

Anaesthesia for Orthopedic surgery

Dr : Miaad Adnan

FIBMS Anaesthesia

15 / 5 / 2022

Orthopaedic surgery

Preoperative :

- Arthritis often makes assessment of cardiorespiratory fitness difficult .
- Patients with rheumatoid disease are at risk of atlantoaxial instability .
- Planning a regional technique .
- A high risk of VTE occurs with certain operations requiring antithromboembolic measures .

Orthopaedic surgery

Perioperative :

1

- Give IV antibiotic prophylaxis .
- Utmost care with positioning to avoid soft tissue or nerve injuries.
- Maintenance of normothermia with blood warmers and warm-air blankets
- Consider invasive monitoring for those patients with CVS disease.

Orthopaedic surgery

Perioperative :

2

- Blood loss may be significant (use a large-bore cannula)
- A urinary catheter should be inserted for long procedures or when epidurals/spinal opioids are used.

Choice of Anesthetic Technique Advantages of Regional **VS** General Anesthesia for Orthopaedic Surgical Procedures :

1. Improved postoperative analgesia .
2. Decreased incidence of nausea and vomiting .
3. Less respiratory and cardiac depression .
4. Improved perfusion because of sympathetic nervous system block .
5. Decreased intraoperative blood loss .
6. Decreased blood pressure .

Fat embolism syndrome :

1

Fat embolism syndrome (FES) is associated with trauma or surgery .

Seen in patients with long bone fractures who develop sudden tachypnoea and hypoxia.

Diagnosis by exclusion. Early surgery and avoidance of intramedullary fixation have both reduced the incidence.

Fat embolism syndrome

Features :

2

Major :

- Respiratory symptoms—tachypnoea, dyspnoea, bilateral crepitations .
- Neurological signs—confusion, drowsiness.
- Petechial rash.

Minor :

- Tachycardia.
- Retinal change—fat or petechiae.
- Jaundice.
- Renal—oliguria or anuria.

Fat embolism syndrome

Features :

3

Laboratory :

- Thrombocytopenia.
- Sudden decrease in Hb by 20%.
- Raised ESR.
- Fat macroglobulaemia.

Fat embolism syndrome

Treatment :

4

- Early resuscitation and stabilization are vital.
- Early O₂ therapy .
- Mechanical ventilation (10–40% of patients).
- Steroid
- FES usually resolves within 7d.

Cement implantation syndrome :

1

Bone Cement has been used extensively in orthopaedic surgery for 30yr.

Its use is associated with the potential for hypoxia, hypotension, and CVS collapse and Fatal cardiac arrest .

Caused by fat embolism , Air embolism , direct effect of cement
That cause mast cell stimulation and Histamine release ,
vasodilation and sever hypotension .

Cement implantation syndrome

Prevention and treatment :

2

- Suction applied to the bone cavity to evacuate air and fat during cement insertion .
- Measure BP frequently during this time (α -agonists if hypotension) .
- Ensure adequate blood volume prior to cementing(IV Fluid Preload).
- Increase FiO₂ (hypoxia common).
- Stop N₂O.

Tourniquets :

1

Used to produce a bloodless field.

- Only pneumatic tourniquets should be used
- Expressive exsanguination using an **Esmarch bandage** is contraindicated in cases **of tumour or severe infection and DVT if suspected (Risk of fatal PE)** .
- Avoid in severe crush injuries.
- SCD: use of tourniquets is controversial.
- Peripheral arterial disease is a relative contraindication

Tourniquets :

2

Site of application :

- The upper arm and Thigh

Pressure setting :

- Upper limb : systolic BP + 50mmHg
- Lower limb : twice systolic BP

Tourniquet time :

- Notify the surgeon at 1hr
- 2hr Maximum

Tourniquet pain :

After 30–60min of cuff inflation, a patient may develop an increase in HR and diastolic BP. This response results from 'tourniquet pain'

Resistant to analgesic drugs and increased depth of anaesthesia.

β -blockers **labetalol**, may be useful.

