

# **“PERIOPERATIVE PROBLEMS IN ORTHOPAEDIC SURGERY”**

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## **INTRODUCTION :**

For the most part, patients coming to the operating room for surgery of the musculoskeletal system are typical of the surgical patient population, ranging from the young child for the correction of congenital anomalies to the octogenarian with a fracture hip and multiple concomitant diseases. The former may present with multiple anomalies necessitating special anaesthetic care, while the latter a museum of pathology, require not only careful preoperative evaluation but also a detailed understanding of pharmacokinetics and pharmacodynamics in the aged. In addition a knowledge of drug interaction is also essential because these patients often ingest a myriad of prescription and non-prescription preparations. Between these extremes is the trauma victim, the adolescent for correction of idiopathic scoliosis and the arthritic for joint replacement. Some procedures are elective, many are emergencies.

Problems of orthopaedic surgery may become complications of anaesthesia on operating table. Therefore careful history taking, detail clinical examination, lab studies, selecting correct and special anaesthesia technique can reduce the incidence of complications during orthopaedic surgeries. Some of these patients taking steroids or suffer from endocrine diseases associated with osteoporosis with increasing frequency.

## **INCIDENCE :**

Incidence of problems varies depending upon the type of surgery, type of patient, and associate co-existing diseases. Different problems incidence are mentioned in particular type of complication.

**Problems during orthopaedic surgery are –**

1. Air way management problems
2. Positioning related problems
3. Blood loss problems
4. DVT and thromboembolism
5. Fat embolism
6. Bone cement related problems
7. Problems due to anticoagulation therapy
8. Tourniquet related problems
9. Other problems –
  - a. Bradycardia / Asystole
  - b. Paraplegia during scoliosis surgery
  - c. Neuropraxia.
  - d. Postoperative delirium and confusion

So many of these complications are preventable by good anaesthetic management.

**I) AIRWAY MANAGEMENT PROBLEMS:**

There are a number of clinical situations in orthopaedics surgeries in which life threatening airway emergencies occur. First, complex airway challenges are common in orthopaedic patients. These include patients with juvenile rheumatoid arthritis, ankylosing spondylitis, or prior cervical fusion, who may be technically impossible to intubate using conventional laryngoscopy. It is vital to identify these patients preoperatively to prevent the complications of failed intubation, trauma to airway and acute respiratory distress after extubation.

**Problems :**

1. Patients with advanced rheumatoid arthritis may have C1-2 subluxation with instability of neck.
2. Uncontrolled flexion in this setting may lead to compromise of the spinal cord.

3. During spine surgery they require prone position, sometime uncontrolled flexion of the neck can result in quadriplegia.
4. Some young muscular athletic patients coming for sports – related injuries may develop acute respiratory distress after extubation and sometimes low-pressure pulmonary oedema.
5. Cricoid joint involvement decrease the glottic area.
6. Triplanar deviation
  - Displaced caudally
  - Deviated to left or rotated to right.
  - Anterior angulated airway.

Some times parasthesia and dizziness can occur due to neck movement in these patients.

Check the flexion and extension, lateral cervical spine x-ray to identify triplanar deviation.

7. Intrinsic and extrinsic airway diseases (needs pulmonary function tests).

**Prevention and management :**

- Preoperative careful assessment of the airway in an anticipated patients.
- Selection of regional techniques
- Avoiding the conventional laryngoscopies and using to fibroptic technique under light sedation.
- Careful positioning them for surgery.
- If general anaesthesia is required, it is vital to identify these patients preoperatively and to intubate them electively with the aid of fibroptic bronchoscope.
- Check the neurological function by asking move all extremities before induction.
- Acute respiratory distress after extubation will prevented by
  - Avoid intubation with conventional laryngoscopy or blind nasal intubation.
  - Careful fibroptic intubation is preferred.
  - During prone position and extended periods. Keep these patients intubated for 4 to 5 hours with head elevated position for 30° to resolve odema before extubation.
  - Some time smaller endotracheal tubes are required when glottis is narrow.

