Postoperative care of neurosurgical patients: general principles

Gahan Bose

Astri MV Luoma

Abstract

The primary aim of care immediately after neurosurgery is to detect and prevent neurological deterioration while supporting systemic and neurological homoeostasis. Surgical-, anaesthetic- or disease-related factors may contribute to a slow return or failure to regain a patient's preoperative status. A period of specific monitoring and observation by nursing and medical staff accustomed to neurosurgical and neurocritical care procedures should be planned for the immediate postoperative period. In many neurosurgical centres the period of postoperative observation may be relatively short (e.g. limited uneventful craniotomies); however, if complicating factors such as cerebral oedema, intracranial haemorrhage, seizures or significant premorbid 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. Meticulous attention to each of these is essential in the post neurosurgical patient as poor management can profoundly affect neurological outcome. Thus 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

Royal College of Anaesthetists CPD Matrix: 3F00, 2A07

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 surgery
- recognize the features of postoperative complications specific to neurosurgery

Postoperative care of neurosurgical patients

Neurosurgery encompasses several sub-specialities and this article will focus on the postoperative care of patients undergoing intracranial and neuroradiological procedures under local anaesthesia (awake), sedation and general anaesthesia.

Gahan Bose *MBBS FRCA is a Clinical Fellow in Neuroanaesthesia at the National Hospital for Neurology and Neurosurgery, University College London Hospital Trust, London, UK. Conflicts of interest: none declared.*

Astri MV Luoma *MBChB FRCA FFICM is a Consultant Neuroanaesthetist at the National Hospital for Neurology and Neurosurgery, University College London Hospital Trust, London, UK. Conflicts of interest: none declared.*

Planning of postoperative care begins at the preoperative assessment. A detailed assessment of risk factors for postoperative morbidity should be made including surgical and anaesthesia related as well as of postoperative needs such as nutrition and analgesia. A comprehensive baseline neurological assessment must be completed. Currently there are few validated formal preoperative risk assessment tools for neurosurgery. The chosen anaesthetic technique is designed to facilitate a prompt and smooth recovery of consciousness to allow early neurological assessment. Preoperative assessment, anaesthetic technique and neurophysiology (effects of partial pressure of carbon dioxide and blood pressure on cerebral blood flow, metabolic rate and intracranial pressure (ICP)) have been discussed previously. Key aspects of postoperative care will be discussed below.

Deciding when to extubate the trachea

The majority of neurosurgical patients can be safely extubated at the end of their procedure once they are cardiovascularly stable, adequately oxygenated and ventilated, and normothermic with normal metabolic status. Neuromuscular blockade should be fully reversed prior to extubation; a significant percentage of patients returning from operating theatre have residual effects of muscle relaxants with consequent reduced respiratory reserve. Extubation should be performed in a manner that minimizes sudden increases in ICP, e.g. under deep anaesthesia or using remifentanil. A head-up position at the time of extubation improves cerebral venous drainage and ventilatory function. Coughing, hypercarbia, hypertension, seizures, hypoxia and systemic vasodialators (e.g. glyceryl trinitrate) cause a rise in ICP by increasing cerebral blood volume and metabolic rate, and should be avoided.

Careful consideration of need for postoperative intubation and ventilation should be made when:

- The ability to maintain the airway postoperatively is in doubt, e.g. compromised bulbar function following posterior fossa surgery.
- Level of consciousness is likely to be depressed following surgery, e.g. emergency surgery or intraoperative haemorrhage.
- High risk of precipitating catastrophic intracranial haemorrhage or cerebral oedema during emergence.

A multi-disciplinary team (MDT) approach to decision making should be undertaken, including neurosurgical and neurocritical care teams.

Any change in conscious level, pupillary response or the development of focal neurological signs requires urgent CT

Please cite this article in press as: Bose G, Luoma AMV, Postoperative care of neurosurgical patients: general principles, Anaesthesia and intensive care medicine (2017), http://dx.doi.org/10.1016/j.mpaic.2017.03.004

scanning of the head; the patient's airway should be secured and all precautions taken for an emergency induction of anaesthesia if indicated.