Esmarch Bandages



Pneumatic Tourniquets :



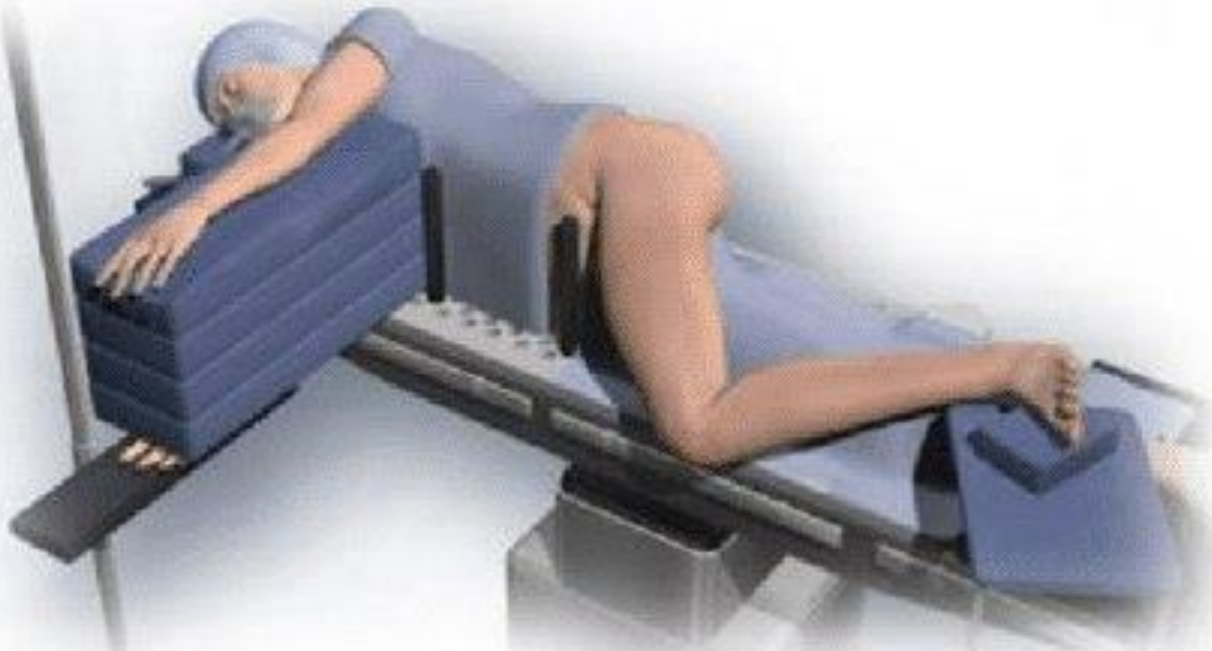
**Expressive
exsanguination
using an Esmarch
bandage**



Total hip replacement :

Procedure	Prosthetic replacement of femoral head and Acetabulum
Time	90–120min
Pain	++++
Position	Lateral or supine
Blood loss	300–500mL,
Practical techniques	Spinal with sedation or GA/LMA ± nerve block

Hip surgery Position



Total knee replacement :

Procedure	Prosthetic replacement of the knee joint
Time	1–2hr
Pain	+++++/+++++
Position	Supine
Blood loss	Minimal with tourniquet, 250–500mL without.
Practical techniques	Spinal plus local infiltration. GA plus local infiltration Epidural or combined spinal/epidural ± LMA

Another Surgery :

Arthroscopic lower limb procedures

Cruciate ligament repair

Ankle surgery

Compartment syndrome :

1

Compartment syndrome arises when the circulation and tissues within a closed space are compromised by increased pressure.

Ischaemia, necrosis, and loss of function result, further increasing compartmental pressure. Damage can become irreversible after only **4hr**

Compartment syndrome is a **serious limb-threatening condition**, which may also lead to systemic organ dysfunction if incorrectly managed.

Compartment syndrome :

2

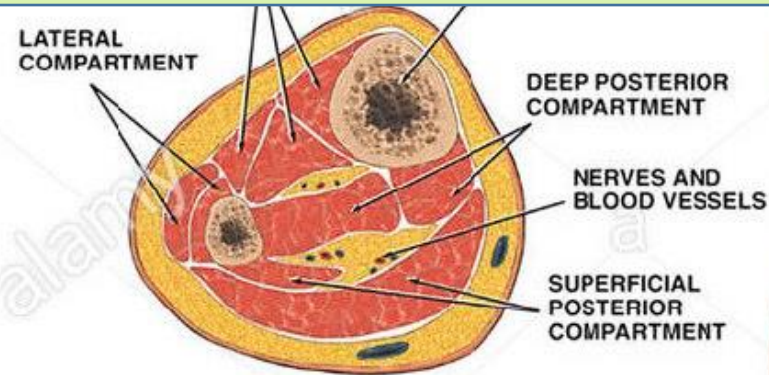
It should be anticipated in any significant limb injury, with or without fracture, especially in crush situations. It can also be caused by tourniquets, malpositioning in theatre, systemic hypotension, haemorrhage, oedema, and direct injection of drugs .

