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Manual of Neurocritical Care



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CHAPTER

4 Management of Routine Postoperative Patients

4.1 ROUTINE CRANIOTOMY

Indu Kapoor, Hemanshu Prabhakar

ROUTINE POSTCRANIOTOMY MANAGEMENT

Craniotomy is the surgical procedure done for various intracranial pathologies, traumatic, or nontraumatic. Nontraumatic intracranial pathologies include different types of tumors, abscess, cysts, or metastatic lesions. Traumatic lesions include extradural hemorrhage, subdural hemorrhage, intracranial bleed, etc. The postoperative care of craniotomy patients would be the same as is with any patient undergoing craniotomy surgery for different intracranial pathologies.

INTENSIVE CARE UNIT MANAGEMENT

- *In immediate postoperative period:*
  - Assess for airway, breathing, and circulation (heart rate and blood pressure) followed by neurological examination to find out any new neurological deficit.
  - Rule out residual anesthesia effect and excessive sedation by using validated scales like Richmond agitation sedation scale (RASS) or Riker Sedation–Agitation scale (SAS).
- *Monitoring:*
  - Glasgow Coma Scale (GCS)
  - Vitals like heart rate, blood pressure, oxygen saturation, and respiratory rate
  - *Invasive monitoring:* Arterial beat-to-beat blood pressure if available
  - Temperature
  - Total intake/output.
- *Send routine postoperative blood investigations:* Hemoglobin, platelet count, coagulation profile, and renal function test with electrolytes.

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- *Imaging:* Noncontrast computed tomography (NCCT) head on day 1 or 2 (depending upon the institution protocol) to rule out the presence of any hematoma or bleed in the intracranial surgical field.
- *Sedation:*
  - Postcraniotomy patients going for postoperative mechanical ventilation require *sedation* to maintain patient ventilator synchrony.
  - Both under sedation as well as over sedation could be deleterious for the patient.
  - Commonly used sedative agents in neurointensive care unit are propofol and α-2 agonist—dexmedetomidine. Both agents have rapid onset of action and are easy to titrate.
  - Light level of sedation should be maintained in these patients, unless indicated otherwise.
  - The validated scales to assess the sedation in neurocritically ill patients are: RASS, Riker sedation score, and Ramsey sedation scale.
- *Pain management:*
  - Postcraniotomy pain is usually ignored in neurointensive care unit, despite the fact that the patients may experience mild to severe pain following craniotomy surgery.
  - Paracetamol and opioids like fentanyl are the most commonly used analgesics for postoperative craniotomy pain.
  - The intensive care personal should assess pain in these patients on a regular basis.
  - The various scores that can be used to assess the pain in neurointensive care unit are behavioral pain score (BPS), critical care pain observation tool (CCPOT), etc.
- *Deep vein thrombosis:*
  - Start prophylaxis in immediate postoperative period.
  - Amongst nonpharmacological methods, compression stockings and intermittent pneumatic compression pumps are the commonly used devices to prevent deep vein thrombosis.
  - Low molecular weight heparin or unfractionated heparin is the pharmacological methods to prevent deep vein thrombosis.
- *Nutrition:*
  - Start early *nutrition* in postoperative period.
  - Enteral nutrition is the preferred mode of nutrition.
- *Management of postoperative nausea and vomiting:* Antiemetic prophylaxis can reduce the incidence of postoperative nausea vomiting.
- Encourage early *mobilization* and early *urinary decatheterization* to improve overall outcome of the patient.
- *Postoperative seizures:*
  - Ensure adequate airway and breathing
  - Antiseizure medication

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- Rule out the possible causes for seizure
- *Immediate NCCT head:* To rule out any hematoma
- Check for electrolyte imbalance, hypoxia.

- *Look for other complications:*
  - Development of new neurological deficit
  - Pneumocephalus
  - Cerebrospinal fluid (CSF) leak
  - Hydrocephalus
  - Venous infarct
  - Hematoma formation at surgical site
  - Venous air embolism
  - Meningitis
  - Hemodynamic instability
  - Coagulation abnormality
  - Fluid overload.