## II) POSITION RELATED PROBLEMS:

Orthopedic procedures are varied, requiring many different types of intraoperative positions. Patients' limbs may be placed into unphysiological positions for surgery that can compromise both nerves and vessels.

The following are a number of specific problems encountered during orthopedic surgery:

1. Compartment syndrome of the dependent leg during THR performed in the lateral position because of extrinsic compression over the dependent groin;
2. Brachial plexus palsy of the arms during spinal surgery in the prone position;
3. Compression by the frame of the femoral or lateral femoral cutaneous nerves of the thigh during spine surgery;
4. Postoperative blindness from compression of the eyes by a head rest when patient is in the prone position for spine surgery;
5. Brachial plexus palsy after total shoulder arthroplasty, presumably caused by stretching of the brachial plexus during surgery.

Postoperatively, application of casts and tight bandages can compress nerves or blood vessels. Abduction braces may be associated with medial or ulnar nerve palsy after shoulder surgery. This list is not intended to be complete, rather to highlight the varied nature of position-related complications in orthopedic surgery.

**Prevention :** Correct positioning, proper padding, avoid compression on eye take care about unnecessary stretching of limbs all will prevent above mentioned complications.

## III) BLOOD LOSS PROBLEMS :

In major orthopaedic procedures blood loss some time exceeds >50% of blood volume.

Eg: Extensive spine reconstruction for scoliosis  
Revision of total hip replacement  
Pelvic fracture  
Radical cancer resections.

DIC shock due to severe coagulopathy is another cause for bleeding.

### **Prevention :**

- Induced hypotensive technique
- Monitor stroke volume and filling pressure throughout the surgery.
- Homologous transfusion
- Intraoperative cell saver.

- Preoperative autologous blood donation
- Third space loss not applied in ortho surgeries
- Fat embolism – pulmonary oedema
- Unnecessary fluid administration to be avoided.
- Hypoxemia, confusion, respiratory difficulty
- Misdiagnosed as pulmonary embolism → heparinization → wound hematoma and bleeding.

#### **IV) DVT AND THROMBOEMBOLISM :**

It is a serious complication of lower extremity orthopaedic surgeries. Fatal pulmonary embolism is reported 1% to 3% of patients who did not receive prophylaxis against thrombosis often total hip replacement with the prophylaxis, the incidence of deep vein thrombosis can be reduced to as low as 20%, and fatal pulmonary embolism can be nearly eliminated.

#### **Risk factors for thromboembolism :**

- Hip and knee surgeries
- Advanced age
- Female gender
- Previous history of thromboembolic disease
- Malignant diseases
- Prolonged bed rest / immobilization
- General anaesthesia increased incidence compared to regional anaesthesia.

#### **Prevention :**

- Selection of regional anaesthesia
- Early patient mobilization
- Use of mechanical devices (eg: pneumatic compression stockings).
- Prophylactic drug therapy (most effective one)
- Application of vascular filters
- The most effective is low dose warfarin, Bleeding is also minimal
- Careful monitor of prothrombin time (PT) partial thromboplastin time (PTT), screening in high risk patients.

#### ***Pulmonary embolism :***

- PE is not a disease, complication of DVT.
- Ken Moser – substantial and unacceptable.
- Lethal condition, diagnosis missed.
- Non specific symptoms and signs.
- Untreated – die from future embolic episodes.
- Most of them die in first few hours.

- 80% death due to massive PE
- Prompt diagnosis and therapy - survival rate.
- Lower extremity # and surgeries.

***Aetiology :***

- Results from venous thromboembolic diseases.
- Verchow's triad
  - Venous stasis
  - Injury to intima
  - Change in coagulation.
- Originates from venous valves of lower limb veins.
- Also from pelvic, renal vessels RA chamber.
- Progresses platelet aggregation and fibrin deposition.
- Dislodgement leads to embolisation

***Acute consequences pulmonary embolism :***

- Acute respiratory consequences :
  - Increased alveolar dead space
  - Pneumoconstriction
  - Hypoxemia – V/Q mismatch
  - Hyperventilation
- Haemodynamic consequences
  - Increases the pulmonary vascular resistance.
  - Increase the right ventricular after load.
  - Severe increased RV after load leads to RV failure.
  - Poor cardiopulmonary status → haemodynamic collapse.