Early diagnosis and treatment are vital. **Urgent fasciotomy** may be required.

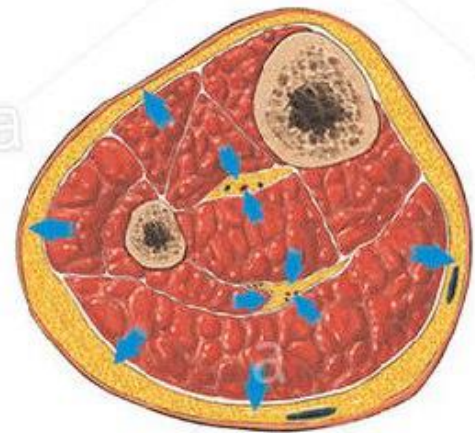
Compartment syndrome



Fasciaotomy for Leg Compartment



CROSS-SECTION THROUGH CALF SHOWING MUSCLE COMPARTMENTS

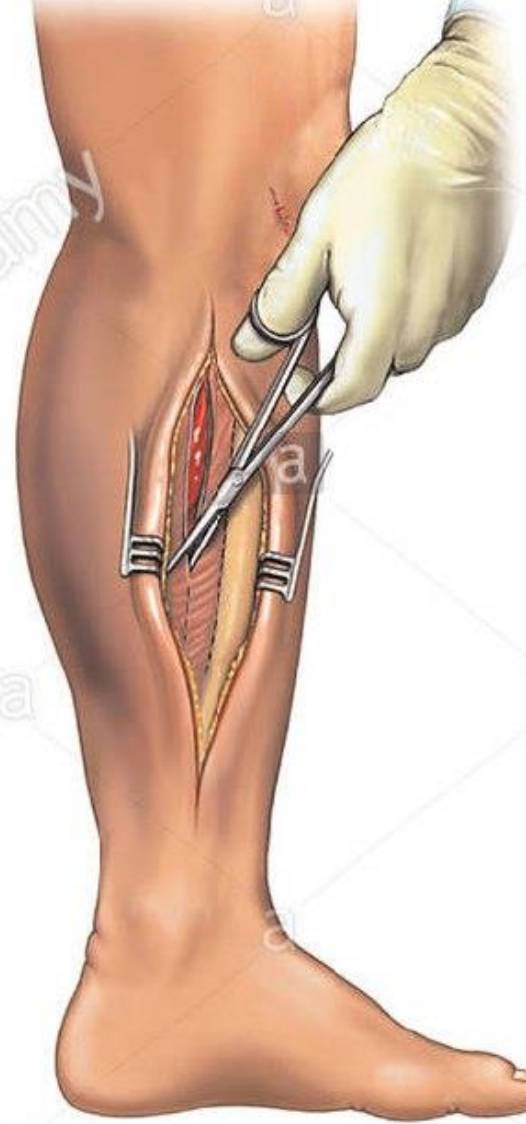
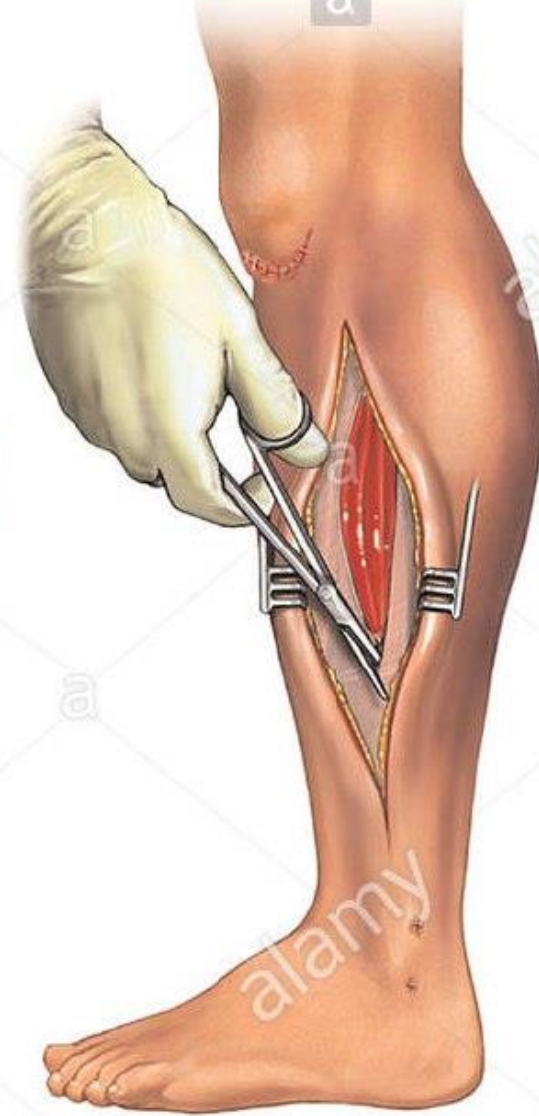


