the shins.
- ●Specially designed pillows with a hollow to accommodate the face and endotracheal tube, while gently supporting the forehead and chin, are also used.

- The patient is intubated and then **log-rolled** onto the operating bed with the assistance of at least four members of the team.
- This position is used in spinal surgery and in certain general surgical procedures, e.g. extralevator abdominoperineal excision for rectal cancer.
- A common modification of the prone position is the jack-knife position, which offers excellent access to the perineum.


wikiHow

Nurseslabs

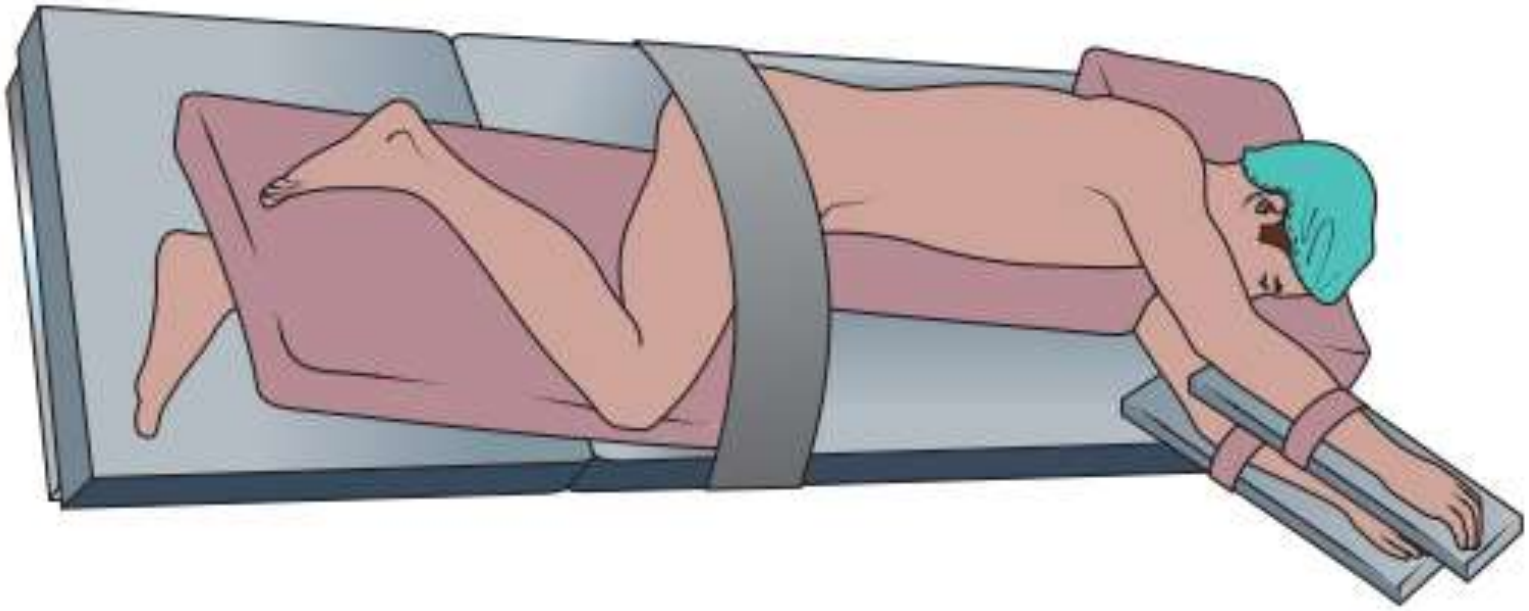


JACKKNIFE POSITION

Potential complications

- Brachial plexus injury and shoulder dislocation.
- Facial trauma, including blindness secondary to vascular congestion of the eye.
- Pressure necrosis of the breasts, external genitalia and pressure-bearing bony prominences.
- Displacement of the endotracheal tube

Lateral position



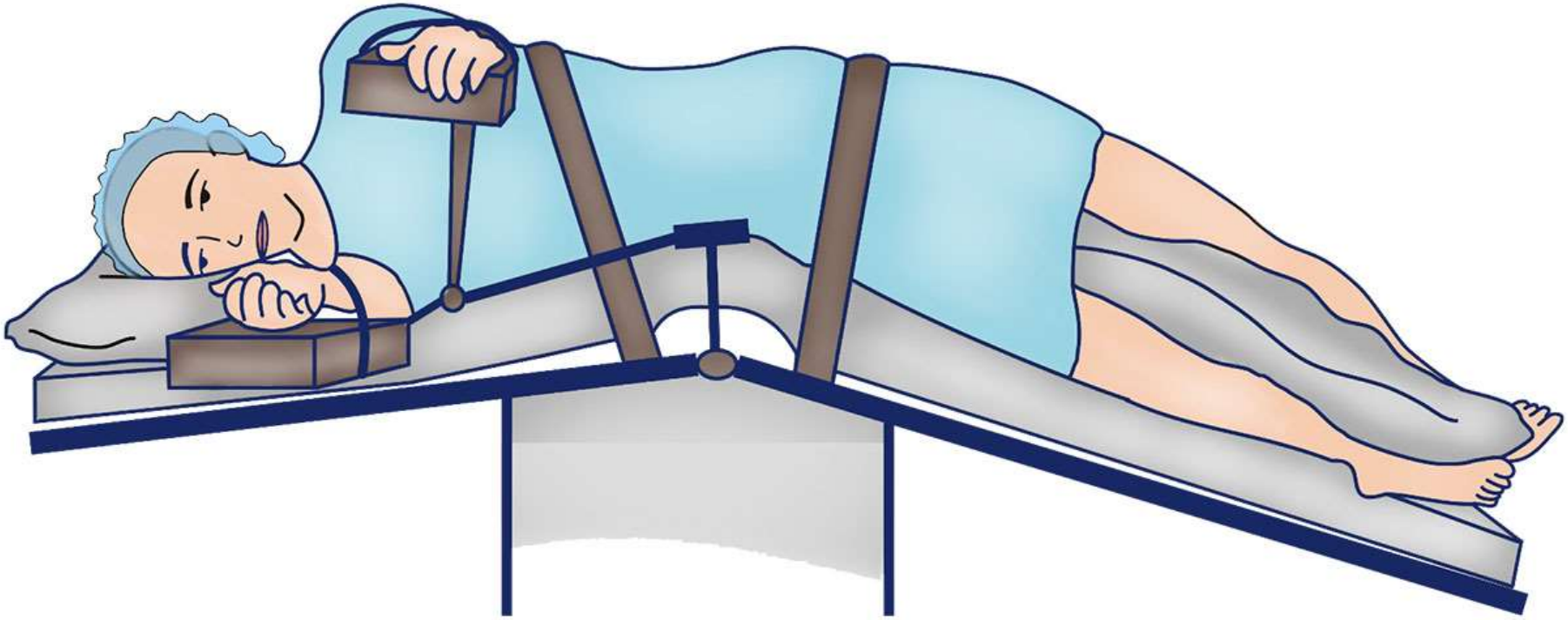
- The lower leg is slightly flexed at the knee, a pillow is placed between both the legs and the upper leg is flexed in a more exaggerated position.

- The arms are usually placed in stirrups.
- Maintaining cervical alignment of the head is very important.

Left or right lateral positioning

- Alternatives to prone positioning in many circumstances, such as the drainage of perianal or pilonidal abscesses.
- Lateral thoracotomy.
- A modified lateral position, ‘kidney position’, can aid in urological and retroperitoneal procedures by increasing the distance between the costal margin and the iliac bone. This is achieved by ‘breaking the table’ or angulating the table with the summit near the middle of the table and the two ends sloping away.

Nurseslabs



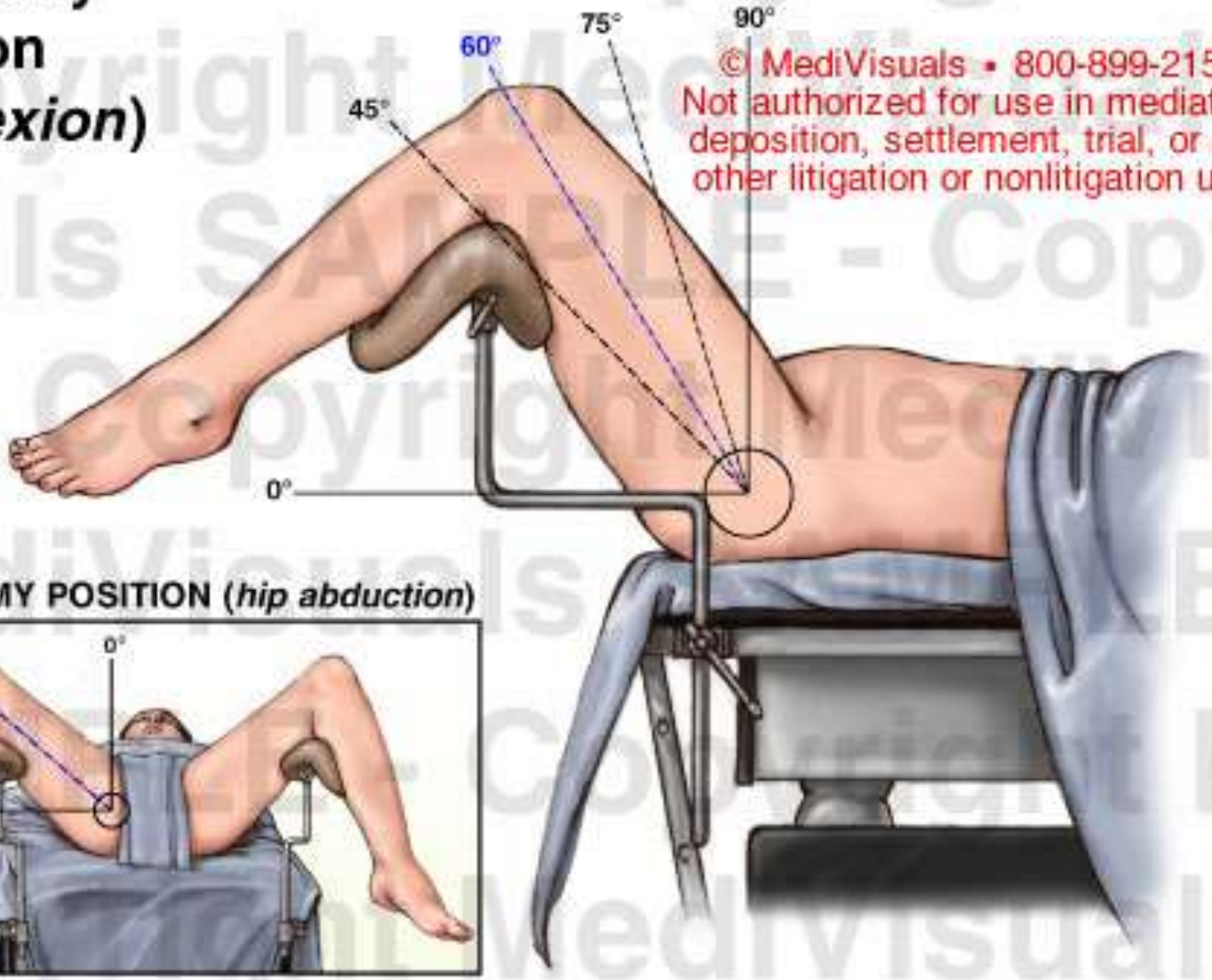
KIDNEY POSITION

Potential complications

- Respiratory complications secondary to preferential ventilation of one lung over the other and accidental endobronchial migration of the tube.
- Traction injury of the brachial plexus and ulnar nerve injury.
- Corneal abrasions and ocular trauma.


LITHOTOMY POSITION

Lithotomy Position (*hip flexion*)



LITHOTOMY POSITION (*hip abduction*)

Lithotomy and Lloyd-Davies position

- Both legs are simultaneously placed in the stirrups.
- ●The fingers should not extend past the edge of the table as they can be crushed or even amputated accidentally.
- ●The legs should not be externally rotated or unduly abducted.
- ●Sequential compression devices may be useful to prevent venous stasis, especially in major operations.

- This is commonly employed for gynaecological, perineal and urological procedures.
- The patient is positioned supine with the legs flexed at the hip and knee and placed in stirrups. Inthe lithotomy position the hips are flexed to 90°; however, the degree of hip and knee flexion can be controlled depending upon the type of procedure performed.
- The Lloyd-Davies position is a modification of the lithotomy position with hips minimally flexed to around 15° with a 30° head-down tilt.

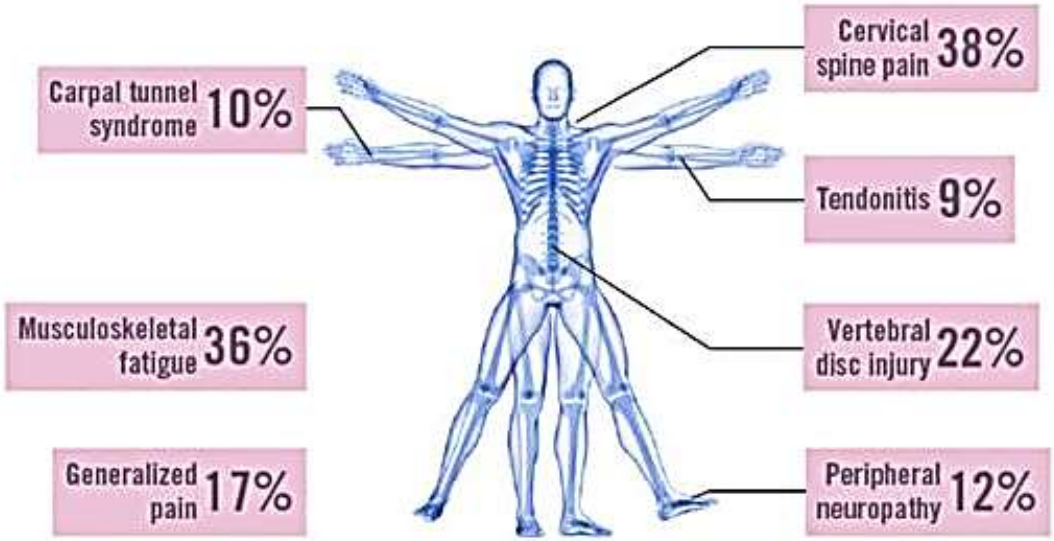
Lloyd Davies Position (??Head Down Lithotomy Or Legs Apart Trendelenburg??)

- For pelvic and rectal surgery where access is required from both abdominal and perineal aspects ie anterior resection; laparoscopic surgery
- Key difference from lithotomy is lesser degree of hip & knee flexion- allows longer surgery
- Position legs first and **then** tilt
- The patient's hands should be padded and tucked in to avoid table attachments
- Risks- as for Lithotomy & Trendelenburg

Potential complications

- Venous and arterial insufficiency in long procedures can lead to limb ischaemia and compartment syndrome, besides having a higher chance of deep venous thrombosis.
- Digital amputation at the edge of the bed.
- Hyperflexion can cause damage to the sciatic nerve.
- Saphenous and peroneal neuropraxia when legs are placed in the stirrups.

Occupational injuries reported by oncologic surgeons



Notes: Based on a survey of 127 oncologic surgeons. Respondents were able to select more than one injury.

Source: Dr. Voss

- Table height
- Sitting vs standing
- Lighting
- Assistants

Surgeons Position

PREPARATION OF THE SURGICAL SITE

Correct skin preparation can reduce surgical site infection (SSI). The steps involved in preparing the skin prior to making an incision are described below.

Removal of metals and other foreign bodies

- Removal of piercings and rings from the surgical site is important as they often act as a nidus for infection; metallic objects could also potentially lead to thermal injury when diathermy is used.
- In addition, finger rings or toe rings can cause digital vascular compromise if there is postoperative oedema following operations on the extremities.

Hair removal from the surgical site

- Interferes with the operation.
- it makes postoperative plaster or dressing changes relatively pain free.
- But it causes microabrasions and can potentially cause cellulitis and SSI.

- **Timing of hair removal**
- Is on the operating table after a dose of prophylactic antibiotic is given.
- Preoperative removal of hair outside the confines of the operating room is discouraged.