***Prevention :***

- Selection of regional anaesthesia
- Early patient mobilization
- Use pneumatic compression stockings.
- Prophylactic drug therapy (most effective one)
  - Low molecular weight heparin
  - Warfarrin therapy

- Heparin blood level 0.2 – 0.4 U/ml
- Application of vascular filters
- Monitor PT & PTT screening in high risk patients.

**Management :**

- **Thrombolytic therapy**
  - Urokinase
    - loading dose 250,000 U IV over 30 min.
    - Maintenance dose infuse 100,000 U/h IV for 12-72hr.
  - Streptokinase
    - Loading dose 2000 U/kg IV over 10 min.
    - Maintenance : 2000 U/kg/h IV for 24 hour.
- **Anticoagulant therapy**
  - Warfarrin for 3-6 months
  - Low molecular weight heparin.
- **IVC filters**

**V) FAT EMBOLISM :**

**Frequency :**

- Frequency is estimated to be 3-4%.
- Clinical diagnosis.
- Miss diagnosis due to subclinical illness.

**Mortality/Morbidity**

- The mortality rate is 10-20%.
- Patients with increased age
- Multiple underlying medical problems.
- Decreased physiologic reserve.

**History**

- Trauma to long bone or pelvis - orthopedic procedures
- Parenteral lipid infusion
- Recent corticosteroid administration

**Aetiopathology :**

- **Mechanical theory – traumatic form**
  - Large fat droplets released to venous system.
  - Deposited in pulmonary capillary blood.
  - Travel through arteriovenous shunts to the brain.
  - Microvascular lodging - ischaemia and inflammation.
- **Biochemical theory - Non traumatic form**
  - Hormonal changes due to trauma and or sepsis.
- **Causes :**
  - Blunt trauma
  - Pathological fractures Eg: DM with fracture
  - Joint reconstructions
  - Sickle cell crisis.

**Criteria for FES :**

<b>Major criteria</b>	<b>Minor criteria</b>
<ul style="list-style-type: none"><li>▪ Petechiae : conjunctiva, axilla</li><li>▪ <math>P_aO_2 &lt; 8\text{kPa}</math> (60mmHg), <math>F_iO_2 &gt; 0.4</math></li><li>▪ CNS depression</li><li>▪ Pulmonary oedema</li></ul>	<ul style="list-style-type: none"><li>• Tachycardia <math>&gt; 110</math></li><li>• Fever (Temp. <math>&gt; 38.52^\circ\text{C}</math>)</li><li>• Emboli on fundoscopic examination</li><li>• Fat in urine</li><li>• Fat in sputum</li><li>• Unexpected anemia</li><li>• Increased sedimentation rate</li><li>• Unexpected thrombocytopenia</li></ul>

- Diagnose FES : 1 major + 4 minor + fat microglobulinemia.

**SYSTEMIC CHANGES OF FES :**

**Cardiopulmonary :**

- Early persistent tachycardia
- Tachypnea, Dyspnea, hypoxia
- V/Q abnormalities 12-72 hours after injury.
- Febrile with high-spiking temperatures.

**Dermatologic :**

- Reddish-brown nonpalpable petechiae over the upper part body and axilla.
- Subconjunctival and oral haemorrhages



**Neurologic :**

- CNS dysfunction early delirium to coma.

**Prevention of FES :**

- Early rapid stabilization of fractures.
- Correction of hypovolemia.
- Drilling a small hole in the distal bone to vent fat.
- Use of an uncemented prosthesis for THR.
- Lavage of canal after each reaming
- Use of fluted rods during TKR.
- Modify the reaming techniques
- Corticosteroids as prophylaxis for FES.

**Management of FES :**

- Bronchoalveolar lavage (BAL)
- Supportive medical care
  - Adequate oxygenation and ventilation
  - Hemodynamic support
  - Blood products if indicated
  - Hydration
  - Prophylaxis for DVT
- Monitoring
  - Continuous pulse oximetry monitoring
- Surgical care
  - Reaming or nailing the marrow
  - Prophylactic placement of IVC filters

**VI) BONE CEMENT RELATED PROBLEMS :**

- Acute hypotension is common during THR.
- Sometimes intraoperative death also.
- Earlier due to toxic effects of methyl methacrylate.
- Acute hypotension - acute RVF from PE or FE.
- Insertion of long stem cemented femoral component.
- Common with long stem cemented revision THR.