COMPARTMENT SYNDROME: SWELLING OF MUSCLES CAUSING COMPRESSION OF NERVES AND BLOOD VESSELS

INCISIONS ARE MADE IN THE LOWER LEG, PARALLEL TO THE ANTERIOR MEDIAL GAITER.

B. THROUGH THE LATERAL INCISION, THE FASCIA OF THE LATERAL AND ANTERIOR COMPARTMENTS IS INCISED.

C. THROUGH THE MEDIAL INCISION, THE FASCIA OF THE SUPERFICIAL AND DEEP POSTERIOR COMPARTMENTS IS INCISED.



Compartment syndrome

Signs and symptoms :

3

- Pain, mainly over the affected compartment, worsened by passive stretching of the muscles
- Tense swelling over the compartment, with drum-tight fascia/skin
- Paraesthesiae in the distribution of nerves traversing the compartment
- Weakness or paralysis of the limb is a late sign
- **Distal pulses** are usually present.

Compartment syndrome

Special considerations :

4

- Keep the limb at the level of the heart. Avoid elevation, as this may decrease perfusion below critical levels.
- Release all constricting bandages, dressings, or casts encircling the limb. If this does not rapidly relieve symptoms, urgent surgical fasciotomy will be required to save the limb.
- After fasciotomy, the limb should be splinted to prevent contractures, and the fracture stabilized to prevent further bleeding.
- Ensure the patient is well hydrated and has a good urine output. Myoglobinuria is maximal after reperfusion.

Compartment syndrome

Regional anaesthesia :

5

Avoid local blocks or epidurals if the patient is at risk of developing compartment syndrome, as the analgesia will mask early signs.

The cardinal symptom is pain, and this occurs early in the syndrome.

Spinal surgery

Definition :

1

- Surgery on the spinal column between the atlanto-occipital junction and the coccyx.³⁰
- Can be loosely divided into four categories :
 - Decompression of the spinal cord and nerves .
 - Stabilization and correction of spinal deformity .
 - Excision of spinal tumours .
 - Trauma .

Spinal surgery

General principles :

2

Children present for scoliosis surgery, young and middle-aged adults for decompressive surgery, and older patients for stabilization.

- Most procedures are in the prone position .
- Airway access will be limited during surgery and must be secure.
- Prevent excessive abdominal or thoracic pressure due to incorrect patient positioning, which may compromise ventilation and circulation.
- Surgical blood loss can be considerable.
- Long procedures necessitate active prevention of heat loss.
- Assessment of spinal function may be required during the procedure.

Spinal surgery

The prone position :

3

A specially designed mattress, allowing unhindered movement of the abdomen and chest (e.g. a Montreal mattress), should be used to minimize complications, as outlined below :

- Turning the patient from prone to supine requires log rolling by a trained team to avoid applying twisting forces in the axial plane.

Spinal surgery

The prone position :

4

- Pressure on the abdomen applies pressure to the diaphragm and increases the intrathoracic pressure, which, in turn, decreases thoracic compliance. This can lead to basal atelectasis and the need for higher lung inflation pressures, particularly in obese patients .
- Raised intra-abdominal pressure also compresses veins and decreases venous return, which may result in hypotension or increased venous bleeding from the surgical site .