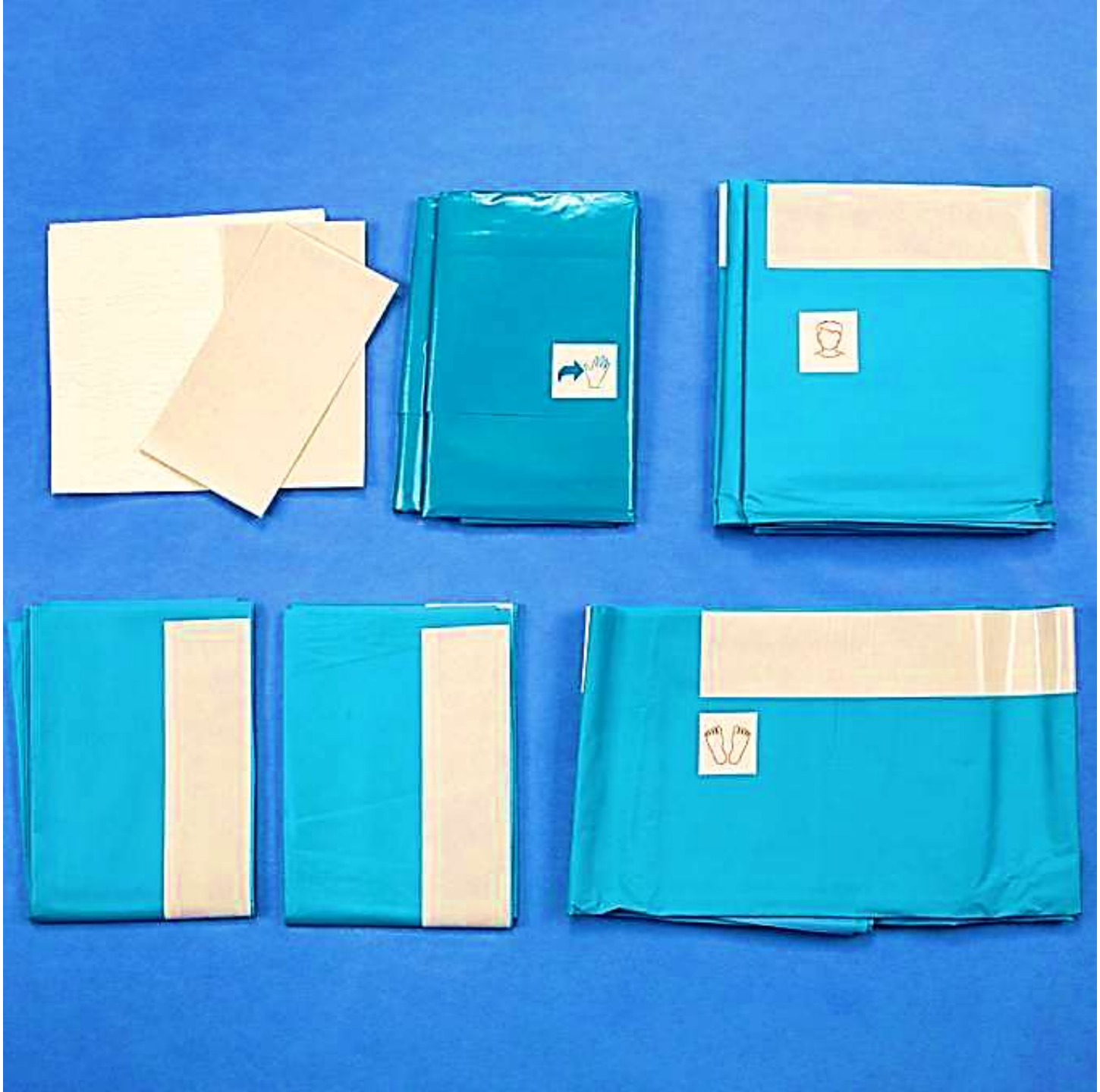
- **Method of hair removal**
- Skin clippers with disposable blades result in the fewest SSIs.
- A razor blade is discouraged as unintended microincisions often result in exaggerated skin infection and inflammation.

Skin antisepsis

- **It removes transient organisms and dirt, thereby preventing SSI. The principles involved in skin antisepsis are as follows:**
- The use of alcohol-based antiseptic solution is recommended (chlorhexidine alcohol); however, the clinical difference between povidone–iodine and chlorhexidine is marginal .
- Extensions of the main incision, additional incisions and drain placement have to be factored in when planning the preparation of the surgical site.
- Clean the umbilicus when preparing for an abdominal procedure.
- In contaminated or dirty wounds it is advisable to start from an area of lower bacterial contamination and move towards a region with greater contamination. However, in clean procedures, starting from the area where skin incision is likely to be made and working towards the periphery is advised.
- Using concentric circles, horizontal or vertical lines do not make a difference in preventing SSI.
- Allow the antiseptic solution to dry and to avoid dripping of the solution onto the diathermy electrodes or pooling under the patient.

Draping

- The process of forming a sterile perimeter around the operating site using disposable or reusable sterile sheets. The drape sheets ideally serve to form a fluid-resistant barrier; they are antistatic, flame resistant, lint free and, although waterproof, are porous enough to prevent heat build-up.
- Each procedure has a unique method of draping.
- The drapes are usually placed over the periphery of the area that has been painted, once the antiseptic solution has dried. This can be aided by dabbing the perimeter with a sterile cloth or waiting for the antiseptic solution to dry.
- It is advisable to stand an arm's length away from the operating table and spread the drapes with arms extended.

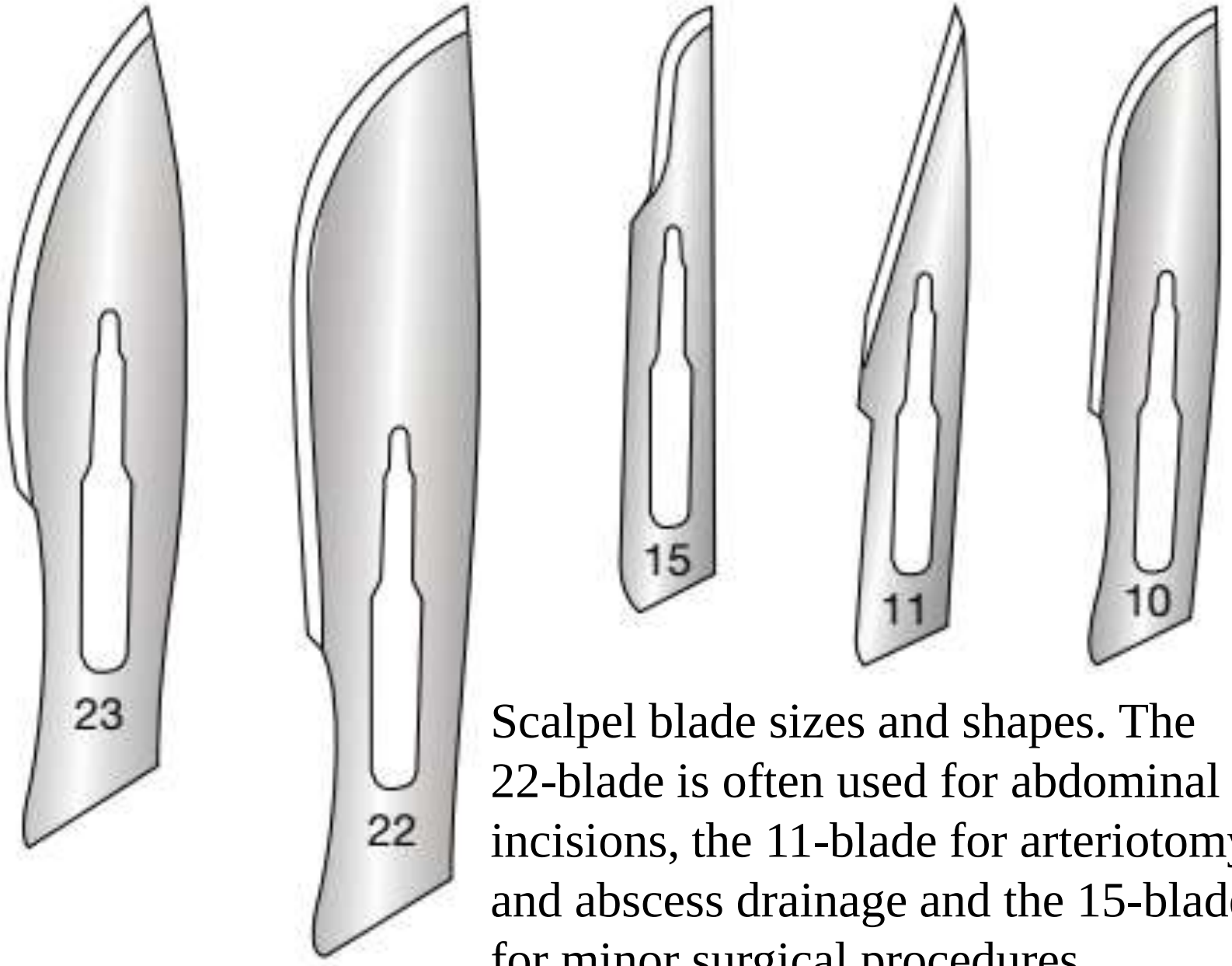


- Avoid reaching across the operating table to drape.
- Avoid sharp towel clips pierce the drapes and thereby contaminate the sterile field.
- Replace/cover the offending drape if there is a breach in sterile technique.
- Draping non-disposable equipment such as laparoscopic cords, ultrasonic devices, image intensifiers and light handles may be required. Prefabricated, customised drapes are preferred where possible.

SURGICAL EXPOSURE AND WOUND APPROXIMATION

Skin incisions

- Skin incisions are made using a scalpel with the blade pressed firmly down at right angles to the skin and then drawn gently across the skin in the desired direction to create a clean incision.
- It is important not to incise the skin obliquely as such a shearing mechanism can lead to necrosis of the undercut edge.
- The incision is facilitated by tension being applied across the line of the incision by the fingers of the non-dominant hand, but the surgeon must ensure that at no time is the scalpel blade directed at their own fingers as any slip may result in a self-inflicted injury.
- Blades for skin incisions usually have a curved cutting margin, while those used for an arteriotomy, abscess drainage or drain site insertion have a sharp tip .
- Scalpels should at all times be passed in a kidney dish rather than by a direct hand-to-hand process as this can lead to a needle stick-like injury.

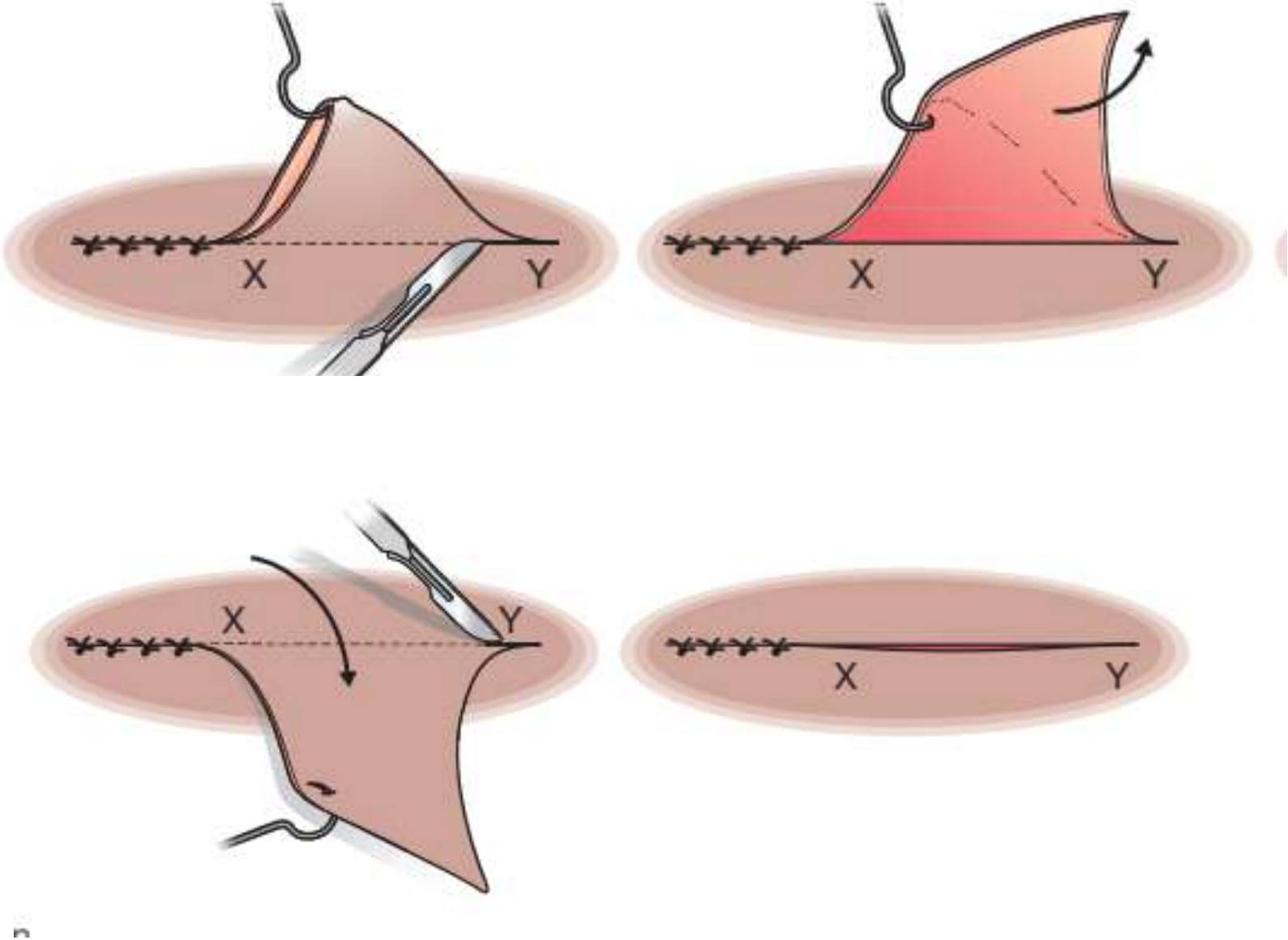


Scalpel blade sizes and shapes. The 22-blade is often used for abdominal incisions, the 11-blade for arteriotomy and abscess drainage and the 15-blade for minor surgical procedures.

When planning a skin incision a few factors should be considered:

- 1 **Skin tension lines and cosmesis**. Langer's lines
- (representing the orientation of dermal collagen fibres) have been used to guide skin incision placement; however, the clinical relevance of these lines has been questioned. The use of relaxed skin tension lines (RSTLs), which follow creases formed when the skin is pinched and relaxed, have increasingly been employed to guide skin incision placement, especially in the head and neck. In practice, placing incisions based on natural body creases and wrinkles can reduce tension on the suture line and camouflage scars.

- 2 **Anatomical structure**. Avoid bony prominences and take into consideration underlying structures, such as nerves and vessels. Surface landmarks, previous operations and body habitus also need to be considered.
- 3 **Adequate access for the procedure.** The incision must be functionally effective as any compromise purely on cosmetic grounds may render the operation ineffective or even dangerous.
- **Occasionally**, it may be necessary to excise a circular skin lesion. An elliptical rather than a circular incision is preferred to enhance tension-free, aesthetic tissue approximation, remembering the rule of thumb that ‘an elliptical incision must be at least three times as long as it is wide for the wound to heal without tension’. Occasionally, ‘dog ears’ remain in the corner of elliptical incisions despite adequate care having been taken during the formation and primary closure of an elliptical wound. In these situations, it is advisable to pick up the ‘dog ear’ with a skin hook and excise it . This allows for a satisfactory cosmetic outcome.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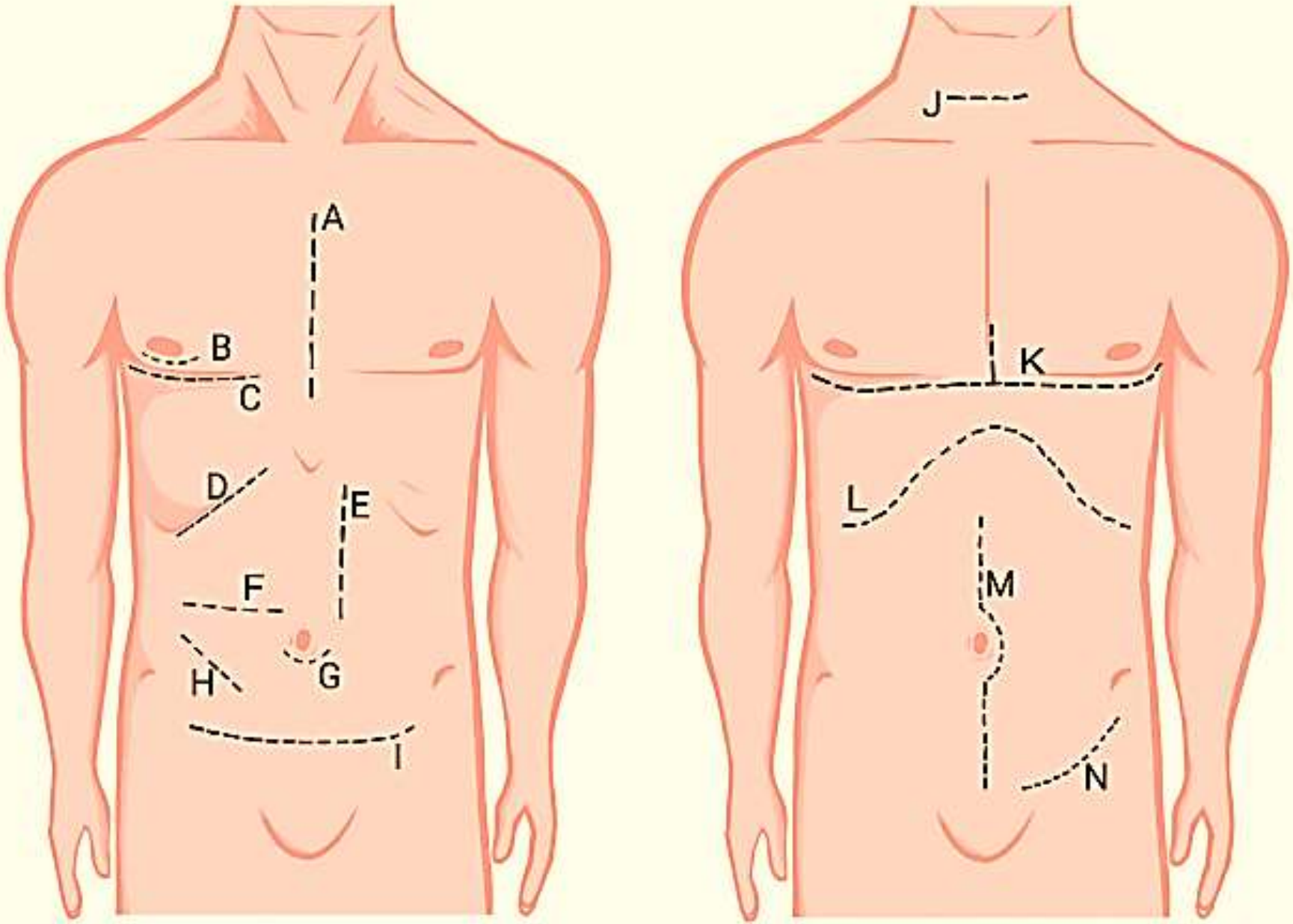


Figure 7.6 Skin incisions in general surgery. A, sternotomy; B, periareolar; C, inframammary; D, subcostal; E, paramedian; F, transverse; G, periumbilical; H, McBurney's; I, Pfannenstiel; J, Kocher's incision for thyroidectomy; K, clamshell thoracotomy; L, chevron incision; M, midline incision; N, inguinal incision (courtesy of Dr Vinay Timothy Kuruvilla).