- Treat with 10-50µg epinephrine
- Prevents outlet obstruction and cardiac arrest.
- Due to modern technique acute hypotension is less.

#### **VII) PROBLEMS OF ANTICOAGULATION THERAPY :**

- Receives drugs for prophylaxis against DVT/PE.
- Aspirin and NSIDS – inhibits platelets function.
- Warfarin therapy more complex.
- Estimation of prothrombin time or INR is must.
- If PT >2 seconds regional is not safe.
- LMWHS → epidural haematoma.
- During insertion catheter & during postop. analgesia.
- First RA – remove catheter – start LMWHS.

#### **VIII) TOURNIQUET PROBLEMS :**

Use of a pneumatic tourniquet to produce a bloodless surgical field places the patient at risk for complications. Certain patients, because of their size, age, or physical condition, are more likely to respond unfavorably to pneumatic tourniquet use than others. Since most complications are pressure - related, institute the following preventive measures:

- Conduct an adequate preoperative patient assessment.
- Assure an accurate pressure display.
- Use a tourniquet cuff that has the proper fit and size and can maintain occlusion of arterial blood flow at the minimum effective pressure.
- Accurately determine systolic blood pressure.
- Pay attention to tourniquet cuff pressure.
- Inform the surgeon regularly of elapsed tourniquet time.

**Tourniquet time :** Initial time 90 minutes ideal is 45 – 60 minutes. > 2 hours deflate for 5 minutes for reperfusion.

**Tourniquet pressure :**

- 50 – 100 mm of Hg above the systolic blood pressure.
- Upper limb 250 mm of Hg
- Lower limb 350 mm of hg

**Doppler occlusion pressure (DOP) :**

- Upper limb DOP + 50 mm of Hg
- Lower limb DOP + 75 mm of Hg Above the DOPR.
- Upper limb 135 to 255 mm of Hg
- Lower limb 175 to 305 mm of Hg

**Width of the cuff :**

- Standard is 8.5 cm
- 15 cm conical shaped also can be used. This type produces subsystolic pressure required to stop detectable flow.

**Ischaemic time information to surgeons :**

- First 2 hours – half hourly intervals.
- Next at 2.5 hours.
- Next every 15 minutes interval thereafter.

**Problems and Preventive Measures**

- Nerve Injury
- Post - Tourniquet Syndrome
- Intraoperative Bleeding
- Compartment Pressure Syndrome
- Pressure Sores and Chemical Burns
- Digital Necrosis
- Toxic Reactions

- Thrombosis
- Other Complications

### **Nerve Injury**

- More common with upper extremity tourniquet.
- Mild transient loss of function to irreversible damage.
- Inability to detect pain, heat, cold or pressure.
- Limb paralysis → Tourniquet paralysis syndrome.
- Radial nerve is most commonly affected.
- Motor paralysis and loss of sensation.
- May be subjected for legal action.

### **Causes**

- Mechanical stress on the nerves under the cuff or edge.
- Anoxia or ischemia of nerves under or distal to cuff.
- Slowing or cessation of sensory and motor conduction.
- Either excessive or insufficient pressure.
- Insufficient pressure is more dangerous.
- Persons with flaccid, loose skin, large amount of subcutaneous tissue and cone shaped limbs.
- Mechanical shearing force - improperly fitting cuff.

### **Preventive Measures**

- Tourniquets use only recommended time.
- Check accuracy of the pressure.
- Do not use faulty pressure gauge.
- Effective pressure to achieve limb occlusion pressure.
- Use a cuff that properly fits the extremity.
- Apply the cuff to the limb with care and attention.
- Apply the cuff at the proper location on the limb.
- Don't apply over the peroneal nerve or ulnar nerve.
- Avoid tourniquet to slip or twist - limb manipulation.
- Do not pinch or kink the connecting tubing.

