REVIEW ARTICLE

Neuroanesthetic considerations for emergent extracranial surgeries: What to know?

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ABSTRACT

Neuroanaesthetic considerations in non neurosurgical cases are utmost important for the optimal management of such cases. These considerations become even more challenging in patients undergoing emergency surgeries. We have highlighted the neuroanesthetic considerations for three broad categories. The two most important considerations in this type of surgery will be the avoidance of secondary brain insult and maintenance of optimal cerebral perfusion pressure.

Key words: *Extracranial, trauma, brain tumor, pregnant, anesthesia*

INTRODUCTION

Brain is the most important and vital organ of the body and any brain pathology including head injury, tumor, etc. can alter the functions of other organs. Thus, the understanding of basic neuroanesthetic considerations in non-neurosurgical cases is utmost important for the optimal management of such cases. These considerations become even more challenging in patients undergoing emergency surgeries. We have classified them into three broad categories such as patients with head injury, patients with brain tumor, and pregnant patients with brain pathology.

PATIENT WITH HEAD INJURY

The motor vehicle accidents are common causes of significant mortality and morbidity.[1] Patients with head injury often present with other extracranial injuries which may result in poor outcome.[2] Polytrauma patients usually require surgeries including exploratory laparotomy, orthopedic or maxillofacial reconstruction. Surgical and anesthesia-induced alterations in humoral and other biochemical mediators may worsen the existing brain injury, and hence the overall outcome. This is known as second hit hypothesis.[3]

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Laparotomy

One of the common indications of surgery in blunt trauma patient is exploratory laparotomy, splenectomy/liver laceration, or intestinal injury.

There are multiple common concerns in this group, some of which include hypotension (major vessel or organ injury, hemo-pneumothorax, shock, etc.) and hypoxemia (pneumothorax, lung contusion, or significant airway trauma); these important abnormalities require utmost attention for immediate assessment and treatment. All trauma patients should be considered as full stomach (increased chances of aspiration risks). There is significant bleeding risk. Hypothermia coupled with coagulation abnormalities can worsen the homeostasis. The large fluid shift can lead to acid base and electrolyte abnormalities.

In polytrauma patients, there can be generalized increase in multiple (intraabdominal, intrathoracic, and intracranial) compartmental pressures. The associated fluid management and lung injury cause increase in intraabdominal and intrathoracic pressure that in turn leads to rise of the pressure in the intracranial compartment.[4] Hence, the decompressive laparotomy may reduce the abdominal pressure, and thus decrease the intracranial pressure (ICP). However, simultaneous decompressive craniotomy with laparotomy needs further large clinical trials to prove its effectiveness.[5] Though minimally invasive, diagnostic laparoscopy may produce catastrophic disturbances in

cerebral homeostasis.[6] Pneumoperitoneum may cause acute rise in ICP and adversely affects the outcome in head injury patients. It increases intrathoracic pressure and decrease venous return, hence increases ICP. In an animal study, the pneumoperitoneum produced rise in ICP that was independent of arterial CO2 and arterial pH.[7] However, in porcine model, the use of apneic abdominal retractors in place of pneumoperitoneum has no effect on ICP and can be used as an alternative.[8] The use of gasless laparoscopy has not been shown to increase ICP in animal model and can be the other option to be considered in the near future.[9]

Anesthetic management

The initial resuscitation (ABCs...) should follow the standard advanced trauma life support (ATLS) protocol. Cervical injury should be considered in polytrauma patients until it is ruled out.

Monitoring

Standard monitoring should include ECG, ETCO2, pulse oximetry, invasive arterial pressure, temperature, and urine output.

If feasible, all head injury patients should undergo non-contrast computed tomography (CT) scan; however, hypotensive severe head injury patient with blunt trauma abdomen requires urgent laparotomy more frequently than urgent craniotomy for intracranial bleed. The hypotensive patients who respond appropriately with primary fluid resuscitation should thereby undergo a head CT scan to rule out intracranial pathology.

ICP monitoring can be used in comatose patients who have severe head injury (Glasgow Coma Scale (GCS) <9) with abnormal CT scan or in patients with normal CT scan with two of the following features: age >40 years, motor posturing, or blood pressure (systolic) <90 mm Hg.[10] Routine monitoring in mild to moderate head injury is not recommended; however, case by case assessment may be warranted.

Other neurological monitoring techniques such as jugular venous oxygenation, cerebral oximetry, and cerebral microdialysis are being used in traumatic brain injury (TBI) patients, but their use in polytrauma patients is yet to be established.

The three most important neuroanesthetic considerations are as follows:

1. Avoidance of secondary brain injury: There is approximately 10–15% incidence of hypotension associated with isolated head injury after blunt trauma. The clinical outcome has been found to be worse with this group as compared to patients with hypotension associated with extracranial bleed.[11] Thus, hypotension is the single most important prognostic indicator. Systolic BP <90 mm Hg should be aggressively treated and cerebral perfusion pressure should be maintained between 50 and 70 mm Hg
2. Maintenance of ICP <20 mm Hg should be achieved with head-up (15°–20°) position and use of osmotic diuretics like mannitol (0.25–1 g/kg) or hypertonic saline
3. Hyperventilation in the first 24 h can aggravate preexisting cerebral ischemia, and therefore is better to avoid.