Spinal surgery

The prone position :

6

- Accurate assessment of the circulation with invasive arterial monitoring and an indwelling urinary catheter is recommended for all major procedures .
- Peripheral pressure areas are at particular risk in the prone position. Pillows and silicone pads should be used judiciously to protect all areas. Ensure that the breasts and genitalia are not trapped. During long cases. Pay particular attention to the nose, eyes, chin, elbows, knees, and ankles.
- The arms are usually placed 'above the head' which puts the brachial plexus at risk of stretching or being pressed against the mattress. Ensure that the axillae are not under tension after positioning.

Spinal surgery

Anaesthesia :

7

- Secure venous access is vital. It may be difficult to access the cannula, so an extension with a three-way tap is recommended.
- Choice of anaesthetic will be dictated by personal experience, but most will choose an IV induction with muscle relaxation and opioid supplementation. Both low-flow volatile anaesthesia and TIVA are frequently used. Remifentanyl is useful perioperatively

Spinal surgery

Anaesthesia :

8

- If spinal cord integrity is at risk during surgery, it may be necessary to use spinal cord monitoring. This is a specialist service provided by a neurophysiologist but may require that muscle relaxation is allowed to wear off. It may be necessary to deepen the anaesthesia during this phase, but, in reality, this is rarely a problem.

Somatosensory evoked potential monitoring is the most commonly employed technique. Intra-operative monitoring has superseded the '**wake-up test**' when patients were woken in the middle of surgery and asked to perform simple motor functions before being re-anaesthetized.

Spinal surgery

Anaesthesia :

9

- In patients with paraplegia or other large areas of muscle denervation (2d to 8 months), **suxamethonium** should be avoided.
- Check the position of the ETT when the patient has been turned. Check that ventilation is adequate, without excessive inflation pressures .
- Hypotensive anaesthesia may reduce blood loss during major spinal surgery. The MAP should be maintained at a safe level—for normotensive patients >60mmHg
- Most procedures will necessitate opioids. PCA morphine .

Spinal surgery

Anaesthesia :

10

- Airway access is likely to be limited once the procedure has started, so securing oral endotracheal intubation with a non-kinking tube is usual. Patients with unstable necks due to trauma or RA can be intubated using AFOI or with manual in-line stabilization, depending on the degree of instability and the anticipated difficulty of intubation .The tube should be moulded around the face, with no bulky joints adjacent to the skin. A throat pack may be used to decrease the flow of secretions onto the pillow, and the tube then secured with adhesive tape or film. Attention to detail and the use of padding are vital to protect pressure areas

Anaesthesia in spinal cord lesions

Pathophysiology of spinal cord injury :

1

Spinal injury can be divided into three distinct phases:

- **The initial phase:** very short (minutes) period of intense neuronal discharge caused by direct cord stimulation. This leads to extreme **hypertension and arrhythmias**, with risk of LV failure, MI, and pulmonary oedema. Steroid usage in acute spinal cord injury remains controversial. If used, steroids must be given within 8hr of injury, in high dosage (e.g. 30mg/kg of methylprednisolone)

Anaesthesia in spinal cord lesions

Pathophysiology of spinal cord injury :

2

- **Spinal shock** follows rapidly and is characterized by **hypotension and bradycardia due to loss of sympathetic tone**. It is commonest after high cord lesions (**above T7**). There is associated loss of muscle tone and reflexes below the level of the lesion. Vagal parasympathetic tone continues unopposed, causing **profound bradycardia or asystole—especially on tracheal suction/intubation**. This phase may last from 3d to 8wk. Paralytic ileus is common

Anaesthesia in spinal cord lesions

Pathophysiology of spinal cord injury :

3

- **Reflex phase:** as neuronal 'rewiring' occurs, efferent sympathetic discharge returns, along with muscle tone and reflexes.

Anaesthesia in spinal cord lesions

Systemic complications of spinal cord lesions :

4

- Reduced blood volume
- Profound postural hypotension
- Lesions above C3—apnoea.
- Lesions at C3/4/5—possible diaphragmatic sparing, some respiratory capacity.

Initial lesions may progress in height with shock and oedema, with recovery as the oedema improves, leading to a marked improvement in respiratory capacity.

Anaesthesia in spinal cord lesions

Systemic complications of spinal cord lesions : 5

- Below C5—phrenic sparing, intercostal paralysis. Recruitment of accessory muscles is necessary to improve respiratory capacity (this may take up to 6 months).
- Paralysis of abdominal muscles severely affects the ability to force expiration, reducing the ability to cough.
- The FVC is better in the horizontal or slight head-down position due to increased diaphragmatic excursion.