Basic haemostatic methods and the principles of electrosurgery

- Bleeding encountered during an operation can be arterial, venous or capillary.
- Surgical haemorrhage is categorised as primary (during the operation), reactionary (24–48 hours postoperatively) or secondary (days to weeks postoperatively).
- Reactionary haemorrhage is usually a consequence of a slipped ligature or when a vessel injury is missed with bleeding temporarily stopped owing to a combination of vasoconstriction and hypotension.
- In the postoperative period, once blood pressure improves bleeding will ensue.
- Secondary haemorrhage is often a manifestation of a deep-seated infection eroding into a blood vessel.

- There can be no substitute for adequate preoperative preparation, careful management of antiplatelets and anticoagulants and meticulous surgical technique.
- When establishing haemostasis, care should be taken to avoid damage to adjacent nerves and organs, prevent unintentional vascular thrombosis and avoid adjacent tissue injury.
- Plunging clamps and suturing blindly in pools of blood may cause more damage than serving any purpose.
- The appropriate use of different techniques to control haemorrhage will depend on the site of bleeding, the extent of bleeding and the surgical pathology encountered.

Common haemostatic technique used intraoperatively

- **Mechanical**

● Digital pressure ● Ligatures ● Haemostatic clamps and ligating clips ● Vascular stapling devices● Wound packing ● Bone wax

● Image-guided embolisation

Thermal

● Electrosurgery ●Cryosurgery
● Argon beam coagulation
● Vessel sealing devices

Chemical or topical haemostatic agents

● **Physical**: absorbable collagen, gelatin, oxidised cellulose
● **Biological**: topical thrombin, fibrin sealant, tranexamic acid

ELECTROSURGERY

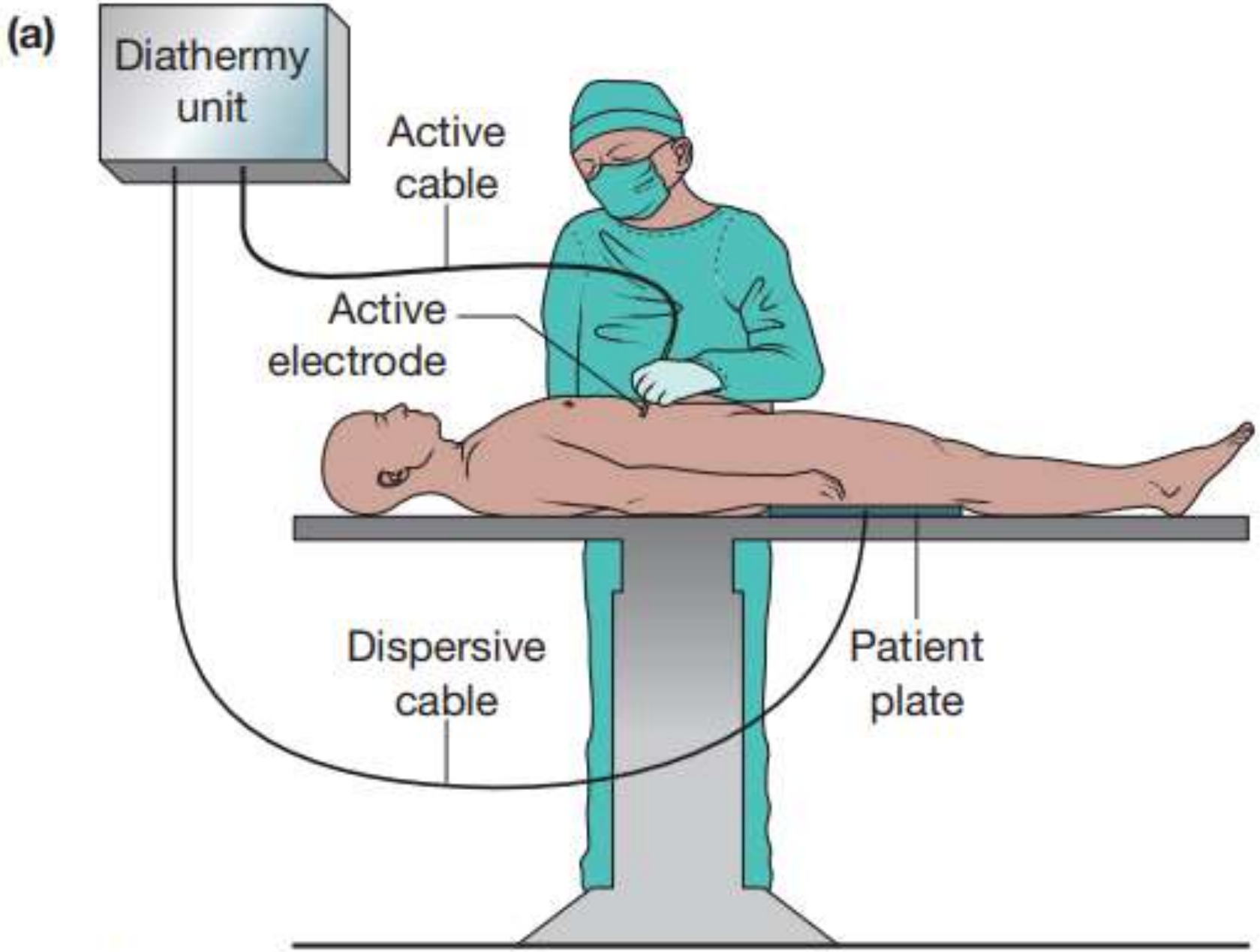
- Electrosurgery employs high-frequency electrical current to assist in making surgical incisions, dissection of tissue and achieving haemostasis.
- Its widespread use in open, laparoscopic and intraluminal endoscopic surgery such as transurethral resection of the prostate have made it an indispensable part of the surgeon’s armamentarium. Despite its uses many avoidable accidents have occurred. It is therefore vital for a surgeon to have a sound understanding of the principles of electrosurgery to facilitate safe surgery

Safe electrosurgery

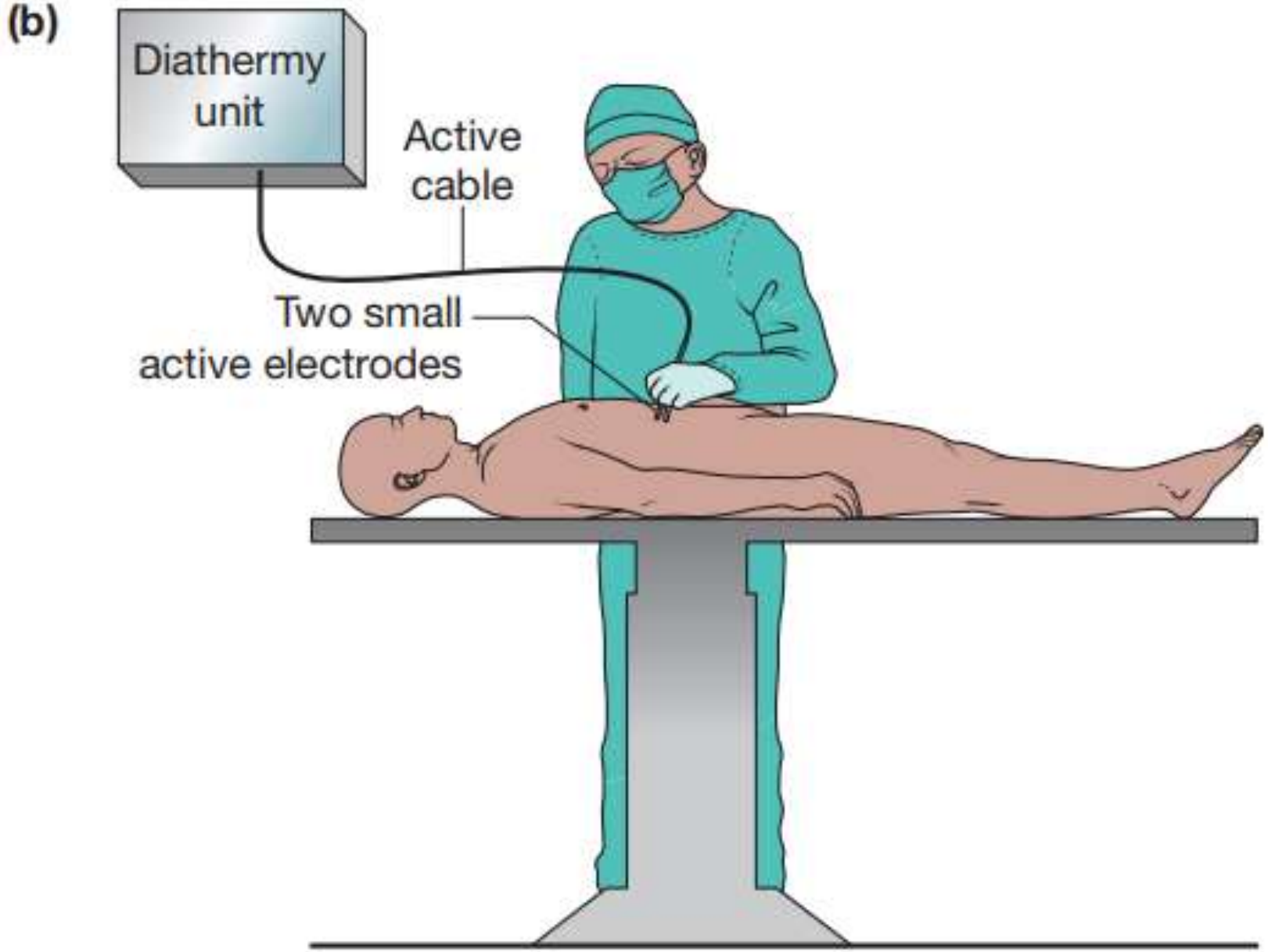
- Always check diathermy setting before use
- Use the safest, lowest diathermy current setting
- Be careful when diathermy is used near other metallic instruments
- Employ the diathermy intermittently and for brief spells
- Use bipolar diathermy and advanced vessel-sealing devices where appropriate
- Smoke extractors to remove bio-aerosolised particles are essential

Monopolar and bipolar diathermy

- In monopolar surgery the electrical current created in the ESU passes through a single electrode (diathermy pencil) to the tissue, causing the desired tissue effect (cut or coagulation). To complete the cycle, the current then passes through the tissues and returns via a very large surface plate (the indifferent electrode or dispersive cable) back to the earth pole of the generator.
- In bipolar diathermy the two active electrodes are usually represented by the limbs of a pair of diathermy forceps, blades of scissors or graspers. Both forceps ends are therefore active and current flows between them and only the tissue held between the limbs of the forceps heats up. This form of diathermy is used when working in sensitive areas (e.g. near the recurrent laryngeal nerve in thyroid surgery) or in patients with implantable electrical devices, as current can interfere with these devices. A separate return electrode (the indierent electrode) to return current is not needed.



(a) **Monopolar diathermy**


(b)
Diathermy unit
Active cable
Two small active electrodes
(b)
Bipolar diathermy

Advanced vessel-sealing devices

- Bipolar electrosurgery devices
- Ultrasonic energy devices
- Combination energy devices

Advanced vessel-sealing devices

- Monopolar diathermy has limitations in terms of sealing larger blood vessels and is accompanied by the risks outlined above.
- Therefore surgeons have increasingly used advanced vessel-sealing devices to facilitate dissection and to seal and divide blood vessels up to 7 mm in diameter, and to reduce operative time and thus recovery is enhanced.
- There are three main types of advanced energy devices: bipolar electrosurgery, ultrasonic electrosurgery and combination devices

I- Bipolar electrosurgery devices

- It is used in both open and laparoscopic surgery by fusing the vessel walls to create a permanent seal.
- It uses a combination of pressure and energy to create vessel fusion that can withstand up to three times the normal systolic pressure.
- New technology such as the LigaSure™ system (Medtronic) involves uses the body's collagen and elastin to both seal and divide (dissecting, ligating and grasping) .
- LigaSure can seal vessels of up to 7 mm diameter, within (2–4)seconds, as well as pedicles, tissue bundles and lymphatics with a consistent controlled and predictable effect on tissue, including less desiccation.

LigaSure™ Small Jaw Open Instrument

II- Ultrasonic energy devices

- The harmonic scalpel is an instrument that uses ultrasound technology to cut tissues while simultaneously sealing them.
- It cuts through tissues, effecting haemostasis by sealing vessels and tissues by means of protein denaturation (by vibration rather than heat) (in a similar manner to whisking an egg white). It provides cutting precision, even through thickened scar tissue, and visibility is enhanced because
- Less smoke is created in comparism with routine electrosurgery.
- Commonly it is used during laparoscopic procedures, as well as open surgery, such as thyroidectomy, and several plastic surgery operations, e.g. cosmetic breast surgery


Clamp arm
Harmonic
coated blade
Harmonic
MAX
MIN
12345

III- Combination energy devices

- Both devices. One product, the Thunderbeat STM (Olympus), has combined both modalities (harmonic and bipolar advanced energy) in a single device.
- It can seal and divide arteries and veins up to 7 mm in diameter in a shorter amount of time with no smoke or mist.

TOPICAL HAEMOSTATIC AGENTS

- Adjunct to traditional mechanical and electrosurgical techniques.
- The physical agents : are absorbable gelatin, absorbable collagen and oxidised cellulose and function by providing a scaffold that encourages fibrin deposition and accelerates clot formation; they can also soak up as much as 40 times their weight in blood, providing tamponade and compression.
- Biological topical agents : i.e thrombin and fibrin sealants encourage clot formation and are often injected or sprayed over the bleeding site.
- A combination of the above can also be used.

DRAINS IN SURGERY

1) To allow fluid that might collect in a body cavity to drain freely to the surface. The fluid to be drained may include blood, serum, pus, urine, faeces, bile, lymph or air. Abdominal drains are usually placed in the pelvis to drain collections as this is the most dependent area. Other locations are usually dictated by the pathology and procedure performed.
2) For wound irrigation in certain circumstances.
3) Their use can be regarded as prophylactic or therapeutic, depending on the circumstance warranting their insertion.

The role of drains in modern surgery

Three basic principles apply in the use of drains:

1 Open drains that utilise the principle of gravity

2 Semi-open drains that work on the principle of the capillary effect.

3 Closed drain systems that utilise suction.

In reality, the use of drains depends on the surgeon's individual preference and surgical philosophy. However, there is reasonable consensus regarding the role of drains in certain surgical procedures.