USEFUL SCORES IN POSTOPERATIVE PERIOD

- *Pain assessment score:*
  - Critical care pain observation tool (CCPOT)
  - Behavioral pain scale.
- *Sedation assessment score:*
  - Richmond agitation sedation scale
  - Riker sedation agitation scale
  - Ramsey sedation scale.

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4.2 CEREBELLOPONTINE ANGLE PROCEDURES/ POSTERIOR FOSSA CRANIECTOMY

Varun Jain

CEREBELLOPONTINE ANGLE PROCEDURES

INTRODUCTION

Possible cerebellopontine (CP) angle tumors operated are acoustic schwannoma, meningioma, epidermoid tumors, arachnoid cysts, and cerebellar tumors.

HANDOVER

When receiving a patient in ICU, intensivists to ask these things in handover:	
Preoperative patient's clinical status	• Lower cranial nerve function • Gag reflex • History of aspiration pneumonia • Breathing pattern
History of raised intracranial pressure	• Hydrocephalous • Nausea/vomiting • Electrolyte imbalance
Airway details	• Mask ventilation status • CL grade in intubation
Intraoperative neurosurgical course	• Blood loss, input/output • Any major vascular or neurological structure damage • Ommaya/VP shunt/EVD placement • Bradycardia/hypertension (s/o brainstem stimulation) • Operative time

(CL: Cormack–Lehane; EVD: external ventricular drain; ICU: intensive care unit; VP: ventriculoperitoneal)

MONITORING

Clinical

- Consciousness/neurological status assessment [Glasgow Coma Scale (GCS) and motor examination] should be performed every 15–20 minutes in early 1–2 hours, then every half hourly for 4–6 hours, then hourly.
- Lower cranial nerve analysis should be done when patient is more awake and oriented. Assessment of eye movement (III, IV, and VI), corneal reflex (V and VII), eye closure (VII), hearing (VIII) and swallowing/gag reflex, and phonation (IX and X) should be done.
- Assess patient for position-related pressure sores.

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Electronic

- Electrocardiogram (ECG)
- Noninvasive and invasive blood pressure monitoring
- Pulse oximeter
- Temperature check
- Blood sugar check
- Respiratory rate monitor
- End-tidal CO_2 (if intubated)
- Intracranial pressure monitoring if external ventricular drain in situ
- NCCT/ MRI Brain (4–6 hours after surgery) if plan is to sedate and ventilate
- Hemodynamic assessment should be done every 5–10 minutes if on inotropic support; otherwise every 15 minutes in ICU.

INVESTIGATIONS

- Random blood sugar
- ABG (if on ventilator, after stabilization)
- Serum electrolytes
- Chest X-ray (if central line is inserted)
- Hemoglobin and coagulation profile (if intraoperative significant blood loss).

POSTOPERATIVE MANAGEMENT CONSIDERATIONS

- *Extubation:* In case patient is received intubated.
  - Parameters to assess before extubation are sensorium (GCS), secretions, cough, gag reflex, breathing pattern, and hemodynamic stability.
  - If gag and cough reflex are impaired then patient should be extubated when consciousness is good, otherwise there is risk of aspiration pneumonia.
  - Control emergence agitation with lidocaine
- Hemodynamic management—control BP with labetalol/nitroglycerin (NTG) infusion.
- *Pain management:*
  - Assess pain using visual analog scale (VAS) score.
  - Pain is due to excessive muscle dissection—control with paracetamol/ nonsteroidal anti-inflammatory drugs (NSAIDs).
  - Use opioids with close neurological/breathing monitoring preferably by patient control analgesia.
- Nausea/vomiting—due to vestibular n. stimulation/hydrocephalus/ hematoma/pneumocephalus. Control with ondansetron, dexamethasone, and metoclopramide.

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- Wound assessment—for blood oozing, cerebrospinal fluid (CSF) leak: CSF leak impairs would healing and increases chances of meningitis.
- Oral intake to be allowed after gag reflex and swallowing assessment.