Anaesthesia in spinal cord lesions

Systemic complications of spinal cord lesions :

6

- Bronchial hypersecretion may occur
- Poor thermoregulation
- Muscle spasms and spasticity
- Poor peripheral perfusion pressure sores and difficult venous access.
- Tendency to thrombosis and PE.
- There is delayed gastric emptying

Anaesthesia in spinal cord lesions

Conduct of anaesthesia :

7

Spinal shock phase :

Surgery is usually confined to the management of life-threatening emergencies and coexisting injury. Anaesthesia should reflect this.

- Severe bradycardia or even asystole may complicate intubation give atropine (300 micrograms IV) or glycopyrronium (200 micrograms IV) prior to intubation.
- Extreme care should be taken if cervical spine injury is suspected.
- Preload with fluid (500–1000mL of crystalloid) to reduce hypotension.
- Central line insertion may be necessary to manage fluid balance and guide appropriate inotrope therapy.

Anaesthesia in spinal cord lesions

Conduct of anaesthesia :

8

Reflex phase :

Previous anaesthetic history is vital—many procedures in these patients are multiple and repeated. Pay close attention to the following:

- Is there a sensory level, and is it complete? (Risk of autonomic dysreflexia is greater in complete lesions.)
- If complete, is the proposed surgery below the sensory level? (Is anaesthesia necessary?)
- Has there been spinal instrumentation? (Potential problems with spinal/epidural anaesthesia.)

Anaesthesia in spinal cord lesions

Conduct of anaesthesia :

9

Reflex phase :

- Is the cervical spine stable/fused/instrumented? (Potential intubation difficulty.)
- Is postural hypotension present? (Likely to be worsened by anaesthesia.)
- Is there a history of autonomic dysreflexia (paroxysmal sweating and/or headache), and, if so, what precipitated it?
- In cervical lesions, what degree of respiratory support is necessary?
- Are there contractures or pressure sores?

Anaesthesia in spinal cord lesions

Is anaesthesia necessary ? :

10

In principle, if the planned procedure would require anaesthesia in a normal patient, it will be required for a cord-injured patient.

- Minor peripheral surgery below a complete sensory level is likely to be safe **without anaesthesia**.
- Even with minor peripheral surgery, minimal stimulation may provoke muscular spasm that may require anaesthesia to resolve. LA infiltration may prevent its occurrence.

Anaesthesia in spinal cord lesions

Is anaesthesia necessary ? :

11

- Care should be taken with high lesions (T5 and above) or patients with a history of autonomic dysreflexia undergoing urological procedures.
- If the decision is made to proceed without anaesthesia, IV access is mandatory, and ECG, NIBP, and pulse oximeter should be applied.

Anaesthesia in spinal cord lesions

Central neuraxil anaesthesia :

12

Advantages :

- Prevents autonomic dysreflexia.
- Unlikely to cause CVS instability, since the sympathetic tone is already low prior to blockade.
- Avoids risks of GA.

Anaesthesia in spinal cord lesions

Central neuraxil anaesthesia :

13

Disadvantages :

- May be technically difficult .
- There is difficulty in determining the success or level of blockade in complete lesions. Incomplete lesions are tested as usual.

Anaesthesia in spinal cord lesions

Anaesthesia :

14

- procedures will usually be in full neck immobilization .
- Patients for open cervical spine stabilization require either an anterior or a posterior approach .
- Perform a full neurological examination before anaesthesia to assess the level and extent of any spinal cord injury.

Anaesthesia in spinal cord lesions

Anaesthesia :

15

- **Anterior approaches** are usually performed in the supine head-up position, through an oblique incision across the anterior aspect of the neck. **The posterior approach** is performed in the prone position, using a longitudinal incision. Occasionally, fractures to C1/C2 may require an **approach through the mouth.**

