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Editorial

A novel checklist for anesthesia in neurosurgical cases

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ABSTRACT

Throughout their training, anesthesiology residents are exposed to a variety of surgical subspecialties, many of which have specific anesthetic considerations. According to the Accreditation Council for Graduate Medical Education requirements, each anesthesiology resident must provide anesthesia for at least twenty intracerebral cases. There are several studies that demonstrate that checklists may reduce deficiencies in pre-induction room setup. We are introducing a novel checklist for neuroanesthesia, which we believe to be helpful for residents during their neuroanesthesiology rotations. Our checklist provides a quick and succinct review of neuroanesthetic challenges prior to case setup by junior residents, covering noteworthy aspects of equipment setup, airway management, induction period, intraoperative concerns, and postoperative considerations. We recommend displaying this checklist on the operating room wall for quick reference.

Keywords: Anesthesiology, Checklist, Neurosurgery, Safety

INTRODUCTION

Throughout their training, anesthesiology residents are exposed to a variety of surgical subspecialties, many of which have specific anesthetic considerations. Given the high pace of anesthesia, it can be difficult to ensure that the setup for the case is done efficiently and taking into account each aspect of a complex case. We are introducing a tool we believe to be helpful for residents during their neuroanesthesiology rotations. A checklist for neurosurgery cases could be posted on a wall of a neurosurgery-dedicated operating room for quick reference during case setup by a resident. We believe that it would reduce inadequate preparation and the stress and delays caused by missing equipment during the case.

According to the Accreditation Council for Graduate Medical Education requirements, each anesthesiology resident must perform anesthesia for at least twenty intracerebral cases.[1] Although there are no minimums for spine cases, they are even more common than intracerebral cases. At the end of residency training, residents are expected to be proficient in providing anesthesia for a wide variety of cases. Nonetheless, early in a subspecialty rotation, it may be challenging to incorporate all relevant anesthetic considerations in an efficient manner. At our institution, checklists are displayed on the wall to ensure uniform room setup in the trauma room and the obstetric operating rooms, which our residents have found helpful. We have

presented an initiative to expand such checklists to cover other subspecialties.

EVIDENCE FOR CHECKLISTS

Checklists are ubiquitously used in medicine, however, they are arguably not commonly used in anesthesia practice. There are several studies that demonstrate that checklists may reduce deficiencies in pre-induction room setup.

Thomassen *et al*. created a 26-point pre-induction checklist, which was used in 502 inductions during a 13-week study period.[8] The study identified that approximately 34% of inductions had one or more missing items, a number that decreased to near 5% by the end of the study. The implementation of the checklist did not significantly affect time to induction. The authors conclude that checklist use is possible in a hectic and stressful clinical environment, and reduces a surprisingly large number of missing items in a standard induction.[8]

Wetmore *et al*. studied a pre-anesthetic induction patient safety (PIPS) checklist in a simulation setting.[9] The PIPS checklist is a 22-point checklist developed by the Anesthesia Patient Safety Foundation. This randomized, controlled, observer-blinded trial compared the performance of 38 anesthesiology residents. The participants were sorted into two groups, one with the checklist embedded into the simulated operating room's electronic medical record, and the other group without the checklist. The study demonstrated that residents at each level of training omitted significantly fewer steps in pre-anesthetic setup when using the PIPS checklist, albeit at the expense of increasing time to induction by 1–2 min.[9]

Beck *et al*. investigated whether self-training with an electronic audiovisual checklist app on a smartphone would improve safe pre-induction setup in anesthesiology residency beginners in the first 8 weeks of their training.[3] The study demonstrated improved safety behaviors in residents using the checklist app, however, that difference disappeared after 8 weeks of training. The authors recommend the use of a self-training checklist tool in the first 3 months of the curriculum to improve safety during anesthesia inductions.[3]

NEUROANESTHESIA

To the best of our knowledge, there are no published checklists for neuroanesthesia, which has multiple considerations distinguishing it from more basic cases. We hope that our checklist can provide a quick and succinct review of neuroanesthetic challenges prior to case setup by junior residents [Table 1].