POSTOPERATIVE COMPLICATIONS TO WATCH FOR

Neurological deterioration—acute drop in GCS	• Postoperative hematoma/seizure/tension pneumocephalus • Rx—secure airway, urgent NCCT/MRI brain to confirm hematoma or pneumocephalus, EEG, and antiepileptics loading
Neurological deterioration—gradual fall or nonimprovement in neurological status	• Hydrocephalous/vasospasm/ischemic stroke • Rx—CSF shunting (Ommaya, EVD, VP Shunt, and ETV). Hypertension (20% more than baseline BP)/ nimodipine if suspecting vasospasm
Cranial nerves palsy	• Impaired eye closure (VII nerve palsy) or sensation (V1 palsy) can lead to exposure keratitis • Rx—tear drops, eye closure, and tarsorrhaphy • Impaired swallowing/gag reflex (X nerve palsy)—risk of aspiration pneumonia • Rx—swallowing assessment and Ryles tube feed
CSF leak	• Risk of meningitis and intracranial hypotension. Wound assessment for soakage of dressing • Rx—acetazolamide and CSF diversion (lumbar drain and Ommaya drainage) may be needed. Reexploration and dural repair are needed if conservative treatment fails

(CSF: cerebrospinal fluid; EEG: electroencephalogram; ETV: endoscopic third ventriculostomy; EVD: external ventricular drain; GCS: Glasgow Coma Scale; MRI: magnetic resonance imaging; NCCT: noncontrast computed tomography; VP: ventriculoperitoneal)

POSTERIOR FOSSA CRANIECTOMY

INTRODUCTION

Posterior fossa craniectomy surgeries may be done for:

- Tumors—medulloblastoma, brainstem glioma, hemangioblastoma, etc.
- Vascular lesions—aneurysm, hematoma, and infarctions.
- Craniovertebral (CV) abnormalities—Arnold–Chiari malformation and AAD.

Besides knowing all the facts as while receiving a patient of CP angle tumor from operation theatre, intensivists should enquire a few more facts in the handover:

- Range of neck movement preoperatively, and possible neck movement postoperatively (if any CV junction fixation done).
- Intraoperative surgical position (sitting, prone, park bench position).

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- Any pressure on eyes.
- Any episode of venous air embolism.

Postoperative monitoring (clinical and electronic), management, and investigations needed are similar to that of CP angle tumors patient.

Posterior fossa operated cases must be monitored in ICU for at least 12–24 hours.

Pain is usually more and severe as compared to supratentorial surgery due to muscle dissection and neck movement. Opioid (fentanyl)-based patient controlled analgesia is effective.

Full Outline of UnResponsiveness (FOUR) score which encompasses eye response, motor response, brainstem reflexes, and respiration is better in predicting outcome.

POSTOPERATIVE COMPLICATIONS TYPICAL TO POSTERIOR FOSSA SURGERIES

Hydrocephalus (HCP)	• Approximately 80% of children having posterior fossa tumor (brainstem gliomas, medulloblastoma, and ependymoma) have HCP • Mostly obstructive • Diagnosis—nonimprovement in sensorium or fall in GCS, nausea/vomiting. NCCT head is confirmatory • Rx—acetazolamide/furosemide/mannitol, lumbar drain as temporary measure. Approximately 25% of cases need CSF shunting postoperatively
Pseudomeningocele/ CSF leak	• Major concern • Confirm water tight closure of dura during surgery. Intraoperative cranioplasty with replacement of bone flap is protective • Diagnosis—soakage of wound dressing, bulge in post-operative site. NCCT head and rarely CT myelography may be needed • Rx—acetazolamide, CSF diversion (Ommaya drainage/ lumbar puncture/drainage) • CSF analysis to rule out meningitis • Prolonged antibiotic coverage necessary
Aseptic meningitis	• Due to blood and degradation products in subarachnoid spaces or ventricles • Occurs by 3rd–5th day, incidence of 2% • Manifests as low grade fever, headache, meningism with negative CSF culture • Rx—treated with small period of steroids with repeated lumbar punctures • It may take several weeks to settle