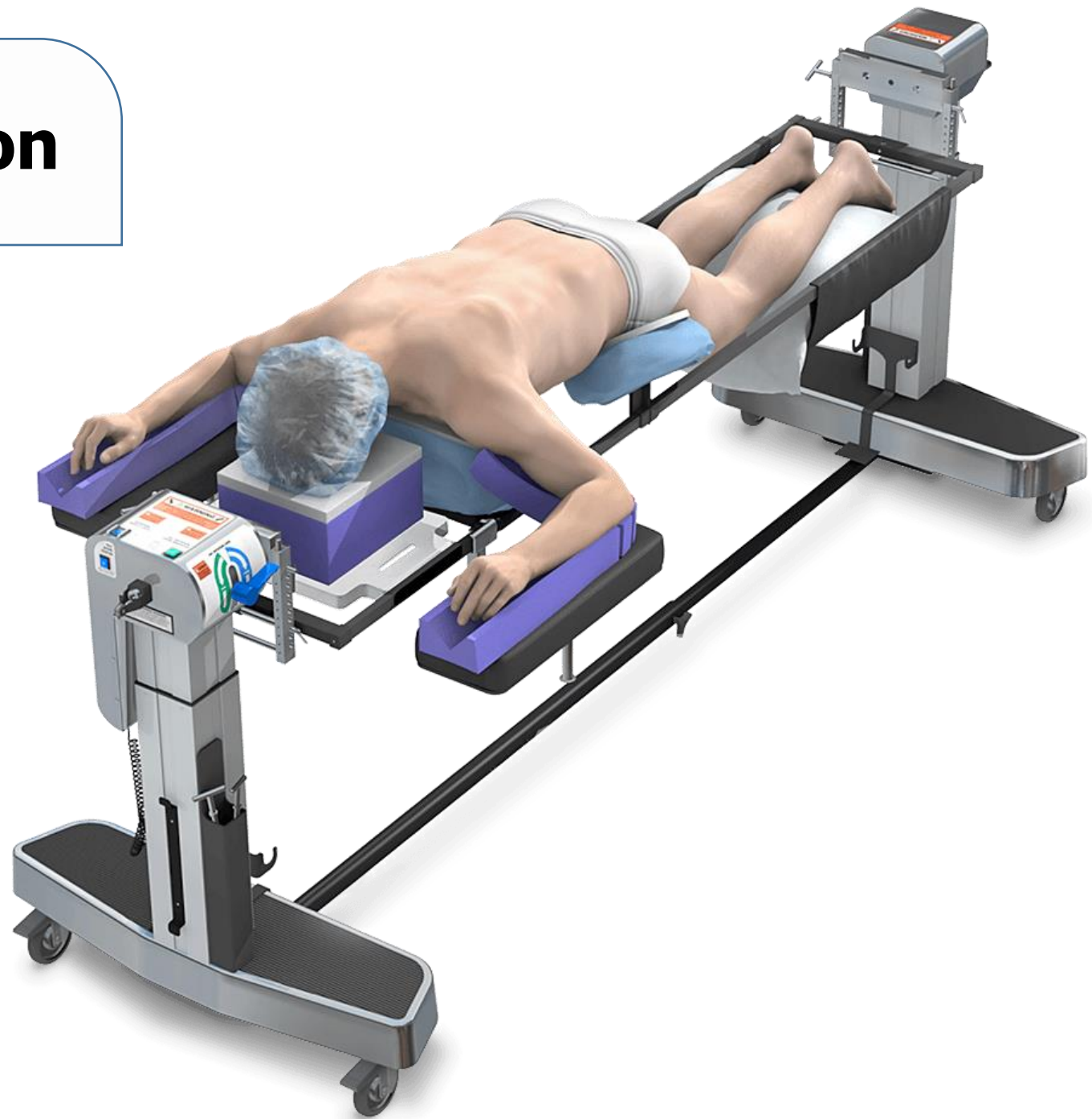
Anaesthesia in spinal cord lesions

Anaesthesia :

16

- Arterial and venous lines should be placed and must be well secured to prevent kinking. A forced-air warming system should be used, and urinary catheterization is required. NG decompression is usual for prolonged surgery or those with pre-existing spinal cord injury.
- For prone positioning, extreme care is needed during turning .

Spine Surgery Position





**Cervical Spine
Surgery Position**

Posterior Approach

Shoulder surgery

Anaesthesia :

1

- The patient is usually positioned with the head distal to the anaesthetist, requiring particular attention to the security of the airway. It is often easier to intubate the patient (south-facing Ring, Adair, and Elwyn (RAE) or armoured tube) .
- The patient may be placed supine, with head-up tilt, lateral, or in a deck-chair position.
- There is the potential for air embolus .

Shoulder surgery Position