The routine use of surgical drains has generated much controversy. Protagonists suggest that the use of drains may:

- Help remove the collection of purulent material, blood, serous fluid, bile, chyle, pancreatic or intestinal secretions;
- Act as a signal for postoperative haemorrhage or anastomotic leakages
- Provide a track for long-term drainage

However, detractors claim that the presence of a drain may:

- Increase intra-abdominal and wound infections by introducing skin bacteria into the peritoneal cavity;
- Delay recovery and increase hospital stay;
- Increase abdominal pain;
- Decrease pulmonary function;
- Falsely reassure the clinician that there is no intraabdominal collection, when in fact the drain is blocked.

Current role of drain placement in non-gastrointestinal surgery

- Avoid routine drain placement
  - Thyroid surgery
  - Breast lumpectomy
  - Inguinal hernia repair

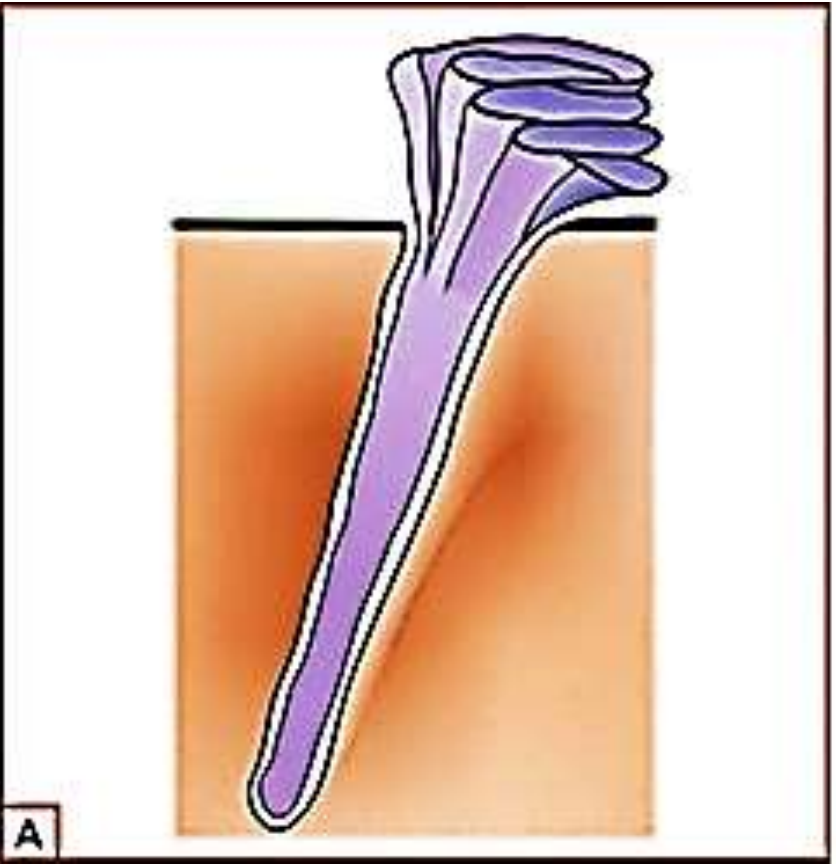
- Consider routine drain placement
  - Radical and modined radical neck dissection
  - Parotid surgery
  - Axillary dissection with or without mastectomy
  - Inguinal lymphadenectomy
  - Ventral hernia repair in obese patients

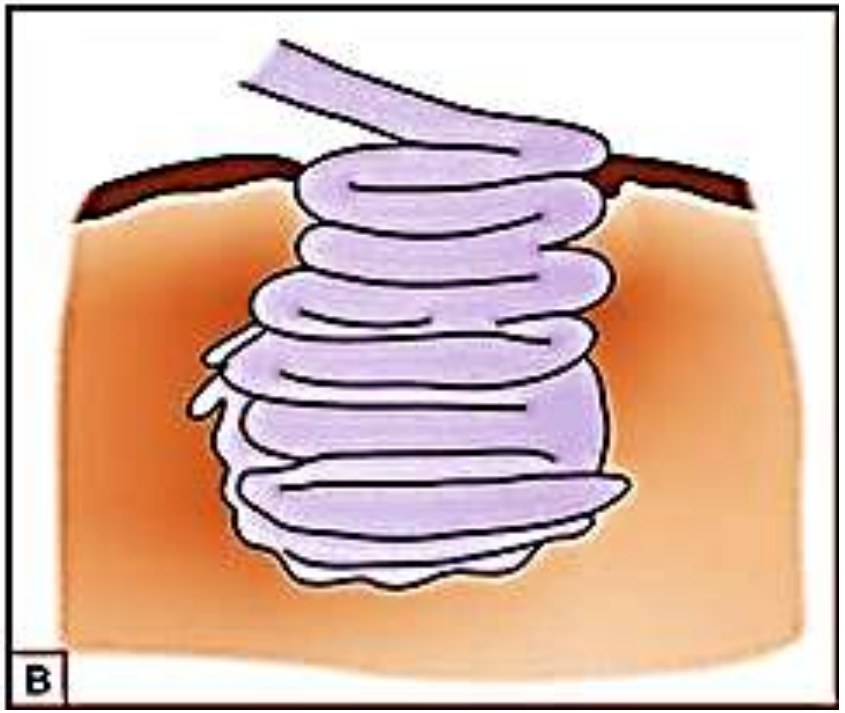
Current role of drain placement in gastrointestinal surgery

- Avoid routine drain placement following
  - Colonic surgery
  - Small bowel resections
  - Hepatic resections
  - Cholecystectomy
- Consider routine drain placement following
  - Oesophageal surgery
  - Major pancreatic resection
- Selective use of drains following
  - Rectal surgery
  - Gastric resections

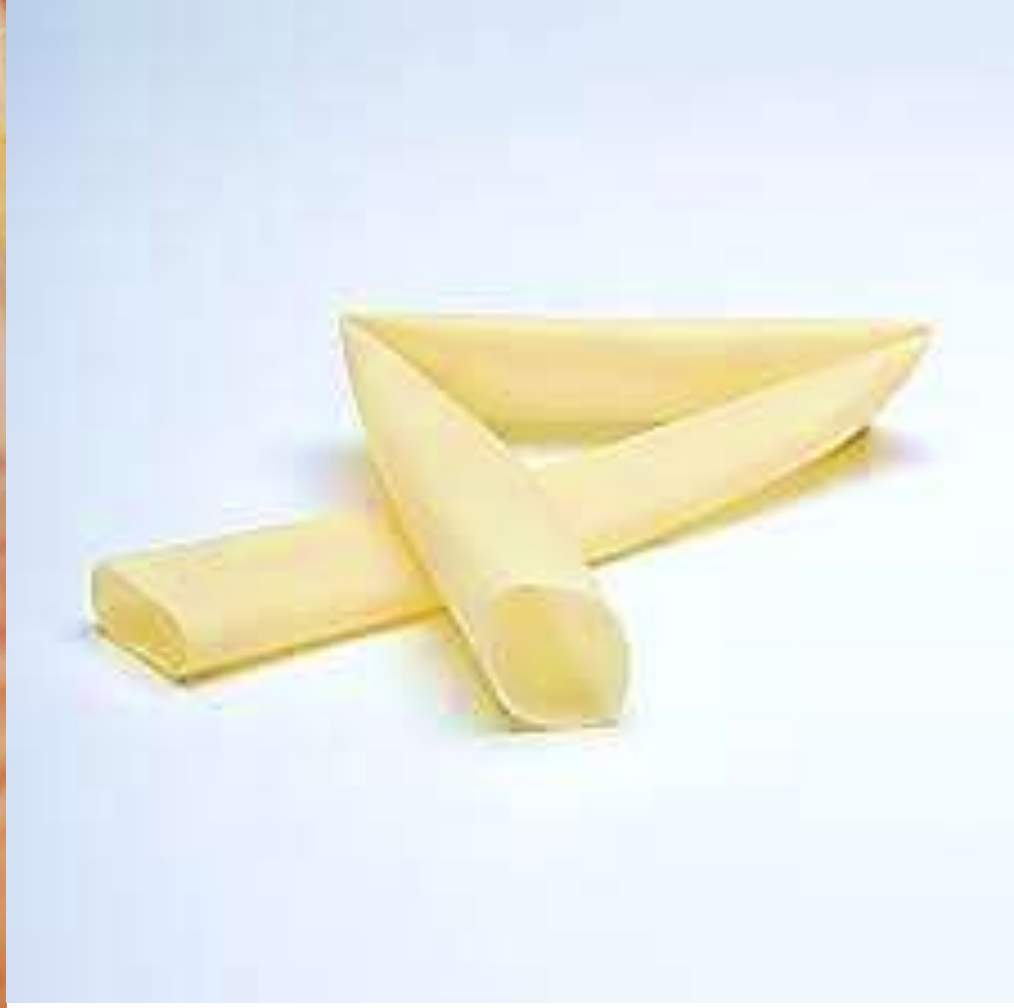
Classification of drains

- Open drains :
- These aid in passive drainage of a cavity based on gravity by forming a channel between the body and the external environment.
- They are often unsightly, require frequent dressing changes and may act as a conduit that enhances bacterial colonisation.
- Gauze wick drain is the oldest , easier and simplest type.
- The Penrose and corrugated drains are examples of an open drain used in debrided wounds and abscess cavities.





Gauze wick drain



Penrose drain

subcutaneous Corrugated drain in the left neck wound

Closed drains:

1) Suctioned (active) (Radi-vag drain & Jackson-Pratt Drain)These maintain negative pressure, thereby actively suctioning out fluid and/or obliterating dead space and preventing fluid accumulation.

- Caution must be exercised when used adjacent to vital structures. A suction drain is often used after ventral hernia repair, following axillary dissections and in head and neck surgery

Radi-vag drain

2) Non-suctioned (passive)

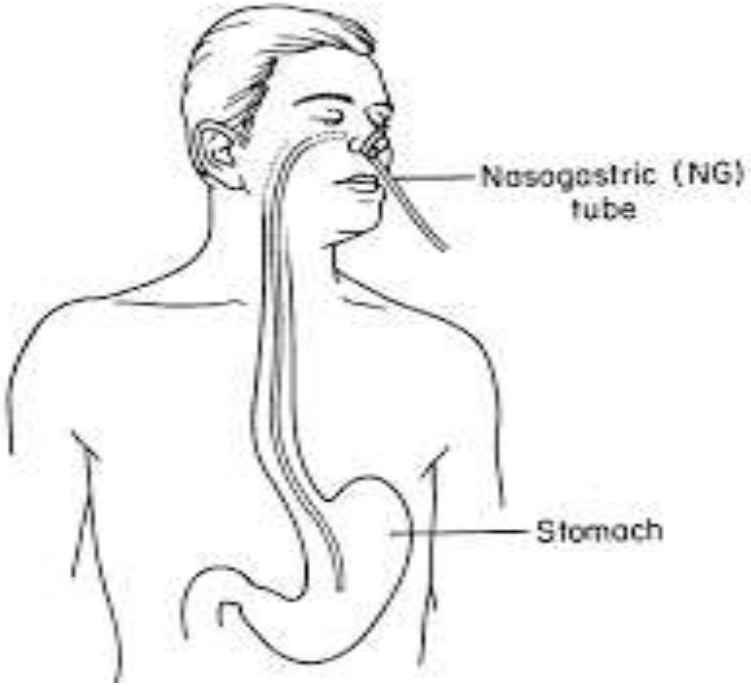
- Use capillary action and gravity to drain fluid. The most common examples are urinary catheters (Foley's catheter), nasogastric drainage systems and a Robinson's drain, which is used within the abdominal cavity to help to evacuate fluid without sucking viscera or omentum.

Robinson’s drain

Nasogastric Tuube (drainage)

- Most enhanced recovery after surgery (ERAS) pathways forbid the prophylactic use of nasogastric tubes in the elective setting, except following procedures in the upper aerodigestive tract.


DANGER
NO ENTRY
AUTHORISED


Nasogastric (NG) tube
Stomach

Indications for placement of the nasogastric tube

- Conservative management of postoperative paralytic ileus
- Conservative management of bowel obstruction (adhesional or partial)
- Decompression of the stomach before an emergency operation
- Prophylactically, when postoperative ileus is anticipated following extensive bowel handling

Feeding purposes

- Following procedures in the upper aerodigestive tract
- (nasogastric or nasoenteral)
- In patient with motor neurone disease or stroke

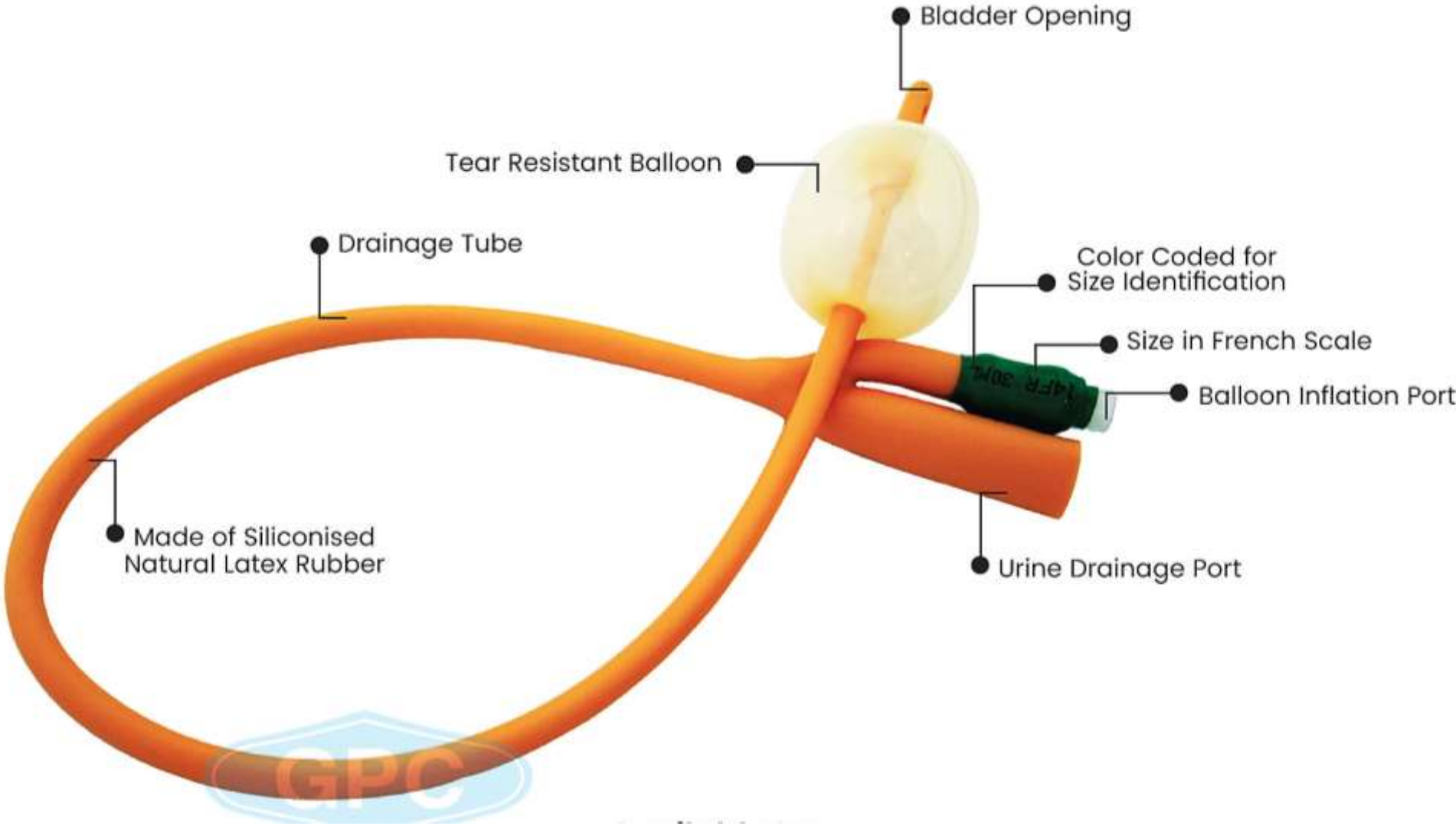
Placement of nasogastric tubes

- **Contraindications**

- Suspected or proven base of skull fracture as this may result in inadvertent cranial injury
- Oesophageal stricture or recent oesophageal surgery (unless under vision)

