POSITIONING ON THE OPERATING TABLE

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Positioning patients is an important daily routine for anaesthetists to facilitate surgical access for a number of procedures. Different positions produce a range of physiological stresses. Particular care is needed for positioning anaesthetised patients to avoid passive movements that would not normally be tolerated. Nerve damage and pressure necrosis commonly result from poor positioning, the incidence is increased by hypotension and hypothermia.

Tourniquets can cause nerve damage if they are applied over a nerve trunk therefore the inflation pressure and the time of application should always be monitored. Diabetics, patients with arterial disease, the elderly and those with neurological deficits are also at particular risk.

Patients with rheumatoid arthritis may suffer from cervical spine instability at the atlanto-occipital level and it is important that their range of neck movement be assessed preoperatively. They should then be comfortably positioned prior to induction and this position maintained once anaesthetised. Sandbags may be employed.

Supine - "On the back"

The most common position. The arms should be carefully secured either next to the patient's body, flexed across the chest or out on armboards. Acute flexion at the elbow may cause ulnar nerve damage due to trapping where it enters the cubital tunnel. The brachial plexus is a relatively fixed structure and therefore susceptible to traction injury. To avoid "stretch" on the plexus, pronate the forearms when the arms are extended by the patient's sides. When both arms are abducted on boards, prevent over-abduction and hyperextension and keep the head facing forward. When one arm is abducted, the head should be turned towards that side, again to prevent traction on the brachial plexus (Figure 1). Legs should lie flat and uncrossed. A soft pad raising the heels from the table avoids pressure necrosis. Other sites susceptible to pressure damage are the sacrum and occiput and postoperative alopecia (hair loss) has been reported after long operations where hypotensive techniques have been employed. The patient's eyelids should be carefully closed and taped to avoid corneal abrasion and dehydration. Direct pressure on the eye should be avoided as central retinal artery occlusion may occur. Ensure that no part of the breathing circuit, or other equipment, is pressing on the patient's face.

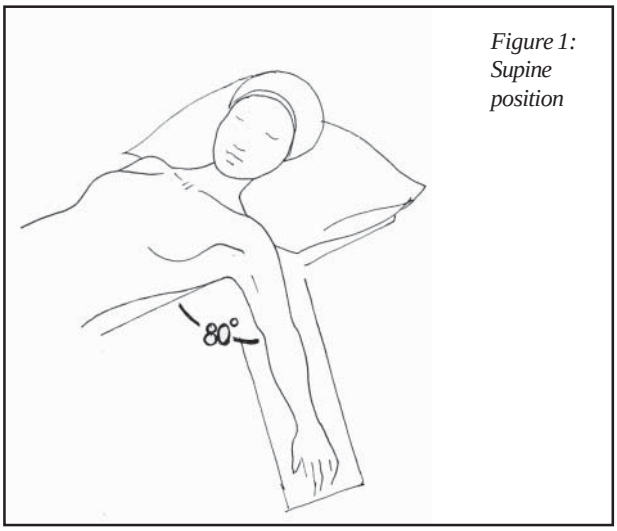

Figure 1: Supine position

Trendelenberg - "Head down"

Supine with head down tilt. This position is used in laparoscopic and varicose vein surgery.

Physiological effects of this position include:

- increased venous return
- raised intracranial and intraocular pressure. Cerebral oedema and retinal detachment may occur if Trendelenberg is prolonged and steep. It is therefore important to avoid this position in a patient with potentially raised ICP.
- lung compliance and functional residual capacity (FRC) are decreased with increased V/Q mismatch, especially in obese patients (IPPV may be preferable to SV)
- increased intragastric pressure may result in reflux of gastric contents
- venous stagnation with resulting cyanosis in the face and neck of plethoric patients

Reverse Trendelenberg - "Head up"

Supine with head up tilt. Reduced venous return in this position may lead to a fall in cardiac output and arterial pressure. As baroreceptor activity is reduced under anaesthesia a vasopressor may be needed. Blood pressure readings should be interpreted in the context of relative positions of the blood pressure cuff and the level of the brain above it. Functional residual capacity (FRC) is improved.