### **Post - Tourniquet Syndrome**

- Prolonged postoperative extremity swelling.
- Blood return after tourniquet release (hyperemia).
- Postischemic reactive hyperemia.
- To restore normal acid base balance in tissue.
- Prolonged bleeding from surgical wound.
- Edema, stiffness, pallor.
- Weakness without paralysis.
- Subjective numbness without objective anesthesia.

### **Causes**

- Primarily due to prolonged ischemia.
- Neuromuscular injury by ischaemia.
- Prolonged tourniquets application.
- Cuff pressure insufficient to occlude arterial flow.
- Elderly patients at risk - calcification arteries.
- Rheumatoid arthritis steroid - vascular calcification.
- Due to bleeding prolonged clotting time also at risk.

### **Preventive Measures**

- Good preoperative history & assessment.
- History of steroids, aspirin & oral contraceptives.
- History of hypertension.
- Coagulation profile.
- History of thromboembolic occurrences.
- Evidence of arterial calcification.
- Strict with the recommended tourniquet time limit.
- Use arterial occlusion pressure than systolic BP.

### **Compartment syndrome**

- Relative complication of tourniquet.
- External and internal pressures on space.
- The first symptom is pain.
- Swelling of the extremity.
- Muscle weakness, paraesthesia,

- Decreased or absent pulse, tense skin.
- Some times irreversible paralysis.

## **CAUSES & PREVENTIVE MEASURES**

### **Causes :**

- Due to either trauma or surgery.
- Prolonged tourniquet time
- Decreases tissue pH
- Increase in capillary permeability
- Prolongation of clotting.

### **Preventive measures :**

- Preoperative evaluation of the patients.
- Limit tourniquet time to under 90 minutes.
- Avoid solid cast placement prior to release tourniquet.

## **INTRAOPERATIVE BLEEDING**

### **Causes :**

- An under pressurized cuff.
- Insufficient exsanguinations.
- Avoid too slow inflation and deflation.
- Improper selection of cuff.
- Excessive padding.
- A cuff that is applied too loosely.

### **Preventive measures :**

- Select the proper style and size of tourniquet cuff.
- Good exsanguinations, some times re-exsanguinations.
- Consider to Re-inflation higher pressure.

### **Toxic reactions**

- Due to local anesthetic agents during IVRA.
- In hypersensitives - symptoms immediate.
- Inadvertent bolus of LA into circulation.

- Affects CNS and heart.
- Early recognition of signs of toxicity.
- Early prompt treatment.

### **Causes**

- Failure of the technique is technical error.
- Accidental, sudden deflation of tourniquet.
- Avoid deflation too soon after injection of LA.
- Sudden release of tourniquet at the end.
- Under inflation of the tourniquet cuff.

### **Preventive measures**

- Test the tourniquet system before each use.
- Obtain a complete allergy history.
- Complete history of CVS, CNS disorders.
- Vascular problems, diabetes.
- Ensure proper size and fit of the tourniquet cuff.
- Use limb occlusion pressure as a guide.
- Use the dual bladder cuff provides a measure of safety.
- At the end use intermittent deflation and reinflation.
- Observe the patient's physiological status at all times.

### **PRESSURE SORES AND CHEMICAL BURNS**

- Pressure sores, skin blisters less with pneumatic.
- Considerable discomfort to the patient.
- Frequently in the sensitive skin of children.
- Skin injuries with/without fluid accumulation under the cuff.
- Fluid leakage, excessive pressure, excess tourniquet duration or combination.

### **Causes**

- Skin breakdown, friction, or soft tissue folding.
- Inadequate padding or faulty cuff application.
- Known with loose or thin skin.
- Obese, elderly or flabby skin patients.

- Antimicrobial preparations seeping under cuff.
- Solution is held tightly against the patient's skin.
- Preparatory solutions - delicate skin of children.

### **Preventive measures**

- Prevent preparatory solutions leak under the cuff.
- Position the cuff properly on the limb.
- Use the correct limb protection technique.
- Before application draw subcutaneous tissue/skin distally.
- Do not readjust by rotation - Already positioned cuff.
- Rotation → shearing forces → damage the tissues.