Orthopedic/maxillofacial injury

Trauma patients with orthopedic injuries comprise a group of patients who may have an associated head injury. Current search is still controversial on the management of orthopedic injuries in the presence of head injuries. A worse outcome is usually associated with secondary brain injury resulting from hypotension, hypoxia, hypo/hyperthermia, and hypo/hyperglycemia.

Timing of surgery

Spine injury

Early cervical, thoracic, and lumbar fracture fixation has been shown to improve the outcome, but the effect on neurological outcome still requires large trials.[12,13]

Long bone fractures

Many studies have shown that early fracture stabilization results in better healing, good functional recovery, decrease in incidence of fat embolism, and improvement in overall neurological outcome.[14] On the other hand, other studies of early orthopedic surgery have been associated with increased overall morbidity. Debridement and external fixation can be an alternative for primary fracture fixation.[15] However, specific decisions in these circumstances should be individualized and other factors such as age, GCS on admission, hemodynamic status, and presence of other comorbidites should be taken into account.

Maxillofacial surgery

The majority of craniofacial trauma is associated with mild TBI. A conservative approach is reasonable in simple fractures, and displaced fractures can be managed with miniplate and screw fixation.[16] In severe injury, the airway remains the priority; however, low GCS and longer duration of surgery have been associated with poor overall outcome.

Anesthetic consideration for these types of surgery includes avoidance of hypotension (rule out concealed hemorrhage), adequate pain control, early detection of compartment syndrome, meticulous use of fluids to avoid rhabdomyolysis (crush injury), and use of

antibiotics for injury-related infections, which can help to stabilize cerebral homeostasis and further control the occurrence of secondary brain injury. Regional anesthesia is contraindicated in view of raised ICP.

PATIENTS WITH BRAIN TUMORS REQUIRING EXTRACRANIAL SURGERY

Brain tumors account for approximately 80–90% of all primary central nervous tumors; however, brain metastases are more common than primary brain tumors (10:1) and occur in 20–40% of all cancer patients.[17,18] Presently, there are no consensus guidelines for anesthetic management in patients with known brain tumor for emergent extracranial surgery. The appropriate management includes a thorough systemic evaluation of every organ system, especially lungs (most common site of primary), the exact nature of brain tumor, review of treatment chart, current level of consciousness, signs of raised ICP, preoperative documentation of neurological deficits, and optimization of patient's medical status.

Investigations include complete blood count (antiepileptic-induced leukopenia and platelet dysfunctions), coagulation profile, electrolytes (H/o vomiting, use of steroids), renal and liver functions, and review of all radiological investigations including chest X-ray and CT scan.

Premedication includes continuation of morning dose of antiepileptics, steroids, antacids, antihypertensive, etc.

Goals

Anesthetic goals include smooth induction, maintenance, and recovery, along with avoidance of acute fluctuations of hemodynamics. It would be extremely important to avoid any secondary ischemic brain insults including hypoxemia, hypotension, hypercarbia/hypocarbia, hypoglycemia/hyperglycemia, and hyperthermia/hypothermia. Also, preservation of optimal cerebral perfusion pressure and avoidance of intraoperative maneuvers that increase ICP, such as Valsalva, high positive end expiratory pressure, or high intraabdominal or intrathoracic pressure, as well as maneuvers that require pneumoperitoneum, such as laparoscopic procedures, are important. At the completion of surgery, a prompt recovery and neurological assessment is warranted. If the patient requires mechanical ventilation in the postoperative period, one should always ensure an adequate sedation protocol with intermittent neurological assessment.

PREGNANT WOMEN WITH BRAIN PATHOLOGY

Recent study shows that CNS tumors are associated with increased cesarean delivery and malignant brain tumors have adverse outcome in pregnancy.[19] When pregnant women with brain pathology undergo cesarean section, appendectomy, or any other emergent extracranial surgery, it imposes significant challenges for the anesthesiologist. It requires thorough understanding of brain pathophysiology and its impact on maternal/fetal physiology. Also, the physiological changes of pregnancy can have significant effect on cerebral homeostasis.[20,21]

The anesthetic considerations would include the effect of pregnancy on brain pathology, including increased tumor vascularity and peritumor edema. The physiological changes in pregnancy increase the risk of aspiration and develop potential difficult airway problems and both may increase the chances of hypoxemia. The raised ICP and its treatment have an impact on feto-maternal outcome.

The goal for the anesthesiologist in this situation is to preserve both cerebral and uteroplacental perfusion by maintaining hemodynamic stability and preventing increase in ICP.

The anesthetic management would require general anesthesia with rapid sequence induction. Attention should be directed to proper patient positioning including left lateral tilt with slight head-up position. The availability of difficult airway equipment, invasive arterial monitoring, and intraoperative fetal heart rate monitoring are important.[22] Meticulous attention to appropriate fluid administration is important to decrease both cerebral and airway edema, yet maintaining adequate hemodynamics. At the completion of surgery, smooth and rapid emergence is warranted.

In summary, a thorough understanding and appreciation of neuroanesthetic considerations and their implications on emergency extracranial procedures can certainly impart a role toward better patient outcome. The two most important considerations in this type of surgery will be the avoidance of secondary brain insult and maintenance of optimal cerebral perfusion pressure.

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