Lawn chair position (Figure 2)

Backache following anaesthesia is common and may occur from stresses on the interlumbar and lumbosacral ligaments, when the convexity of the lumbar spine is lost in the "lying to attention" position. The lawn chair position was developed to reduce this backstrain. The operating table is modified so that the patient lies slightly head up with hips and knees partially flexed. It is particularly useful for patients undergoing awake local anaesthetic procedures.

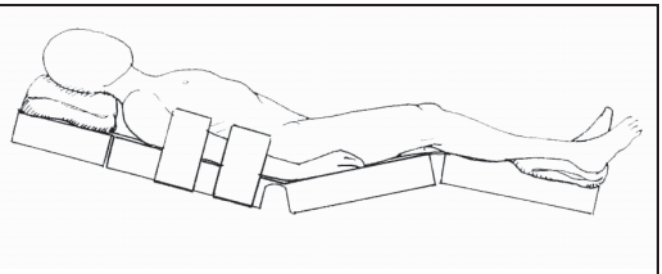

Figure 2:

Prone - "Face down"

Used for spinal surgery, ligation of the short saphenous vein and some ankle operations. Intubation is normally required (although for short procedures a Laryngeal mask airway is sometimes used). A well-secured, armoured endotracheal tube is most suitable. Adequate eye protection and padding is vital because pressure on the eye can cause retinal artery occlusion and blindness.

A sufficient number of persons are required to turn the patient prone - the larger the patient the greater the number of assistants required. Usually 4 people will suffice: the anaesthetist to control the head, and 2-3 assistants to support the torso and arms, buttocks and legs respectively. The patient may be turned prone after transfer to the operating table or alternatively, turned in the process of the transfer. The head is positioned to one side or face down on a piece of hollow foam or headrest. Pressure should be limited to the forehead. Avoid any pressure on the eyes and ensure the endotracheal tube is secure. The arms are positioned fully adducted so they lie by the patient's side or are abducted and flexed at the elbow so they lie alongside the head. Avoid undue pressure in the axillae as axillary nerve or brachial plexus neuropraxia may occur from overstretching (Figure 3).

Pressure points tend to be the head/face, anterior superior iliac spines, knees and feet which should all be well padded. Lung compliance is reduced due to decreased chest wall and diaphragmatic excursion. To aid compliance, a "Montreal" mattress (a rectangular mattress with a hole in its centre) may be used to prevent the abdominal contents forcing the diaphragm upwards. Alternatively, pillows should be placed under the iliac crests and chest, leaving the abdomen unhindered. This also prevents undue movement of the back and allows for efficient drainage from the epidural veins by reducing intrathoracic and intra-abdominal pressure. When using frames that support the anterior superior iliac spines, the lateral cutaneous nerve of the thigh may be compressed and stretched. The "Tarlov knee-chest position" (prone seated position) is a reliable position for lumbar surgery. The buttocks are supported on a "seat" and the table tilted upwards. This position rarely causes any damage other than an erythematous reaction on the skin of the knees.

Figure 3:

Lithotomy - "Legs up"

Used for gynaecological and anal surgery. Both legs should be moved together to avoid strain on the pelvic ligaments and the knees should be positioned outside any metal supports. Avoid placing arms at the side as metal contact with the lithotomy pole may occur and trapping of digits in the lower section of the table is possible.

Potential problems include:

- common peroneal nerve damage due to compression between the head of the fibula and lithotomy pole if knee positioned inside the metal support
- saphenous nerve compression between lithotomy pole and medial tibial condyle
- autotranfusion from the leg vessels will increase preload. The effect on cardiac output will depend on the patient's volume status
- vital capacity is decreased
- risk of aspiration is increased therefore anaesthesia should never be induced in this position. Further, if reflux or vomiting occurs during induction, turning the patient will be delayed.

Lateral - "On the side"

Usually used for thoracotomies, renal, shoulder surgery and hip operations. The lateral position alters respiratory physiology: if breathing spontaneously, the dependent (lower) lung is efficiently perfused and ventilated. But with IPPV the dependent lung is better perfused and the non-dependent (upper) lung better ventilated, resulting in V:Q mismatch. Pressure points in this position are the dependent hip, shoulder and ankle and these should be padded where appropriate. The patient may be stabilised with chest and hip supports, or with a mattress which becomes rigid when air is evacuated from it. A pillow is placed between the legs, with the lower leg flexed at the knee and the upper leg in a neutral position. The upper arm may be allowed to hang freely above the head or placed in an arm support.