- **Complications**

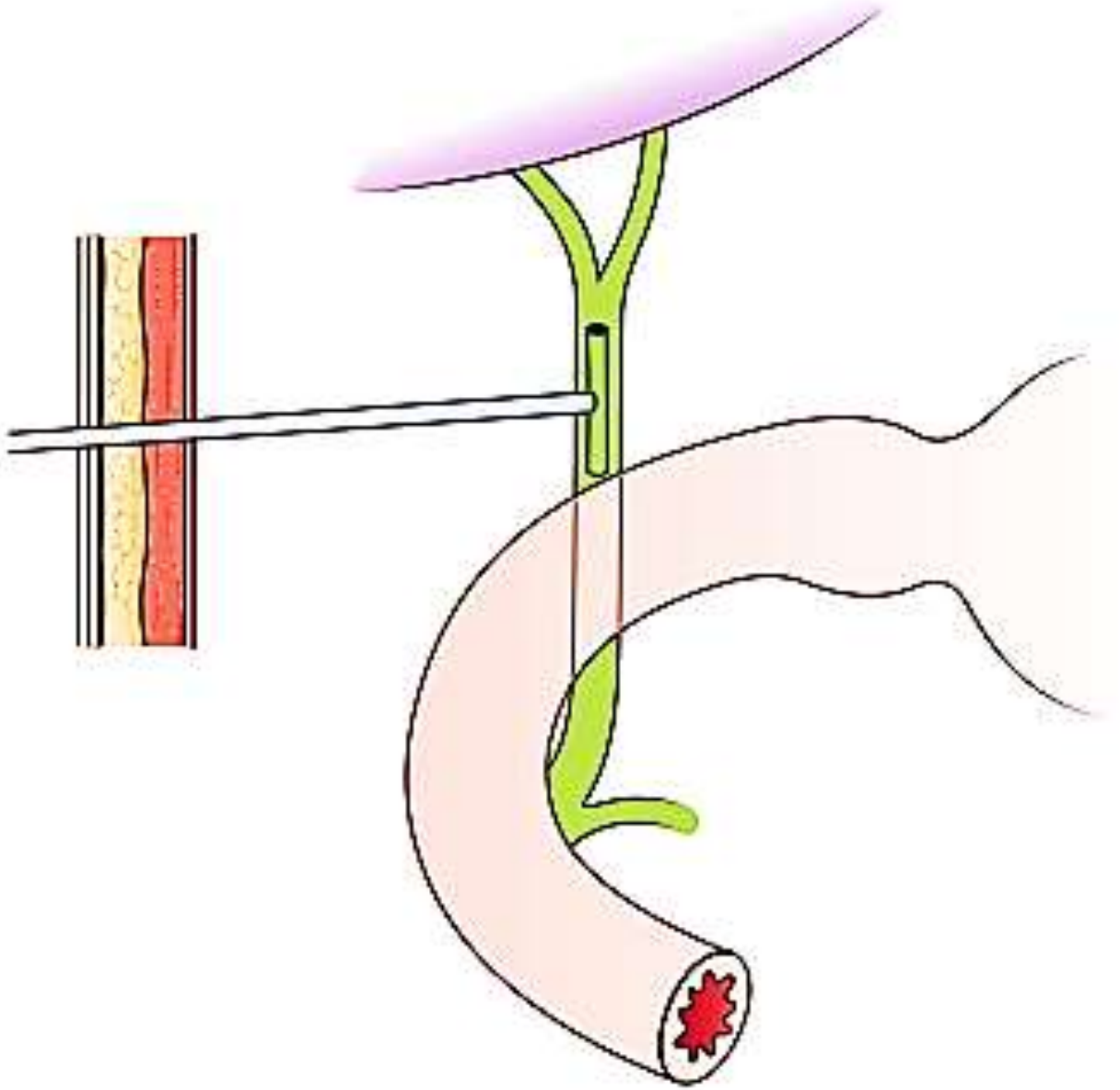
- Upper airway damage – pressure necrosis of the nasal ala owing to the placement of an oversized tube or following prolonged placement
- Refloux oesophagitis
- Pulmonary aspiration due to impaired function of the lower gastro-oesophageal sphincter
- Inadvertent placement into the lungs
- Traumatic placement causing bleeding and perforation

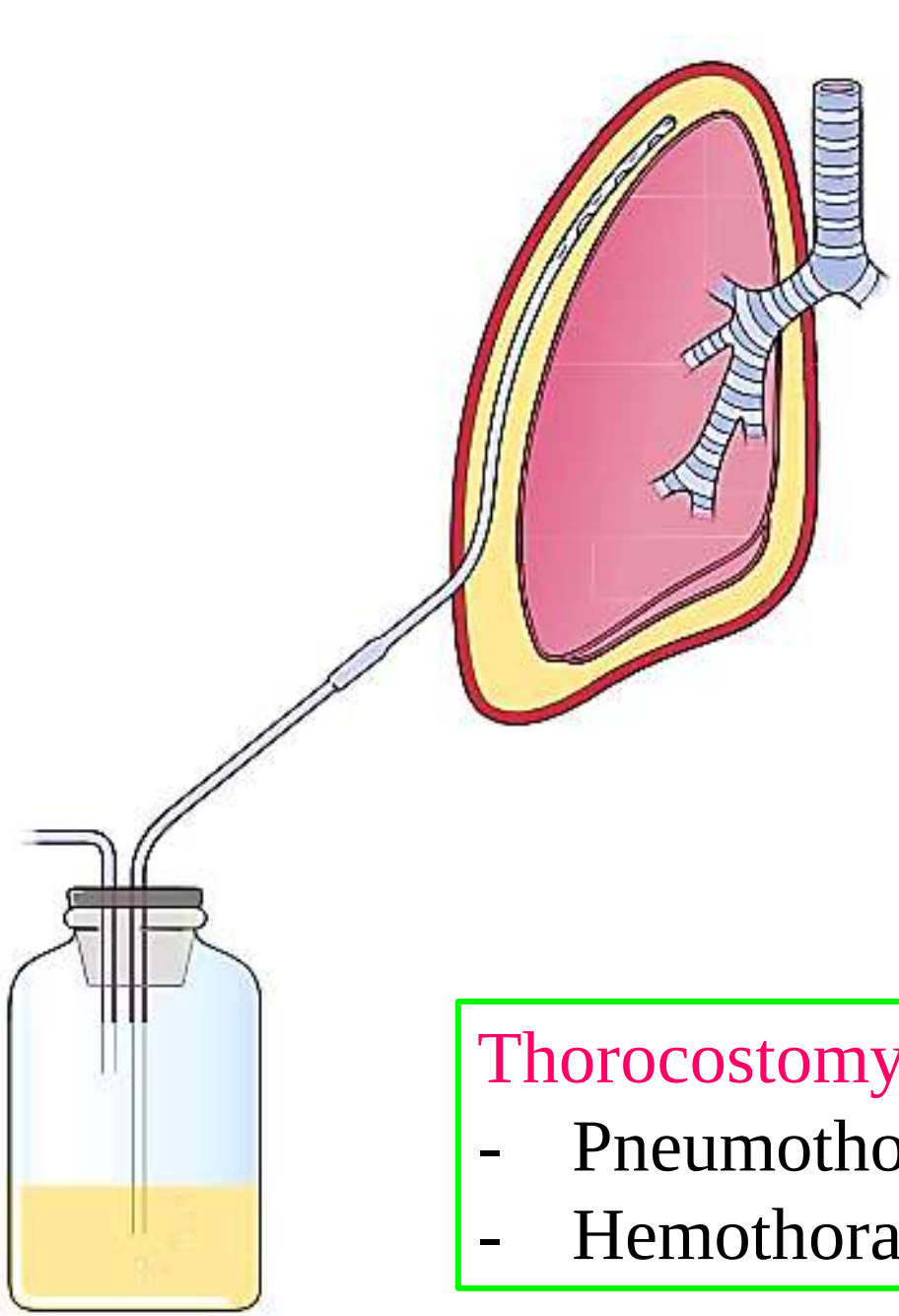


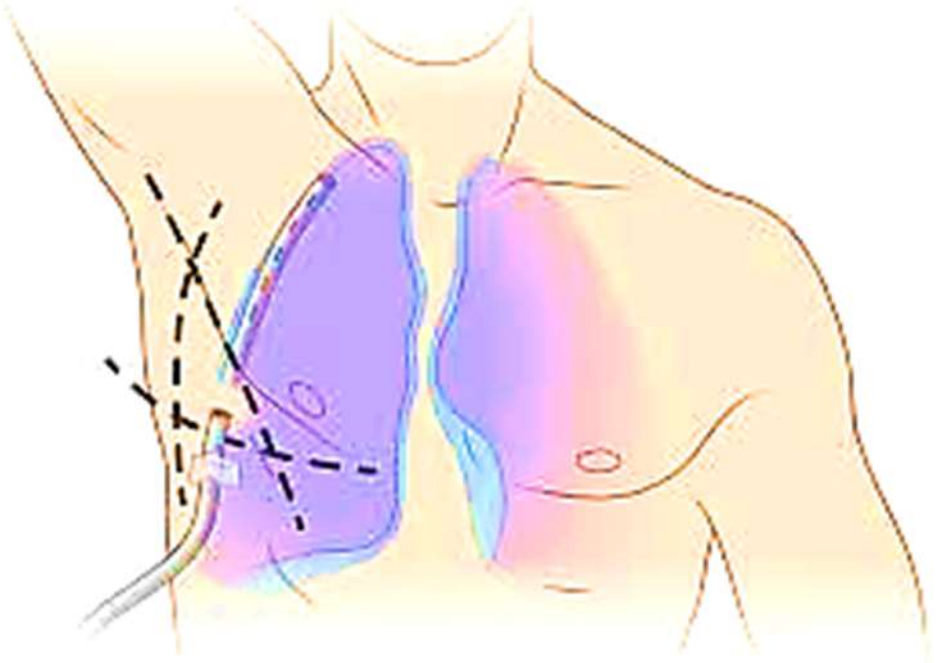
Foley's catheter is used for urinary bladder evacuation, decompresion and monitoring for urine out put.

T-tube drain

- After exploration of the common bile duct and stone retrieval or following repair of a damaged common bile duct. The principle is to allow bile to drain while the sphincter of Oddi is in spasm postoperatively and to act as a safety valve if there are any stones retained in the distal common bile duct. Complication :
- it is associated with increased bile leakage and increased hospital stay and cost with minimal benefits.
- it should remain in place for at least 2–3 weeks to encourage fistulous tract formation, thereby minimising the risk of biliary peritonitis after removal.
- Before removal, a T-tube cholangiogram should demonstrate the free flow of bile into the duodenum with no retained stones or bile leak.
- The T-tube is then clamped for 24 hours and removed. The T-tube is clamped to allow preferential drainage of bile to the duodenum; if there is no distal obstruction the patient will be asymptomatic.
- Once the T-tube is removed, there will be minimal bile leakage through the fistulous tract for a few days. This should stop as a fistula will close if there is no distal obstruction.

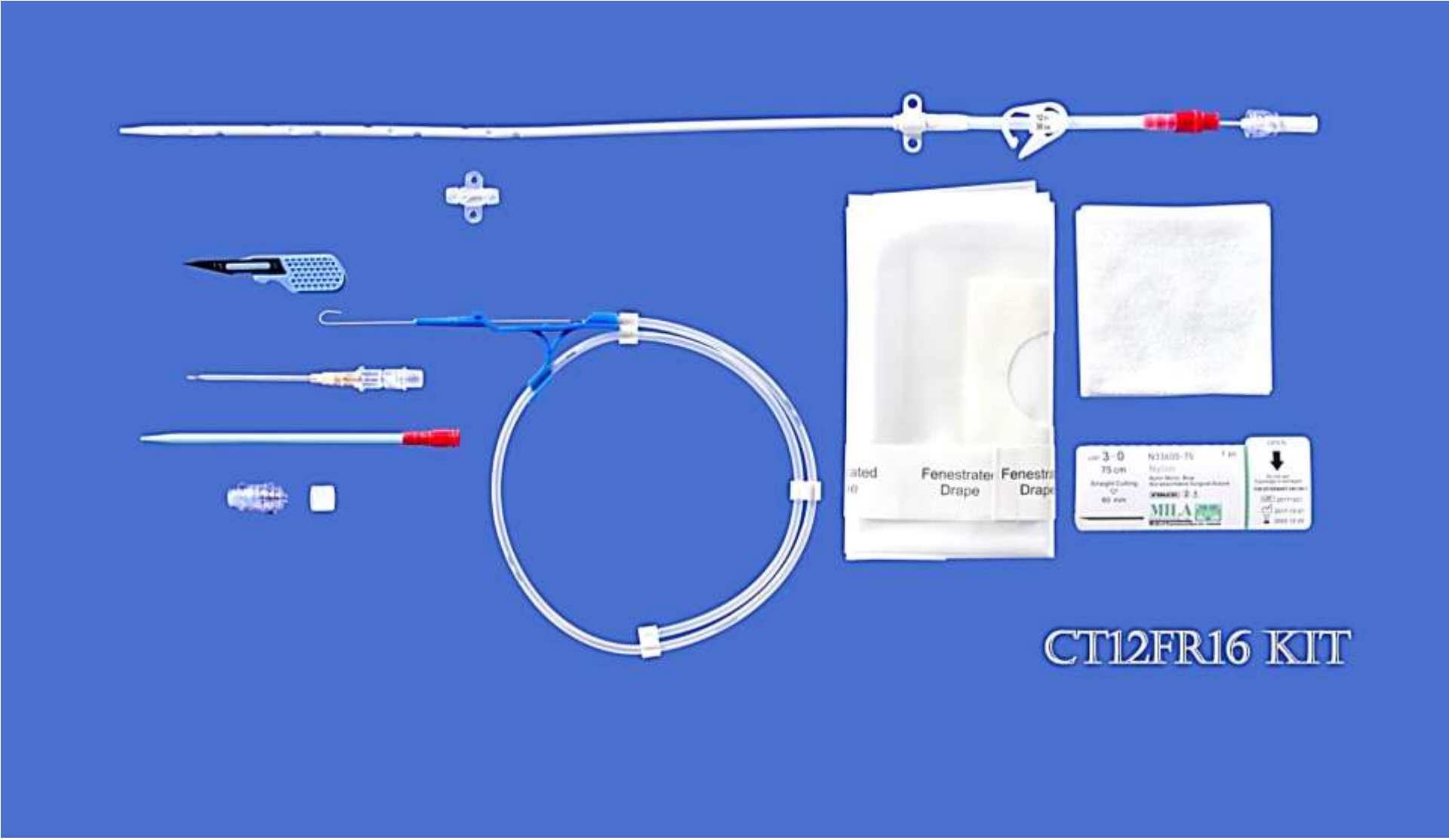






Thorocostomy tube under water seal

- Pneumothorax.
- Hemothorax.



Thorocostomy under water seal set

Removal of drains

- A drain should be removed as soon as it has served its purpose. It is important to define the objective of each drain and to ensure that, once that objective has been met, the drain is removed rather than waiting for an arbitrary drain volume amount.

- Drains placed to signal perioperative bleeding may usually be removed after 24 hours.
- Drains put in because of infection should be left until the infection is subsiding or the drainage is minimal.
- Drains placed following routine bowel anastomoses should be removed at 3–5 days. However, it should be stressed that in no way does a drain prevent an intestinal anastomotic leak, but merely may assist any such leakage to drain externally rather than producing life-threatening peritonitis.
- A suction drain should have the suction taken off before removal of the drain.
- During removal of a chest drain, the patient should be asked to breathe in and hold their breath, thus doing a Valsalva manoeuvre. In this way, no air is sucked into the pleural cavity as the tube is removed. Once the drain is out, a previously inserted purse-string suture should be tied.

THE PRINCIPLES OF SUTURING

WOUND CLOSURE AND SUTURING TECHNIQUE

The suturing of an incision or wound needs to take into consideration the site and tissues involved. There is no ideal wound closure technique that would be appropriate for all situations, and the ideal suture has yet to be produced, although many of the desired characteristics are below :

Suture material: desired characteristics

- **Easy to handle**
- **Predictable behaviour in tissues**
- **Predictable tensile strength**
- **Sterile**
- **Glides through tissues easily**
- **Secure knotting ability**
- **Inexpensive**
- **Minimal tissue reaction**
- **Non-capillary**
- **Non-allergenic**
- **Non-carcinogenic**

Types of wound healing

- Clean wounds with a good blood supply heal by primary intention and so closure simply requires accurate apposition of the wound edges.
- However, if a wound is left open, it heals by secondary intention through the formation of granulation tissue, which is tissue composed of capillaries, fibroblasts and inflammatory cells. Wound contraction and epithelialisation assist in ultimate healing, but the process may take several weeks or months.
- Delayed primary closure or tertiary intention is utilised when there is a high probability of the wound being infected. The wound is left open for a few days and if the infective process is resolved then the wound is closed to heal by primary intention. Skin grafting is another form of tertiary intention healing.

Suture characteristics

There are five characteristics of any suture material that need to be considered:

1 Physical structure: monofilament or multifilament.

- ●Monofilament sutures are smooth and tend to slide through tissues easily, but are more difficult to knot effectively. Such material can be easily damaged by gripping it with a needle holder and this can lead to fracture of the suture.
- ●Multifilament or braided sutures are much easier to knot but have a surface area of several thousand times that of monofilament sutures and thus have a capillaryaction and interstices where bacteria may lodge and be responsible for persistent infection or sinuses.
- To overcome some of these problems, certain materials are produced as a braided suture that is coated with silicone to make it smooth.