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Pneumocephalus	• Presentation as delayed recovery, neurological deficits, headache, confusion, agitation, and seizures • Diagnosed by NCCT head • Treatment is oxygen supplementation (high FiO_2), rarely twist drill and aspiration of air (in case of tension pneumocephalus)
Respiratory insufficiency	• Mechanical airway obstruction due to macroglossia or airway edema resolves in a days time with neutral upright head and neck position • Rx—intubation and mechanical ventilation for 1–2 days may be needed • Low GCS, cranial nerve dysfunction (IX, X cranial nerve palsy) may interfere with airway patency. Manifests as impaired gag/cough reflex • Rx—these patients need ENT evaluation of vocal cord function and sometimes tracheostomy
Cranial nerve palsies	• May be temporary due to retraction injury • Partial due to disruption of blood supply, or permanent due to direct injury • Cranial nerve III, IV, and VI compromise can lead to diplopia • V1 and VII cranial nerve injury can lead to exposure keratitis. Rx—tear drops and eye closure. Short course of steroid therapy (dexamethasone or methylprednisolone) • Lower cranial nerve injury can impair swallowing and airway patency. Swallowing assessment should be done by a dedicated physician
Cerebellar mutism	• Comes on Day 1–4, incidence is 2–40% • Likely after resection of vermian tumors or cerebellar arteries vasospasm • Posterior fossa syndrome—emotional lability, ataxia, and hypotonia—due to disruption of dentato-thalamo-cortical outflow tract • Prognosis is usually good but speech may return after several days

(CSF: cerebrospinal fluid; ENT: Ear, nose, and throat; GCS: Glasgow Coma Scale; FiO_2: fraction of inspired oxygen; NCCT: noncontrast computed tomography)

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4.3 SITTING POSITION PROCEDURES (SUPRACEREBELLAR INFRATENTORIAL)

Charu Mahajan, Indu Kapoor

INTRODUCTION

Sitting position is used in neurosurgery for:

- Cerebellopontine angle tumors.
- Infratentorial tumors—sitting position is the preferred position for *pineal region* and *posterior third ventricle tumors.*
- Cervical spine surgeries.

Advantages of sitting craniotomy:

- Decreased risk of bleeding
- Decrease in intracranial pressure
- Improved surgical field
- Better cranial nerve outcome
- Improved respiratory mechanics
- Better access to patient's airway.

SPECIFIC NEUROINTENSIVE CARE UNIT (NICU) MANAGEMENT OF PATIENTS AFTER SITTING CRANIOTOMY

- *Mechanical ventilation* with *analgosedation* may be indicated in cases with:
  - Poor preoperative neurological status
  - Involvement of lower cranial nerves
  - Prolonged surgery
  - Venous air embolism (VAE)
  - Massive blood loss
  - Hypothermia
  - Metabolic and electrolyte derangement
  - Delayed/inadequate recovery from anesthesia
  - Suspicion of large pneumocephalus
  - Anticipation of surgical complications
- *Monitoring:* Monitor
  - Glasgow Coma Scale (GCS)
  - Look for any new neurological deficits
  - Vitals [heart rate (HR), blood pressure (BP), oxygen saturation (SpO_2), end-tidal carbon dioxide ($EtCO_2$), and central venous pressure (CVP) advanced monitoring if needed]

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- Check gag and cough reflex
- Intake/output
- Temperature

- *Postoperative lab tests:* Hemoglobin, platelet count, coagulation profile, electrolytes, and arterial blood gas (for ventilated patients)
- Insert Ryle's tube (if gag and cough impaired or swallowing reflex absent)
- Nutrition and bowel care
- Deep venous thrombosis prophylaxis
- *Medications:* Analgesics, proton pump inhibitors, and antibiotics; rest symptomatic treatment.
- *Imaging:*
  - Chest X-ray to confirm correct placement of central venous line and to look for any other complications
  - Rule out pulmonary edema post-VAE
  - Postoperative CT head to be done
- *Electrocardiogram (ECG):* In cases where VAE has occurred intra-operatively, look for ST-T wave changes postoperatively.

