General principles of postoperative neurosurgical care

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Learning objectives

After reading this article, you should be able to:

- appreciate the holistic approach necessary for monitoring early recovery from neurosurgery
- describe the areas of principal physiological concern after intracranial neurosurgery
- recognize the features of postoperative intracranial haemorrhage

Abstract

The primary aim of care immediately after neurosurgery is to detect and prevent neurological deterioration while supporting systemic and neurological homeostasis. A slow return to, or failure to regain, a patient's preoperative status may be due to surgical, anaesthetic or disease-related factors. A period of specified monitoring and observation by nursing and medical staff accustomed to neurosurgical and neurocritical care procedures should be planned preoperatively. In many neurosurgical cases (e.g. limited uneventful craniotomies), the period of postoperative observation required may be relatively short; however, if complicating factors such as cerebral oedema, intracranial haemorrhage, seizures or significant pre-morbid conditions are present, a period of higher dependency care over several days may be anticipated. In common with all postoperative care, safe management of the airway, weaning of ventilatory support, control of circulation and fluid balance, feeding, sedation and analgesia are the mainstays of care. A robust perioperative plan is mandatory for management of the airway, control of blood pressure, and to ensure continuation of preoperative medication. Furthermore, the plan may entail elective creation of tracheostomy and percutaneous endoscopic gastrostomy. The early postoperative neurosurgical patient continues to require a high degree of clinical vigilance.

Keywords Analgesia; consciousness; monitoring; neurosurgery; ventilation

Anaesthetic considerations at the end of surgery

The neuroanaesthetist aims to optimize the anaesthetic technique for each patient so that, upon completion of surgery, a prompt and smooth recovery of consciousness is achieved. This allows neurological assessment and the detection of intracranial or spinal cord complications at the earliest opportunity. When surgery has been conducted without general anaesthesia, or under sedation, a similar level of care provision is needed. In terms of speed of early recovery there is little practical difference between anaesthetic maintenance with sevoflurane or propofol.

Tracheal extubation

In general, the neurosurgical patient's trachea can be extubated as soon as their cardiovascular system is stable and ventilation is adequate. Unless there are extenuating circumstances (e.g. a history of gastrointestinal reflux), extubation may be performed under deep anaesthesia to prevent coughing, which will increase intracranial pressure. A head-up position at the time of extubation improves cerebral venous drainage and ventilatory function.

On occasion, the neuroanaesthetist may opt for a period of postoperative ventilation and sedation in the intensive care unit. Broadly, this occurs if:

- the ability to maintain the airway postoperatively is in doubt (e.g. following posterior fossa surgery when bulbar function may be compromised)
- the level of consciousness is likely to be depressed following the procedure
- there is a high risk of precipitating catastrophic intracranial haemorrhage or cerebral oedema during emergence.

Location and duration of postoperative care

Recovery time and location of postoperative care depends on the surgical procedure, underlying pre-morbid conditions, anaesthetic risk and expected postoperative neurological status. Patients undergoing intracranial procedures are advised to stay for at least 2–6 hours (Table 1) in a specialized and designated recovery area which conforms to Association of Anaesthetists of Great Britain and Ireland (AAGBI) guidelines[1] in respect to staffing and equipment. Operating lists must, therefore, be organized to allow for this. Following extracranial surgery, patients typically stay for shorter periods. Recovery stay is prolonged if the patient has altered neurological status, is in pain or is vomiting. Local protocols are required to ensure safe and adequate duration of recovery facility provision for 'out of hours' or unscheduled operations.

Monitoring during the postoperative period

Standard monitoring should follow the AAGBI guidelines for recovery areas. The intensity of monitoring depends on the complexity of the operative procedure and any underlying pre-morbid condition. A high degree of clinical vigilance is required for the earliest identification of surgical complications. Figure 1

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Typical guidelines for postoperative neurosurgical care

Surgical procedure	Minimum length of stay (hours)	Location
Cranioplasty	2	Specialized and designated recovery area which conform to AAGBI guidance
Insertion VP/LP CSF shunt		
Cranial biopsy		Discharge to specialized neurosurgical ward once appropriate discharge criteria have been met
Burr hole		
Deep brain stimulation electrode, movement disorders	4	
Glue embolization (AVM or tumour) and elective aneurysm coiling		
CP angle surgery		
Temporal lobectomy		
Minicraniotomy (<6 cm diameter craniotomy)		
Craniotomy	6–12	Overnight recovery or high-dependency unit
Carotid stent	12	
Coiling of ruptured aneurysm		
Subdural grid electrode insertion		
Complex spinal surgery		
Cerebral aneurysm surgery	12–24 onwards	Intensive care unit
Large meningioma		
Trans-oral procedure		
Posterior fossa surgery		

AVM, arterio-venous malformation; CSF, cerebrospinal fluid; CP, cerebellopontine; LP, lumboperitoneal; VP, ventriculoperitoneal.

Table 1

illustrates the recovery observation chart of a patient after a routine craniotomy for removal of a parietal metastasis (Figure 2). In the early recovery period he developed an acute subdural haematoma (Figure 3) which required an emergency exploratory craniotomy and evacuation.

In addition to standard monitoring, particular attention needs to be focused on airway problems, ventilation, the cardiovascular and neurological systems and temperature.

Airway problems

- A decline in conscious level (as measured by the Glasgow Coma Scale (GCS)), results in diminished airway reflexes. A patient with a GCS of 8 or less may not protect their airway; similarly, patients with lower cranial nerve dysfunction (e.g. after posterior fossa surgery) are at risk if laryngeal reflexes, cough or swallow are diminished.
- Airway obstruction may occur following surgery in the neck (e.g. carotid artery surgery, anterior cervical decompression) with obstructive haematoma, soft-tissue swelling and vagal nerve injury. Vagus nerve dysfunction may also occur following operative procedures for movement disorders. Trans-sphenoidal surgery may give rise to bleeding and blood clots in the airway, whereas trans-oral procedures may cause macroglossia and oral oedema.
- A 'difficult airway' may be pre-existing or created by occipito-cervical spine fixation, especially when combined with trans-oral surgery. In these cases, either a tracheostomy will be considered or extubation delayed until oedema has subsided. In many cervical spine patients with severe deformity tracheostomy placement and care may also be difficult.

Ventilation

- Respiratory control may be impaired as a result of posterior fossa surgery or brainstem compression. Clinically, this may manifest as irregular patterns of breathing or periods of apnoea. Monitoring in an intensive care unit and ventilatory support will be required. Arterial carbon dioxide tension must be monitored, where respiratory suppression or disturbance is suspected, significant rises will result in increases in cerebral blood volume and may raise intracranial pressure (ICP).
- Respiratory mechanics will be compromised following high spinal cord injuries, or with some underlying neuromuscular diseases (e.g. severe muscular dystrophies). A forced vital capacity (FVC) of less than 20 ml/kg may indicate the need for admission to an intensive care unit, and when under 15 ml/kg tracheal intubation and ventilatory support is often necessary.
- Neuromuscular blockade needs to be fully reversed. Patients returning from the operating theatre have residual effects of non-depolarizing neuromuscular blockade which may consequently reduce their respiratory reserve.
- Continuous positive airway pressure (CPAP) and non-invasive ventilation may be necessary in patients with reduced ventilatory capacity, but both modes of support are contra-indicated if the surgical wound involves the nasopharynx (with potential continuity with the intracranial space, e.g. after trans-sphenoidal surgery).

Cardiovascular system

- Postoperative hypertension is avoided to minimize the risk of precipitating an intracranial haemorrhage or increasing cerebral