- **2 Strength**: It depends upon its constituent material, thickness and its response to various tissues and circumstances. Suture material thickness is classified according to its diameter in tenths of a millimetre.
- **The tensile strength** of a suture can be expressed as the force required to break it when pulling the two ends apart.
- Absorbable sutures show decay of this strength with time. Although the material may last in the tissues for the stated period in the manufacturer's product profile, its tensile strength cannot be relied on in vivo for this entire period.
- Materials such as catgut (no longer in use in the UK) have a tensile strength of only about a week while polydioxanone sulphate (PDS) will remain strong in the tissues for several weeks.
- However, even non-absorbable sutures do not necessarily maintain their strength indefinitely. Non-absorbable materials of synthetic origin, such as polypropylene, probably retain their tensile strength indefinitely, whereas non-absorbable materials of biological origin, such as silk, will fragment with time and lose their strength, and such materials should never be used in vascular anastomoses for fear of late fistula formation.

- **3 Tensile behaviour**:
- Suture materials behave differently depending upon their deformability and flexibility.
- Some may be ‘elastic’, in which case the material will return to its original length once any tension is released, while others may be ‘plastic’, in which case this phenomenon does not occur.
- Many synthetic materials demonstrate ‘memory’, which means they keep curling up in the shape that they adopted within the packaging.
- A sharp but gentle pull on the suture material helps to diminish this memory, but the more memory a suture material has, the less is the knot security.

4 Absorbability: suture materials may be non-absorbable or absorbable

Absorbable

- VICRYL (polyglactin) (synthetic). Braded
- PDS (Polydioxanone) (synthetic). Monofilement

Non- absorbable

- Silk (natural). Braded
- Prolene (Polypropylene) (synthetic). Monofilement
- Nylon (synthetic). Monofilement

Silk

- Tissue reaction : Moderate to high.
- Absorption rate : Slowly over 1–2 years.
- Tensile strength retention in vivo :

  80–100% lost by 6 months.
- Raw material : Raw silk from silkworm.
- Types : Braided
- Common name : Silk

Polyglactin / (Vicryl®)

- Tissue reaction : Mild
- Absorption rate :

  Hydrolysis until 5–6 weeks. Complete absorption 60–90 days.
- Tensile strength retention in vivo:

  60% remains at 2 weeks, 30% remains at 3 weeks.
- Raw material : Polyglactin.
- Types : Braided multinlamen.
- Common name (Vicryl®).

Polydioxanone (PDS)

- Tissue reaction : Mild
- Absorption rate :

  Hydrolysis at 90 days. Complete absorption at 180 days
- Tensile strength retention in vivo:

  70% remains at 2 wks, 50% remains at 4 wks, 14 % remains at 8 wks.
- Raw material : Polyester polymer .
- Types : Mononlament.
- Common name : PDS

Nylon

- Tissue reaction : Low.
- Absorption rate : Degraded by 15–20% per year.
- Tensile strength retention in vivo :

  Loses 15–20% per year.
- Raw material : Polyamide polymer .
- Types : Mononlament.
- Common name : Ethilon®, Danlon® .

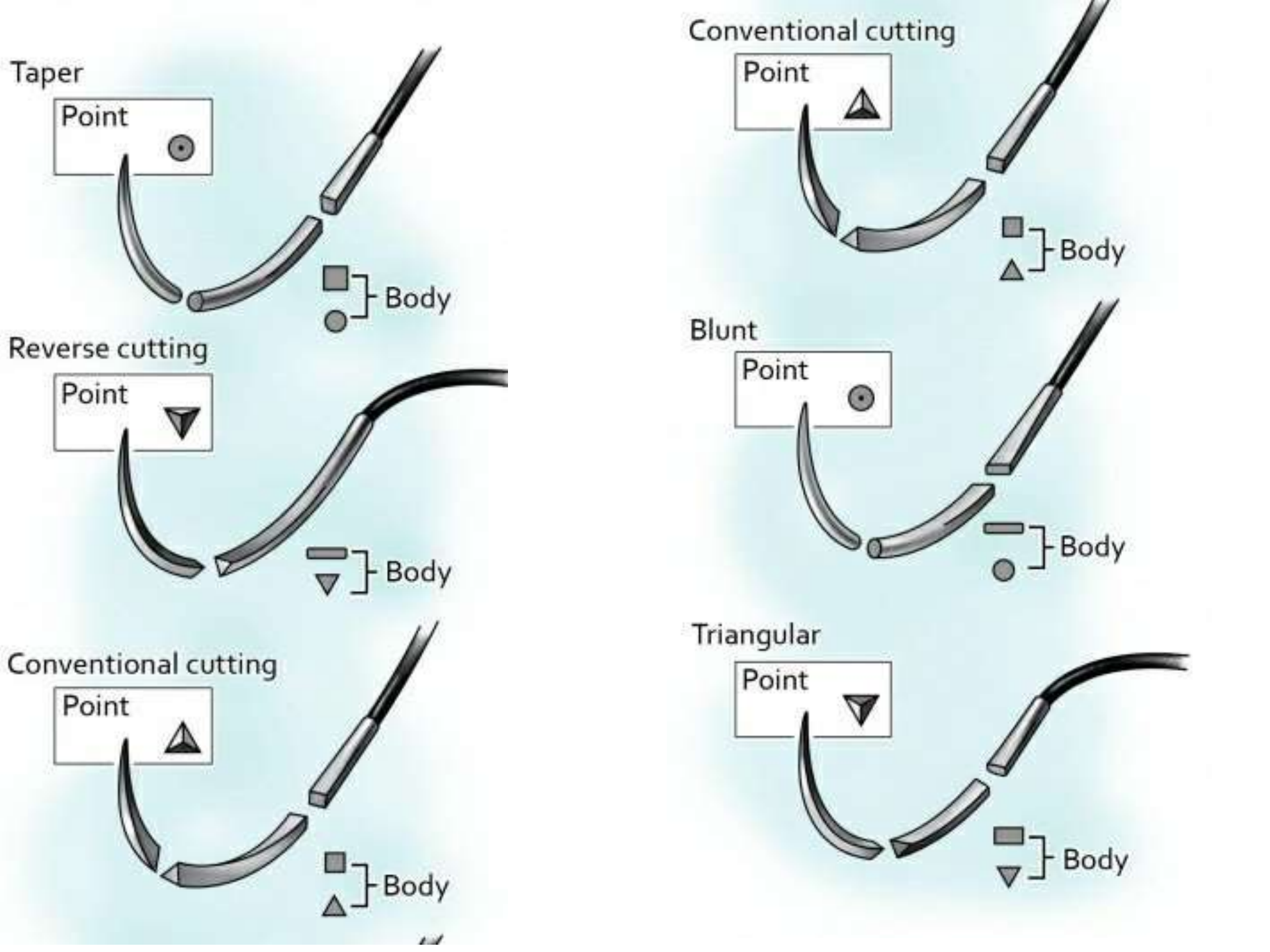
Polypropylene

- Tissue reaction : Low.
- Absorption rate : Non-absorbable.
- Tensile strength retention in vivo: Infinite (>1 year)
- Raw material : Polymer of propylene.
- Types : Mononlament.
- Common name : Prolene®.

- **5 Biological behaviour** within the tissues depends upon the constituent raw material.
- Biological or natural sutures, such as catgut, are proteolysed, but this involves a process that is not entirely predictable and can cause local irritation; therefore, such materials are seldom used.
- Man-made synthetic polymers are hydrolysed and their disappearance in the tissues is more predictable.
- The presence of pus, urine or faeces influences the final result and renders the outcome more unpredictable.

Needles

- Most needles in present practice are eyeless, or ‘atraumatic’, with the suture materia embedded within the shank of the needle. The needle has three main parts:
- 1 shank;
- 2 body;
- 3 point.


Taper
Point
Body
Reverse cutting
Point
Body
Conventional cutting
Point
Body
Conventional cutting
Point
Body
Blunt
Point
Body
Triangular
Point
Body

- The needle should be grasped by the needle holder approximately one-third of the way back from the rear of the needle, avoiding both the shank and the point.
- The body of the needle is either : (round, triangular or flattened).
- Round-bodied needles gradually taper to a point, are designed to separate tissue fibres and are used in intestinal and cardiovascular surgery.
- Triangular needles have cutting edges along all three sides. are used where tough or dense tissue needs to be sutured, such as skin and fascia
- The point of the needle can be round with a tapered end, conventional cutting, which has the cutting edge facing the inside of the needle’s curvature, or reversed cutting, in which the cutting edge is on the outside..

- Blunt-ended needles are used in the closure of the abdominal wall.
- The choice of needle shape tends to be dictated by the accessibility of the tissue to be sutured, and the more confined the operative space, the more curved the needle.
- Hand-held straight needles may be used on skin, but prefer to use needle holders to prevent needle-stick injuries.

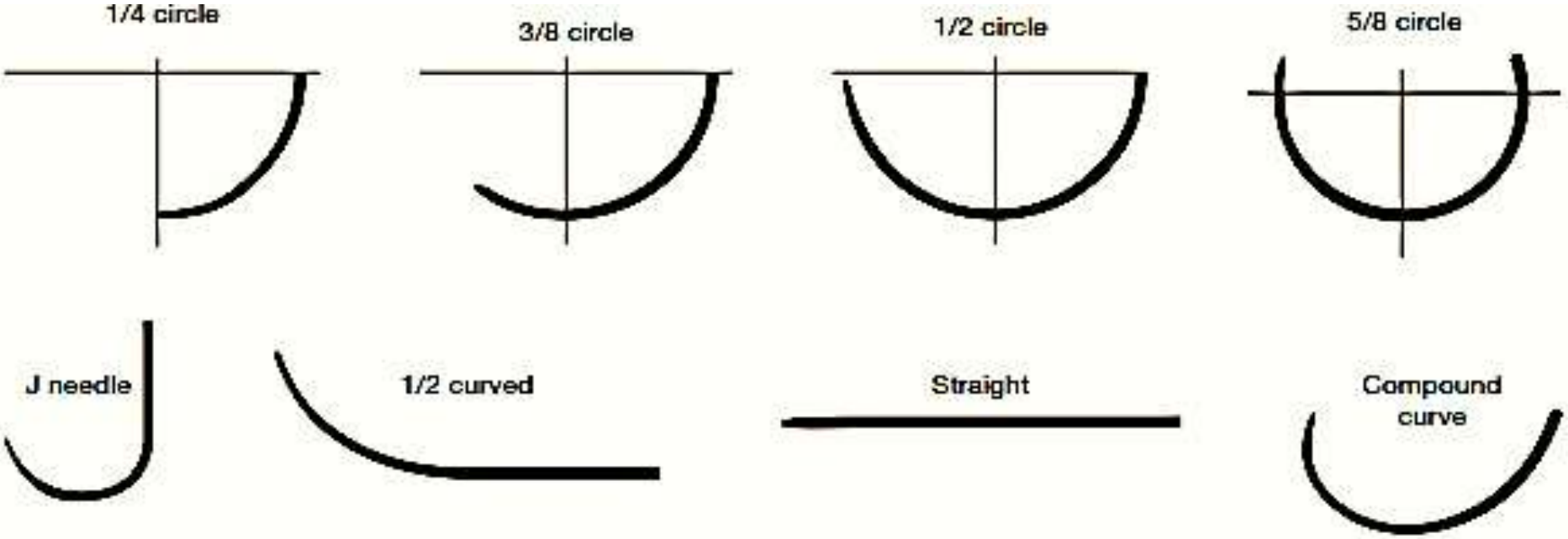
- Half-circle needles are used in the GIT while J-shaped needles, are used in the laparoscopic port site closure, eye and oral cavity.
- The size of the needle tends to correspond with
- the gauge of the suture material.

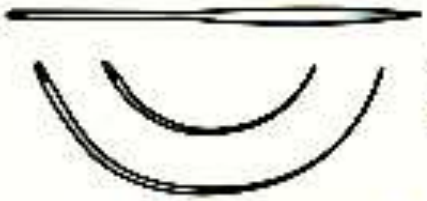
Choosing suture materials, depends on the tissue to be sutured :

- Vascular anastomoses require smooth, non-absorbable, non-elastic material.
- Biliary anastomoses require an absorbable material that will not promote tissue reaction or stone formation.
- Bowel anastomosis is usually performed using polyglactin, PDS or polypropylene based on the surgeon’s preference.
- The size of the needle and suture size used depends on the tissue that is .

TABLE 7.3 Size of suture material.

Metric (EurPh)	Range of diameter (mm)	USP ('old')
1	0.100–0.149	5–0
1.5	0.150–0.199	4–0
2	0.200–0.249	3–0
3	0.300–0.349	2–0
3.5	0.350–0.399	0
4	0.400–0.499	1
5	0.500–0.599	2





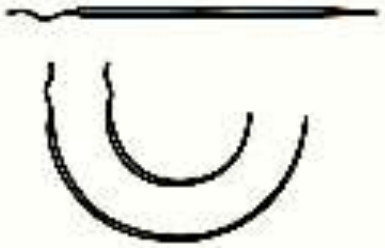
Δ Cross-section

Cutting needles for stitching skin

Needles used for suturing the abdominal wall:

Round-bodied needles for peritoneum, muscles and fat o

Cutting needles for aponeurosis Δ



o

Needles used for suturing the bowel
The threads are swaged into the needles

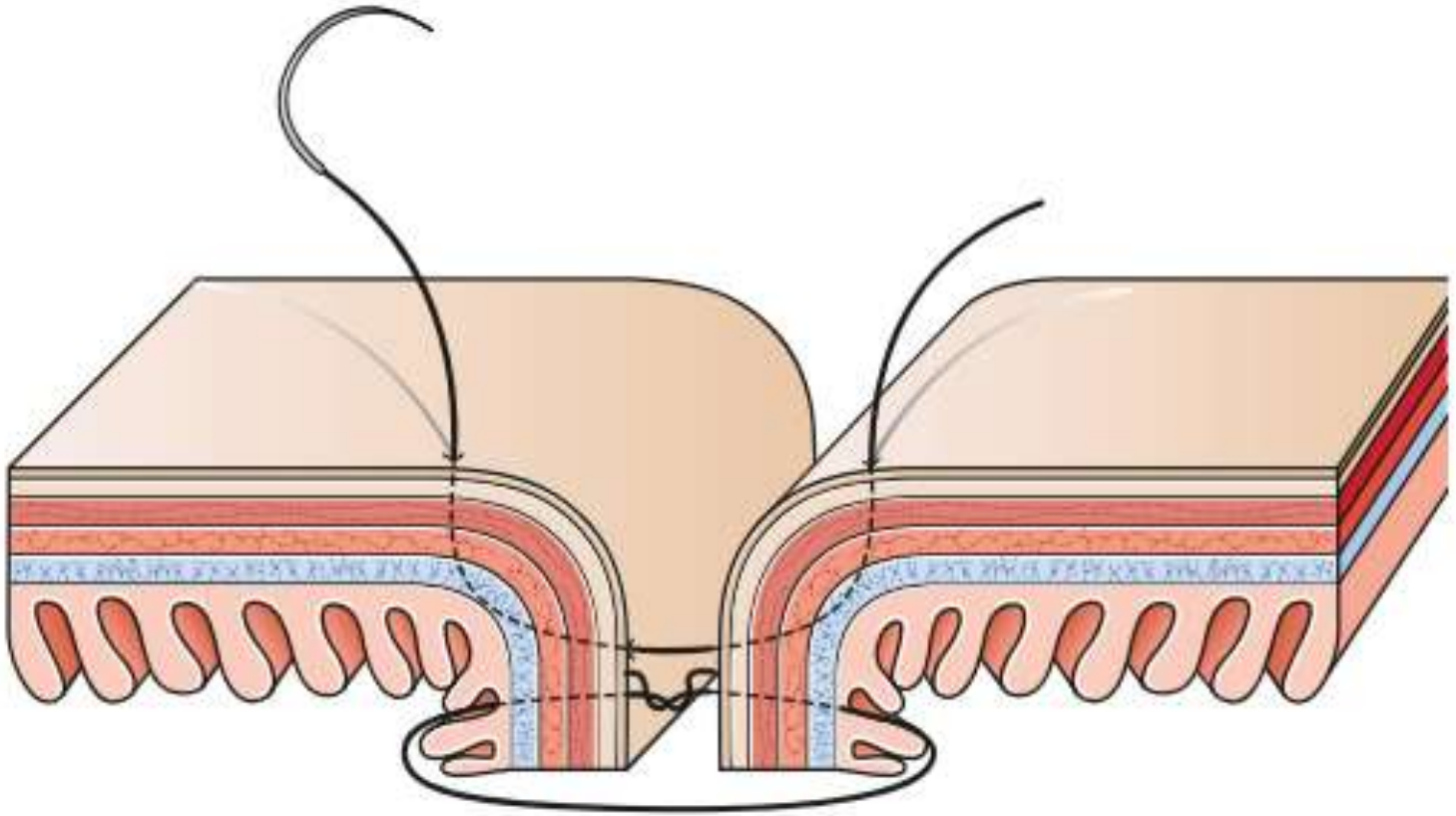
THE PRINCIPLES OF ANASTOMOSES

Bowel anastomoses

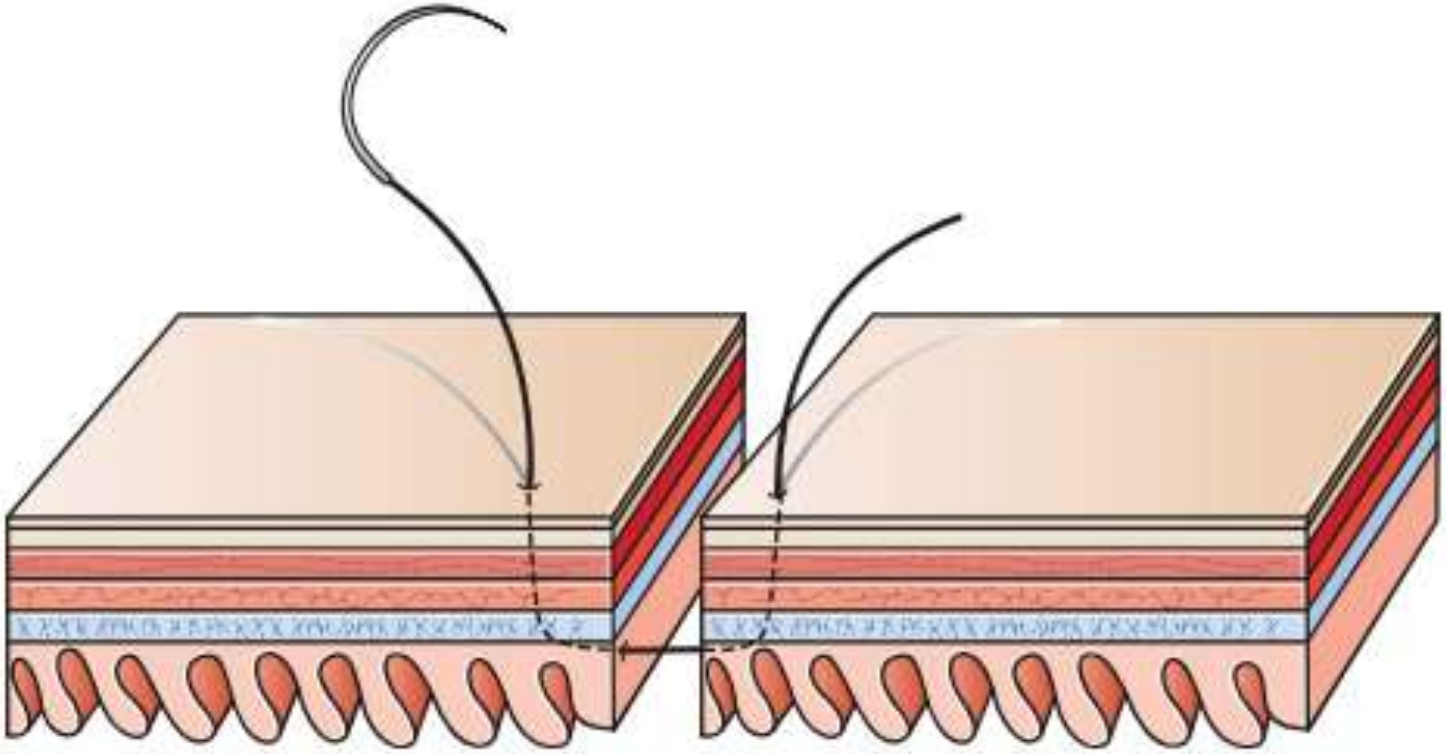
- Reflecting the join of a tubular viscus (bowel) or vessel (usually arteries) after a resection or bypass procedure.

- Bowel preparation (??????).
- Ideally, the bowel edges should be pink and bleeding prior to anastomosis.
- Ensure good blood supply to both bowel ends before and after formation of anastomosis
- Ensure the anastomosis is under no tension.
- Avoid risk to mesenteric vessels by clamps or sutures .
- Use atraumatic bowel clamps to minimise contamination
- Interrupted and continuous single-layer suture techniques are adequate and safe
- Stapling devices are an alternative when speed is required or access is a major factor

- The apposition of bowel edges should be as accurate as possible and the suture bites should be approximately 3–5 mm deep and 3–5 mm apart, depending on the thickness of the bowel wall. The suture materials should be of 2/0–3/0 size and made of an absorbable polymer, which can be braided (e.g. polyglactin) or mono|lament (e.g. polydioxanone), mounted on an atraumatic round-bodied needle. Braided, coated sutures are the easiest to handle and knot.



Kocher's method utilised a **two-layer anastomosis**, first a continuous all-layer suture using catgut, then an inverting continuous (or interrupted) seromuscular layer suture using silk, which became the mainstay of bowel anastomoses for many years



Halsted favoured a one-layer **extramucosal** closure . it was felt to cause the least tissue necrosis or luminal narrowing .This technique has now become widely accepted, although it is essential that this is not confused with a seromuscular suture technique. The extramucosal suture must include the submucosa because this has a high collagen content and is the most stable suture layer in all sections of the gastrointestinal tract.

Abdominal wall closure

- **Abdominal wound closure technique**
- The aim is to provide a tension-free closure with adequate strength to prevent early dehiscence or an incisional hernia in the long term.
- Most abdominal incisions are closed such that the rectus sheath or linea alba is approximated in a continuous manner using delayed absorbable or non-absorbable sutures employing round-bodied, blunt-tipped needle.

- ●Layered versus mass closure of the abdomen.
- Abdominal wounds can be closed either by closing all layers of the abdomen (musculoaponeurotic layers avoiding skin) together or by closing individual layers of the rectus sheath.
- An alternative would be to approximate only the anterior rectus sheath in situations where mass closure is not feasible .
- ●Continuous versus interrupted sutures.
- Simple continuous sutures theoretically seem to be better than
- interrupted sutures as the tension is evenly distributed, re-
- sulting in less ischaemia; in addition, they are quicker to
- perform. The literature supporting this practice is, how-

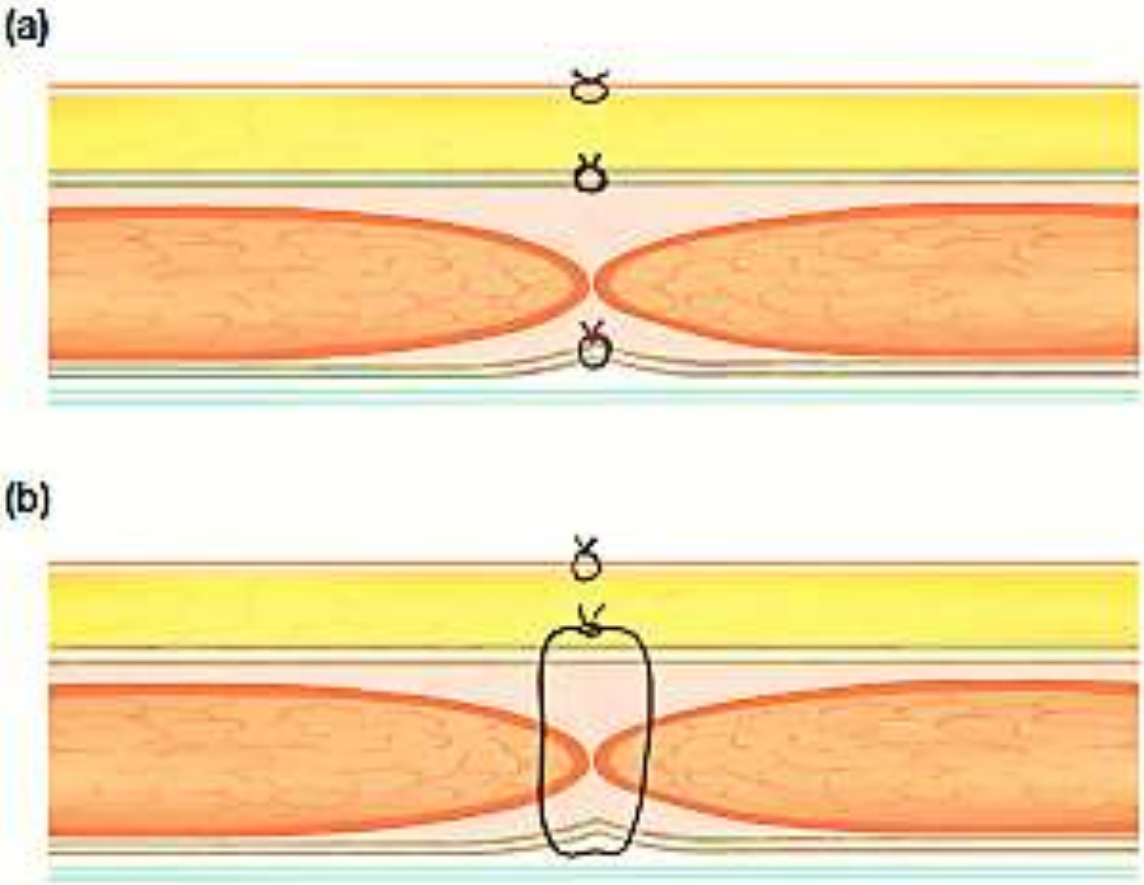


Figure 7.17 Abdominal closure techniques. (a) Layered closure. (b) Mass closure of all musculoaponeurotic layers (courtesy of Dr Vinay Timothy Kuruvilla).

Absorbable versus delayed absorbable versus non-absorbable suture material.

- Delayed absorbable monofilament material such as PDS is usually the suture material of choice.
- In patients with multiple previous operations, non-absorbable material such as nylon or polypropylene may be an alternative.

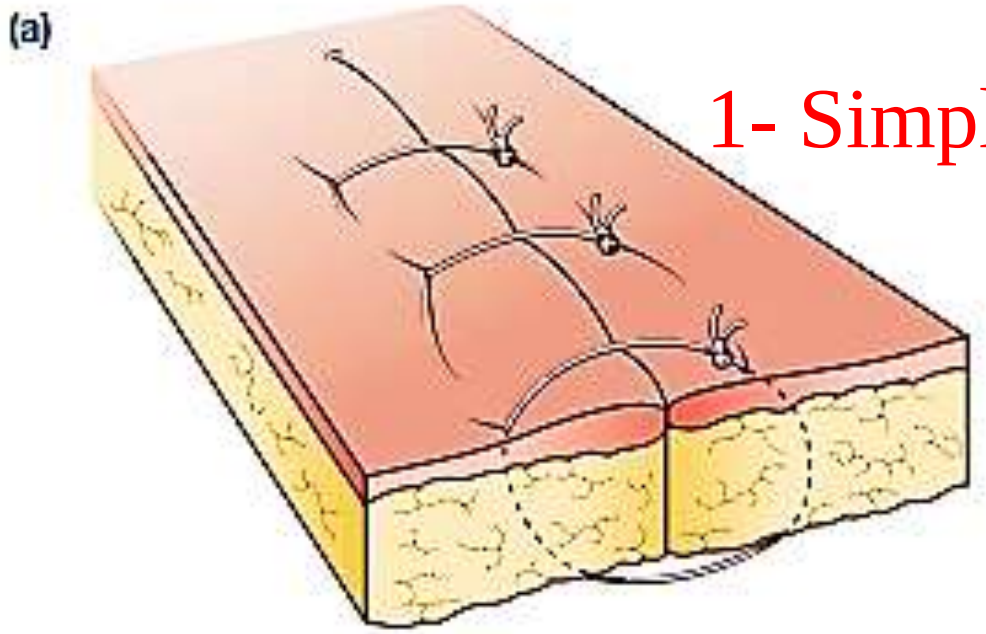
- **●Big bites, big needle versus small bites, small needle.**
- Abdominal closure is commonly performed by placing the sutures 1 cm apart from each other and 1 cm from the fascial edge.
- It is argued that the larger needle causes buttonhole defects when compared with the entry point of a narrow needle and thread. This, coupled with the increased distance between bites, causes the suture to act like a cheese wire through the tissue, thereby slackening the stitch and resulting in hernia.
- It is important to provide a tension-free approximation, to avoid subcutaneous fat (as the fat is likely to necrose) and, if employing a continuous suturing technique, to start from the inferior and superior ends with two separate sutures and meet in the middle to aid in better visualisation of the final stitches.

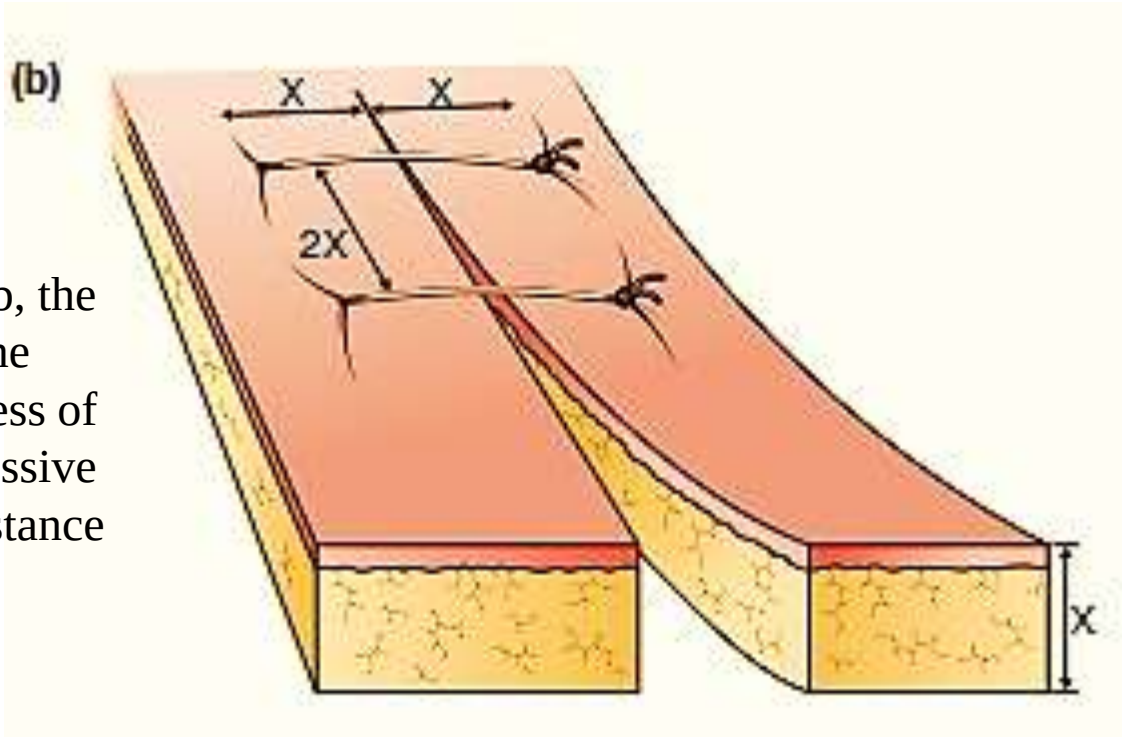
Suture techniques

There are four frequently used suture techniques.

- 1 Simple Interrupted sutures.
- 2 Continuous sutures.
- 3 Mattress sutures.
- 4 Subcuticular suture.