Complications to be Observed for

- *Deterioration in neurological status*
- *Hemodynamic instability*
- *Impaired cough and gag reflex:*
  - These patients require good chest care and implementation of cough augmentation techniques.
  - Pooling of secretions and respiratory infection can lead to extubation failure and reintubation—leads to prolonged mechanical ventilation.
  - If no improvement, tracheostomy needs to be done, followed by weaning from ventilator.
- *Stigmata of VAE and Paradoxical air emboli:* This can involve central nervous, cardiovascular, or pulmonary systems.
  - Fundoscopic examination of retinal vessels shows presence of air bubbles which confirms the occurrence of cerebral air embolism.
  - Neurologic deficit from cerebral ischemia, increase in ICP and even cerebral infarct can occur. These patients require ventilation with 100% oxygen for faster clearance of cerebral air. Hyperbaric oxygen therapy if available should be started as soon as possible.
  - Air present in pulmonary circulation can lead to development of pulmonary hypertension and pulmonary edema which can be appreciated on postoperative chest X-ray. The perfusion defects can result in compromised oxygenation.
  - Air in coronary vessels or even hypotension can lead to myocardial ischemia which may be evident as ST-T wave changes on ECG. The

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pulmonary hypertension can result in right sided heart strain and right ventricular failure.
- Postoperative CT head, chest X-ray, and ECG are routinely done to look for new changes.
- Management is supportive with administration of oxygen therapy, maintenance of blood pressure and small doses of diuretics for pulmonary edema.
- *Platelet count:* VAE is known to cause thrombocytopenia and platelet dysfunction.

- *Pneumocephalus:*
  - Clinical features are headache, confusion, seizures, neurological deficit, and failure to regain consciousness after anesthesia.
  - Postoperative head CT scan shows presence of intracranial air.
  - Management includes administration of 100% oxygen with nursing in flat head position.
  - Tension pneumocephalus is apparent as *Mount Fuji* sign on noncontrast computed tomography (NCCT) and poses significant risk of brain herniation.
  - Requires immediate twist drill and evacuation of intracranial air.
- *Macroglossia:*
  - Obstruction of venous and lymphatic drainage of tongue due to extreme flexion of the head or use of oral airways for long duration results in macroglossia.
  - Can lead to obstruction of the airway postextubation.
- *Mid-cervical quadriplegia:*
  - Results from extreme flexion of head that result in stretching of the cervical spinal cord, especially in those who have associated cervical stenosis or had decreased intraoperative cerebral blood flow.
  - Care taken during positioning and avoidance of hypotension can help in its prevention.
  - Evoked potential monitoring can help in early detection of cord ischemia and thus prevention of such a complication.
- *Peripheral nerve injuries:*
  - Brachial plexus injury—this is caused by inadequate support to the hanging arm.
  - Common peroneal nerve injury—this occurs due to nerve compression at neck of fibula, resulting in foot drop.
  - Sciatic nerve injury—the hyperflexion of the thigh can lead to stretching and injury to the nerve.
- *Subdural hemorrhage:* This happens due to mechanical displacement of brain and tearing of bridging veins. This can be seen in postoperative CT head.

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- *Other surgical complications* like hematoma, cerebellar edema, hydrocephalus, wound infection, CSF leak, meningitis, venous infarct, and cranial nerve palsies can also occur.
- *Cerebellar mutism:* Decrease in speech, hypotonia, ataxia, and emotional instability seen due to injury to vermis.
- *Other rare complications* such as acute parotitis and anosmia have also been reported.

Patients with lower cranial nerve palsies, impaired neurological status, having large infarcts usually remain intubated for long times. This set of patients requires tracheostomy before they can be gradually weaned off the ventilator.

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Manual of Neurocritical Care

This book presents a ready-reckoner for the practicing intensivists in the field of neurocritical care, offering insights into the real world clinical situations encountered in the neuro-ICU. The purpose has been to present solutions to all commonly faced problems in day-to-day management of the neuro-ICU in a comprehensive manner, enabling the intensivist to manage neuro-specific issues with utmost ease. This manual would serve as an important educational aid for the fellowship students and trainees appearing for an examination in neurocritical care, providing them quick points and concepts that need to be answered in the viva-voce.

Salient Features

- Discusses practical concepts of neurocritical care
- Focuses on the management of neurocritical care issues in a comprehensive manner
- Presents information in the form of flowcharts and algorithms, that is easy-to- read and implement
- Provides insight into all common problems in neuro-ICU, including day-to-day issues such as drop in sensorium, pupillary asymmetry, bradycardia, CSF leaks, urinary retention, etc.

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