Postoperative monitoring and level of care

Most patients undergoing elective neurosurgery can be safely managed on the neurosurgical ward postoperatively. The decision for planned higher level of care depends on:

- Surgical factors: location and size of lesion, surgical approach, perioperative complications.
- Patient factors: preoperative neurological status, medical co-morbidities, anaesthesia risk. The Royal College of Anaesthetists recommends that patients with an estimated risk of death of $\geq$10% should be admitted to a critical care location.[1] Locally agreed protocols for postoperative intensive care admission should be followed.
- Anticipated postoperative needs such as management of analgesia, control of blood pressure, risk of hormonal complications e.g. diabetes insipidus.

Options for a higher level of care include 'Post Anaesthetic Care Unit' (PACU), level 2 or 3 care. Routine ward admission for patients undergoing elective craniotomy with selective ICU admission is safe; however, approximately 2% of patients may require a direct postoperative unplanned ICU admission.

Intracranial surgery is associated with significant morbidity (23.6%). The most frequent complications following neurosurgery are bleeding requiring transfusion, reoperation within 30 days of the initial operation and failure to wean from mechanical ventilation postoperatively. Significant predictors of complications include preoperative stroke, sepsis, blood transfusion, and chronic steroid use.[2] Complications (e.g. intracranial haemorrhage) are usually evident within 4 hours of surgery.[3] Patients undergoing intracranial procedures are advised to stay for at least 2–6 hours (Table 1) in a specialized and designated recovery area that conforms to the Association of Anaesthetists of Great Britain and Ireland (AAGBI) guidelines in respect to staffing and equipment. Operating lists should be organized to allow for this. Following extracranial surgery patients typically stay for shorter periods.

Recovery stay may be prolonged if the patient has altered neurological status, is in pain or vomiting. Local protocols are required to ensure safe and adequate duration of recovery facility provision, including ward discharge criteria.

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

Following a craniotomy, patients should ideally be nursed at 30° head-up for optimal ICP management. In some circumstances this may not be appropriate (e.g. chronic subdural haematoma).

Figure 1 illustrates the recovery observation chart of a patient after a routine craniotomy for removal of a parietal metastasis. This patient developed an acute subdural haematoma (Figure 2) in the early postoperative period and required an emergency re-evacuation.

Airway management

A decline in conscious level (as measured by the Glasgow Coma Scale [GCS]), results in diminished airway reflexes. Generally, patients with a GCS $\leq$8 cannot protect their airways; similarly, those 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 also occur due to blood clots in the airway following transphenoidal surgery or macroglossia because of prolonged posterior fossa surgery performed in sitting position.

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 intensive care unit and ventilator support will be required. Arterial carbon dioxide tension must be monitored carefully; significant rises will result in increases in cerebral blood volume and ICP.

Continuous positive airway pressure (CPAP) and non-invasive nasal ventilation may be necessary in patients with reduced ventilatory capacity, but both modes of support may be contraindicated if the surgical wound involves the nasopharynx, with potential continuity with the intracranial space (e.g. after transphenoidal surgery).

Cardiovascular system

Post-craniotomy intracranial haemorrhage (ICH) is associated with severely prolonged hospital stay and mortality.[4] Acute blood pressure elevations occur frequently prior to this and must be avoided. Postoperative hypertension may precipitate ICH or increase cerebral oedema by exceeding the local limit of cerebral autoregulation. It is therefore usual to continue invasive arterial monitoring during the recovery period. Common causes of systemic hypertension in the postoperative phase include acute pain, bladder sensation, shivering and hypercarbia.

Hypertension may also be a result of raised ICP and can precede a fall in conscious level and heart rate (Cushing reflex).

Strict arterial blood pressure limits are often required following aneurysm surgery or coiling to optimize cerebral perfusion. Limits depend on pre-morbid blood pressure, whether the aneurysm has ruptured and whether it is protected (coiled or clipped) or unprotected.

Manipulation of BP with use of vasopressors (e.g. noradrenaline) or hypotensive agents (e.g. labetalol) may be necessary to achieve predetermined goals. This must be accompanied and guided by neurological assessment.

Neurological system

Neurological observations should include GCS, cranial nerve function, limb power and sensation, and pupillary responses. The exact emphasis will depend on the nature of the surgery. Observations should be carried out every 20 minutes for the first 2 hours, every 30 minutes for the next 2 hours and then hourly thereafter. Patients returning to the general ward environment will initially receive half-hourly neurological observations. There

Please cite this article in press as: Bose G, Luoma AMV, Postoperative care of neurosurgical patients: general principles, Anaesthesia and intensive care medicine (2017), http://dx.doi.org/10.1016/j.mpaic.2017.03.004