### **DIGITAL NECROSIS**

- Gangrenous destruction of a finger or toe
- Prolonged ischemia/ anoxia.

#### **Causes :**

- Penrose drain, rubber band, rolled finger of glove.
- Failure to remove the constricting device.
- Excessive, uncontrolled pressure.
- Prolonged tourniquet time.

#### **Prevention :**

- Adhere strictly to a predetermined tourniquet time.
- Avoid excessive, uncontrolled pressure – constriction.

### **THROMBOSIS**

#### **Causes :**

- DVT and associated pulmonary embolism.
- Major cause - lower extremity surgery.
- Lower extremity DVT.
- PE - Tourniquet related cardiac arrest.

#### **Preventive measures :**

- Prevent dislodgement of thrombi.
- Do not use elastic bandage for exsanguinations.



- Subtherapeutic heparinization prior to inflation.

### **TOURNIQUET PAIN**

- Most common complication in clinical practice.
- In spite of adequate anaesthesia -dull aching pain, HTN.
- Severe aching sensation at the site or distal to cuff.
- After deflation - reperfusion – different pain.
- Pain tolerance after inflation of cuff - 30min un sedate.

### **OTHER PROBLEMS :**

- Thermal Damage to Tissues.
- Hyperthermia.
- Rhabdomyolysis.
- Metabolic Changes

### **IX) OTHER PROBLEMS :**

#### **a) BRADYCARDIA/ASYSTOLE :**

- GA with vacuoronium / fentanyl combination.
- Regional – severe acute bradycardia.
- Common life threatening during regional.
- Block above T4 decrease heart rate.
- Needs beta agonists or atropine.
- Bezold-Jarisch type of reflex even below T6 block.
- Vagal mediated leads to asystole.
- Triggered by reduction in intrathoracic volume.
- Shoulder surgery - sitting - venous pooling → ↓ volume.

#### ***Management :***

- Rapid treatment is required.
- Some times death or permanent brain damage.
- Proper vigilance
- Maintain adequate – blood volume with IV fluids
- Prophylactic administration of atropine, beta agonists.
- Treat with epidrine 10-20mg, atropine 0.4 – 0.8 mg.

- Asystole treated by epinephrine, chest compression,

**b) PARAPLEGIA AND SCOLIOSIS SURGERY :**

- Tragedy, uncommon in uncomplicated cases.
- Congenital scoliosis and more severe thoracic curves.
- Spinal cord function monitor - SSEP and wakeup test.
- Hypotensive anaesthesia with MAP 60 mm of Hg.
- Facilitate optimal blood flow to spinal cord.
- Stable blood volume with CVP and urine output.
- Avoid massive blood loss.
- Care during spinal distraction.
- Maintain stable circulation.
- Invasive monitoring as and required.
- Blood transfusion as and required.

**c) NEUROPRAXIA :**

- Postoperative nerve injuries are common.
- Neuropathy, surgical injury, malpositioning or tourniquet.

***Prevention :***

- Avoid malpositioning, tight bandages or casts.
- Avoid compartment syndrome.
- Perioperative neuropraxia - anaesthesiologists concern.
- Legally shared the responsibility with surgeon.
- Medico legal problems are common.
- Preoperative nerve function assessment documented.

**d) POSTOPERATIVE DELIRIUM/CONFUSION :**

- Postoperative cognitive function disturbance - delirium.
- Confusion state 12 to 72 hrs postop. restore 2-5 days.
- Elderly with preoperative cognitive function disturbance.
- History of Parkinson's disease and alcohol intake.
- Delirium → bilateral one stage TKR.

- This is not related to type of anaesthesia
- Management is difficult
- Use sedatives, Acetaminophen.

### **SUMMARY:**

During orthopaedic surgery unusual, occasional and sometime fatal problems arises. These can be prevented by proper preoperative evaluation, selection of best anaesthetic technique suitable for the patient and particular type of surgery. This will reduce the incidence of morbidity and mortality. Whenever the require intensive management it should be provided to prevent death from fatal problems.

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