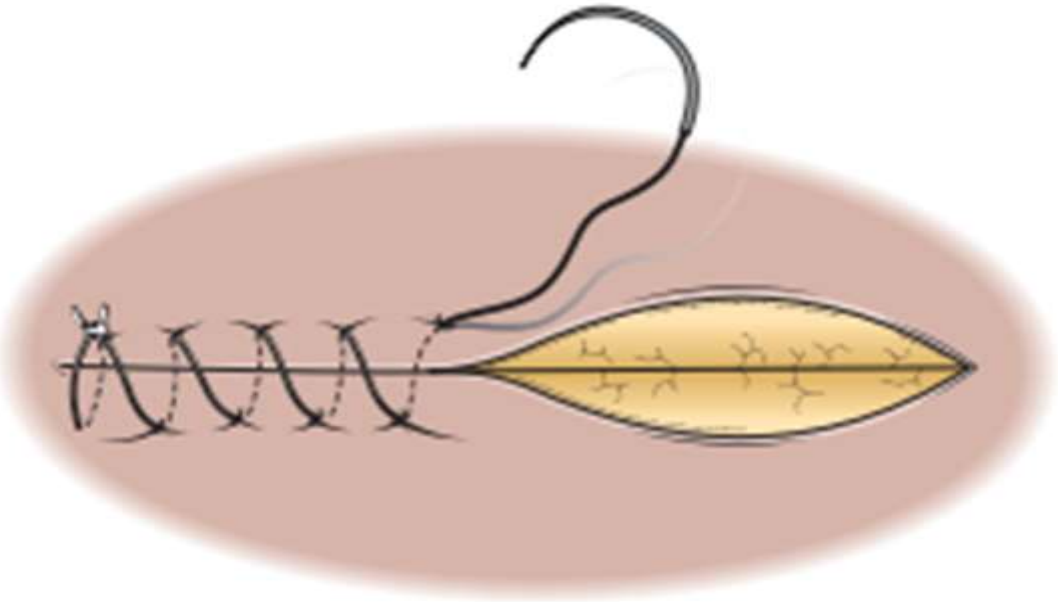
1- Simple Interrupted sutures





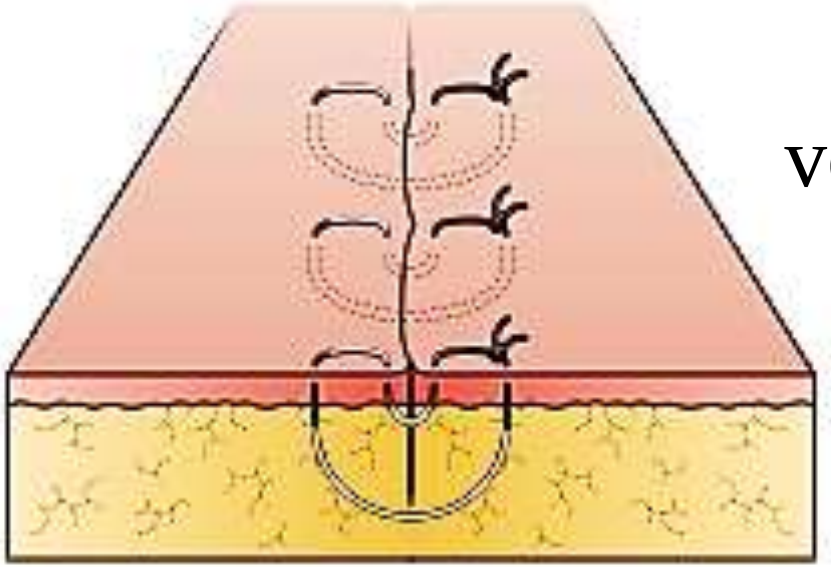
The siting of sutures. As a rule of thumb, the distance of insertion from the edge of the wound should correspond to the thickness of the tissue being sutured (×). Each successive suture should be placed at twice this distance apart (2×).

- 2 Continuous sutures.
- the first suture is inserted in an identical manner to an interrupted suture, but the rest of the sutures are inserted in a continuous manner until the far end of the wound is reached
- Don’t produce too much tension .



- 3 Mattress sutures.
- may be either vertical or horizontal and tend to be used to produce either eversion or inversion of a wound edge .
- The initial suture is inserted as for an interrupted suture, but then the needle moves either horizontally or vertically and traverses both edges of the wound once again. Such sutures are very useful in producing an accurate approximation of wound edges, especially when the edges to be anastomosed are irregular in depth or disposition.

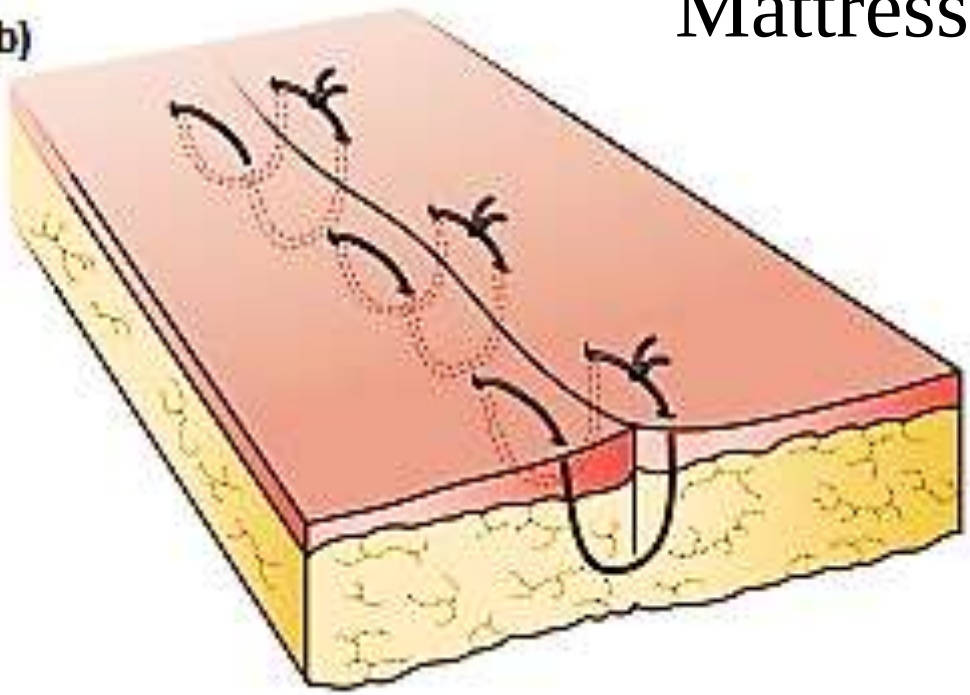
(a)



vertical

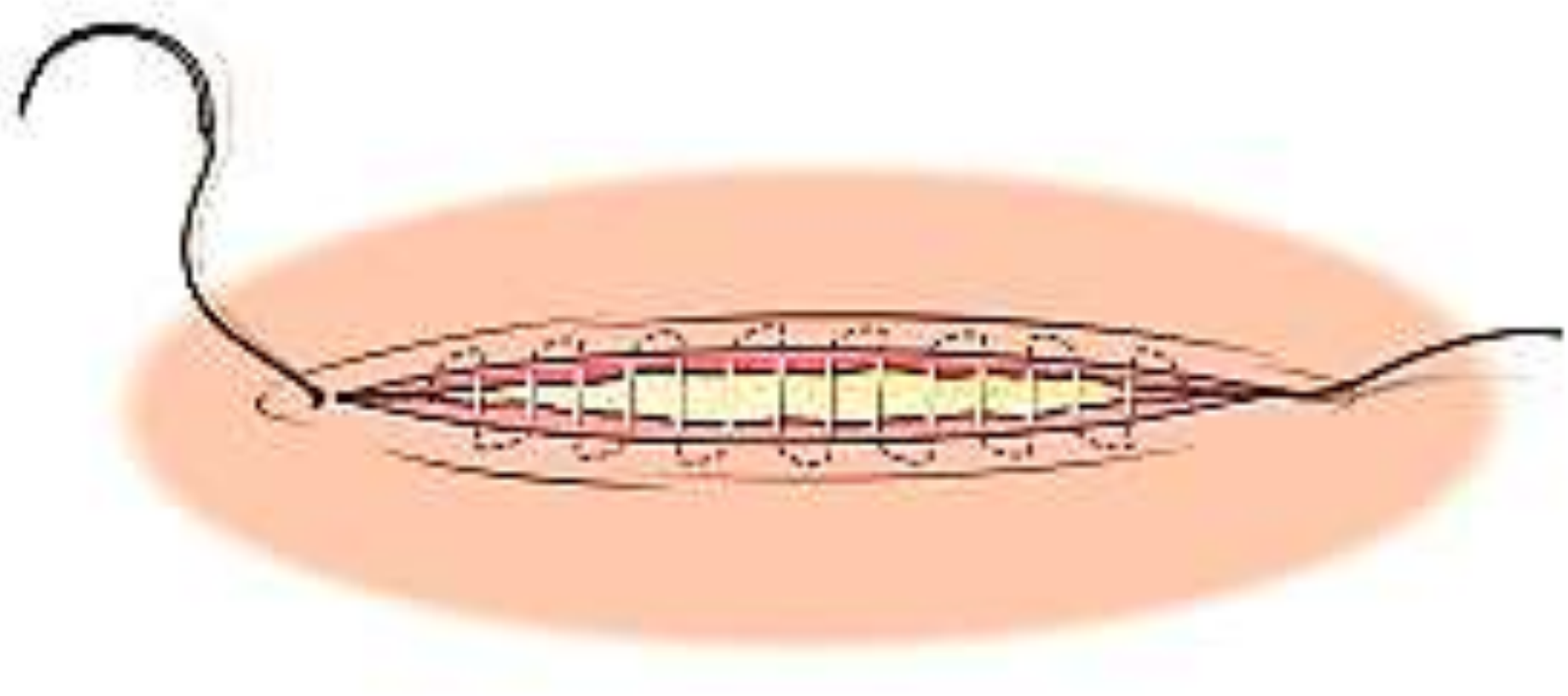
Mattress suture techniques.

(b)



horizontal

- 4 Subcuticular suture.
- This technique is used in skin where a cosmetic appearance is important and where the skin edges may be approximated easily.
- The suture material used may be either absorbable or non-absorbable. For non-absorbable sutures, the ends may be secured using a collar and bead, or tied loosely over the wound. When absorbable sutures are used, the ends may be secured using a buried knot. Small bites of the subcuticular tissues are taken on alternate sites of the wound and then gently pulled together, thus approximating the wound edges without the risk of the cross-hatched markings of interrupted sutures.



Subcuticular suture technique.

Knotting techniques

- Knot tying is one of the most fundamental techniques in surgery and a poorly constructed knot may jeopardise an otherwise successful surgical procedure. The general principles behind knot tying are as follows:

●The knot must be tied firmly, but without strangulating the tissues.

●The knot must be as small as possible to minimise the amount of foreign material.

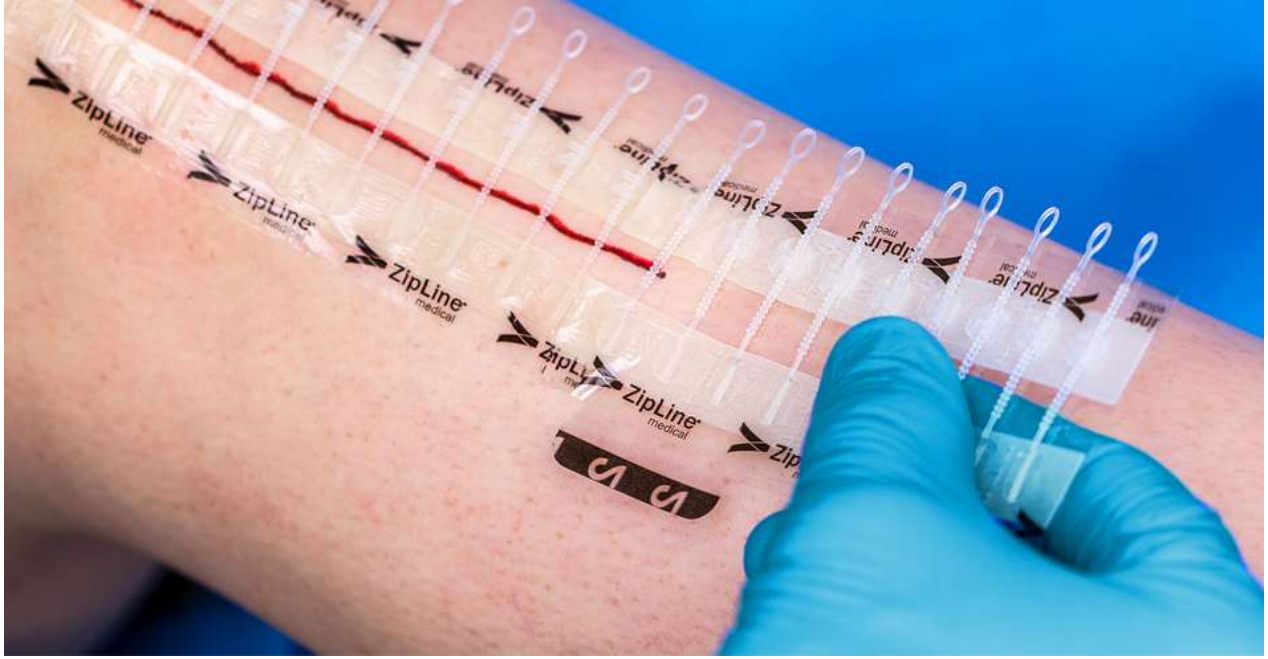
●The knot must be tightened without exerting any tension or pressure on the tissues being ligated, i.e. the knot should be bedded down carefully, only exerting pressure against counter-pressure from the index finger or thumb.

●The suture material must not be ‘sawed’ as this weakens the thread and cuts through delicate tissue like a cheese wire.

- The suture material must be laid square during tying; otherwise, tension during tightening may cause breakage or fracture of the thread.
- When tying an instrument knot, the thread should only be grasped at the free end, as gripping the thread with the needle holder can damage the material, resulting in breakage or fracture.
- The standard surgical knot is the reef knot with a third throw for security, although with monofilament sutures six throws are required for security.
- When added security is required, a surgeon's knot using a two-throw technique is advisable to prevent slippage.
- When using a continuous suture technique, an Aberdeen knot may be used for the final knot.
- When the suture is cut after knotting, the ends should be left about 1–2 mm long to prevent unravelling. This is par-ticularly important when using monofilament material.

Alternatives to sutures

- Skin adhesive strips
- Self-adhesive tapes may be used where there is no tension
- and the wound is clean; for example, adhesive strips are used
- following clean procedures on the face.
- Tissue glue
- Tissue glue can be used as a means of primary tissue apposition or as an adjunct to sutures. Some specific uses have been described such as closing a laceration on the forehead of a fractious child in Accident and Emergency, thus dispensing with local anaesthetic and sutures.
- Staples
- There is a wide range of mechanical devices that can be used to staple skin, bowel or even major vascular pedicles. Most of these devices are disposable and relatively expensive, but their cost is offset by the saving of operative time.

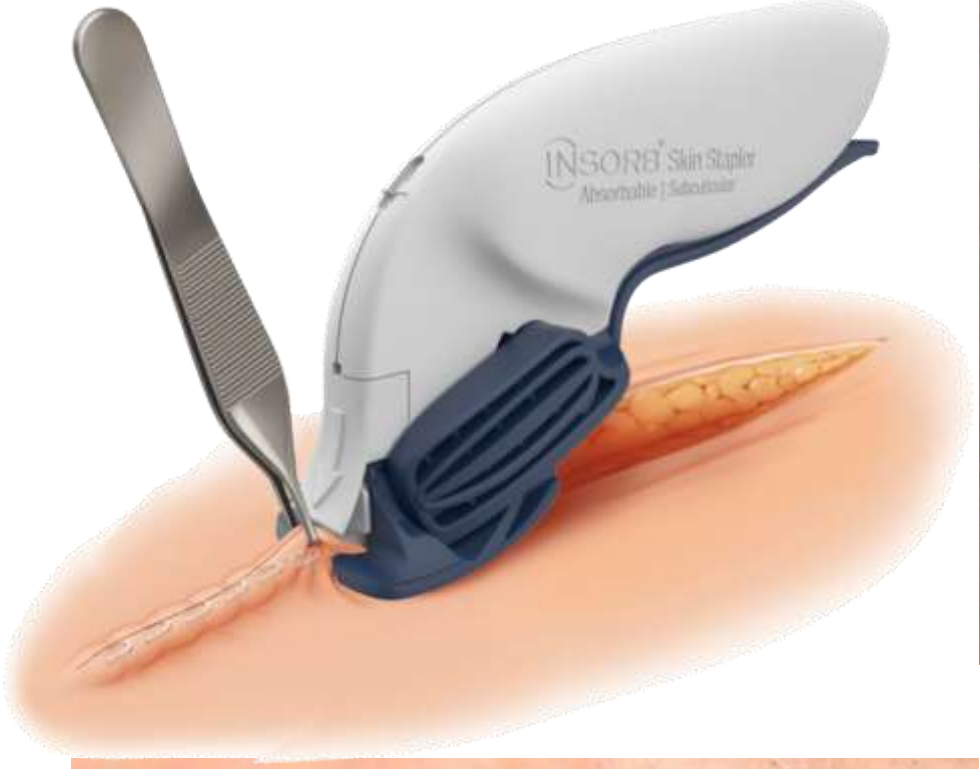


Zip Surgical Skin Closure

Steri-Strip

Removal of skin staples or sutures

- The timing of removal of non-absorbable sutures depends on the anatomic location, tension with which the wound was closed and the operation performed.
- It is customary for the operating surgeon to specify the time of suture removal in the operative notes.
- While early removal can minimise unsightly scars and prevent sutures from being embedded in the skin, removing them prematurely can result in wound dehiscence.
- As a rule, facial sutures are removed in 3–5 days after the operation, neck sutures in 5–7 days and abdominal sutures between 10 and 14 days.


INSORB Skin Stapler

تم بتوفيق الله