Lateral decubitus position for nephrectomy

The table is flexed in the centre in addition to the lateral position. The lateral decubitus position causes a V:Q mismatch as previously mentioned. This position can cause direct caval compression resulting in decreased venous return and hypotension. It is important to monitor blood pressure closely - an arterial line may be useful. Pressure points are the dependent hip, shoulder and ankle. Once again, the patient is stabilised with chest and hip supports or with a mattress which becomes rigid when air is evacuated.

Sitting

Occasionally for posterior fossa neurosurgical procedures. It has a number of advantages over the prone position: better surgical access, more neck flexion, improved gravitational drainage of blood. Serious disadvantages include: postural hypotension, high risk of venous air embolism. This position has marked cardiovascular effects: cardiac output and arterial pressure may decrease dramatically due to pooling of blood in the lower extremities with resulting hypotension and reduced cerebral blood flow. Invasive monitoring (arterial/ central lines) is required.

In order to minimise the effects of changing from supine to a sitting position, a number of measures can be taken. These include fluid loading, compression stockings or G-suits and/or the use of vasopressors. The patient should be raised slowly with elevation of the legs above the horizontal once in the sitting position to aid venous return. The head may be supported in a horseshoe headrest that allows pressure to be applied to the head and neck without movement. Alternatively a skull clamp may be used which minimises pressure-related complications involving the face. Its insertion is stimulating but may be attenuated by using local anaesthetic, a small bolus of propofol or a short acting opioid. Flexion of the head on the neck aids surgical access, but raises ICP and may cause swelling of the face and tongue because venous return is decreased. These patients are at marked risk of air embolism and should be monitored using $ETCO_2$, Doppler, transoesophageal ECHO or oesophageal stethoscope. The risk is reduced by IPPV and by maintaining mean arterial pressure. Spontaneous ventilation is permissible (indicates that respiratory centre is intact), but is seldom used now.

Armchair position for shoulder surgery

Occasionally an armchair position is adopted for surgical access. This position has cardiovascular effects similar to the sitting position namely, hypotension due to pooling of blood in the lower limbs.

These effects can be reduced by elevating the patient to a head up position slowly, using vasopressors and fluids as required, and elevation of the patient's legs above the horizontal. These patients are also at risk of air embolism.

Nerve	Site of Potential Damage	Result of Damage
Supraorbital	Compression from a tight facemask	Photophobia, pain in the eye, numbness of the forehead
Facial	Lies superficially and may be damaged at the ramus of the mandible	Paralysis of the face and orbicularia occuli (buccal branch)
Axillary	Prone to stretching when shoulders are extended and arms placed above the head (prone position)	Decreased abduction of arm, reduced skin sensation over lateral aspect of upper arm.
Radial	At risk of external pressure in axilla if arm hangs over the edge of table (posterior cord)	Wrist drop
Median	Very uncommon injury. At risk of direct needle trauma in artecubital fossa	Inability to oppose thumb and little finger
Ulnar	- May be compressed by edge of operating mattress where it lies superficially in groove behind medial epicondyle of humerous - Internal compression between two heads of flexor carpi ulnaris - Full flexion at elbow causes compression where the nerve enters the cubital tunnel	Hand weakness, tingling and pain
Sciatic	Main source of damage direct trauma from misplaced i/m injections pneumatic tourniquet	Paralysis of all muscles and sensory loss below knee
Femoral	Susceptible to damage where it passes beneath inguinal ligament - excessive leg flexion in lithomy may cause entrapment	Loss of hip and knee extension, loss of sensation over anterior thigh and anteromedial aspect of calf
Lateral cutaneous nerve of the thigh common peroneal	At risk if frames are used to support anterior superior iliac spines when the patient is prone may be compressed by lithomy pole where it passes around the head of the fibula (superficial)	Meralgia paraesthesia - numbness and hyperalgesia of the upper lateral thigh Foot drop, loss of sensation over lateral aspect of leg and dorsum of foot
Pudendal	Compression against perineal post used in hip surgery	Loss of perineal sensation, faecal incontinence
Saphenous	Compressed between medial tibial condyle and lithotomy pole (leg lateral to pole)	Sensory loss along medial aspect of calf