Neurosurgery cases are frequently long, positioning is prone, the head of the bed may be rotated away from the anesthesia provider, and the patient's head may be stabilized with a horseshoe or pins.[2] These aspects emphasize the importance of securing the endotracheal tube and adequate intravenous (IV) access, typically with an additional IV line (s). Most patients tend to be older and have multiple comorbidities. Tight blood pressure control tends to be particularly important, warranting placement of an arterial line, and in some cases, a central line. Vasopressor and antihypertensive drips need to be available. If extensive blood loss is expected, plans for a possible transfusion must be in place.

Table 1: Ghaly Checklist for General and Neuro-Anesthesia.

A) Preoperative
   1. Anesthesia machine checked, self-test passed
   2. Preoperative Assessment completed, medical/surgical history and laboratory values reviewed
   3. Patient consent signed, surgical site marked
   4. Preoperative medications and choice of regional blockade

B) Monitors (Connected and functioning)
   1. O2 Saturation
   2. Blood pressure
   3. EKG
   4. etCO2

   Anesthesia setup completed

C) Airway
   1. ETT/LMA checked and available (need for specialty ETT?)
   2. Head positioning optimized for intubation, preoxygenation adequate (etO2 >80%)
   3. Intubating device functioning (direct laryngoscopy, video laryngoscopy, fiberoptic awake/asleep), difficult airway backup plans
   4. Suction available and working

D) Induction and Lines
   1. IV access adequate and functioning
   2. Need for Arterial line and/or Central venous line placement
   3. Induction agents available, drawn and labelled

E) Intraoperative
   1. Patient positioning and operating room setup (prone, lateral decubitus, supine), pressure points protected
   2. Anesthetic maintenance regimen selected (volatile anesthetic, TIVA, balanced)
   3. Antibiotic of choice administered, perioperative subcutaneous heparin requested
   4. ERAS protocols indicated?
   5. Invasive and noninvasive cardiac/hemodynamic monitoring
   6. Warming: forced air blanket, fluid warmer
   7. Blood pressure parameters, pressor/antihypertensive drips
   8. Anticipated blood loss and management plans (TXA, cell saver, blood/FFP/platelet transfusion)
   9. Prophylaxis for postop nausea/vomiting
   10. Intraop and postop pain management plan selected/discussed (prn IV medications, PCA, regional blocks, neuraxial)

F) Emergence
   1. Awake or deep extubation vs keep patient intubated
   2. Need for postoperative ventilatory support (mechanical ventilation, BiPAP, High flow, nasal cannula, room air)

(*Contd...*)

Table 1: (*Continued*)

3. Postoperative Patient disposition (Phase I PACU, Phase II, medical/surgical floor, telemetry, Stepdown, ICU)
4. Post-operative blood pressure and pain control

G) Specific for Neuroanesthesia

1. Specific neurosurgery positioning requirements (head of bed, head pins, horseshoe, sitting, Jackson table)
2. Cervical spine stability/airway management (video laryngoscopy, awake/ asleep fiberoptic intubation, in-line stabilization) and post-intubation neuroassessment
3. Anesthetic Regimen (Awake, TIVA, volatile agents) and neuromuscular blockade use (can non-depolarizing paralytics be used for induction?)
4. Intraoperative fluoroscopy, IR Angiography, Navigation and other imaging modalities
5. Neuromonitoring (Awake, TCD, SSEP, MEP, EEG, EMG)
6. Air Emboli Risk (Transthoracic doppler, TEE)
7. ICP concerns and EVD management (drainage level and rate, max allowable drainage per hour)
8. Recommended PaCO2 and etCO2 level
9. Perioperative blood pressure parameters (systolic/mean), pressor/antihypertensive drips
10. IV crystalloids/colloid choice, fluid restriction indicated?
11. Specific medications and neuroprotective agents (Steroids, antiepileptics, osmodiuretics, burst suppression, hypothermia, etc.)
12. Pre-extubation neuroassement, awake vs deep extubation
13. Postop infusion drips (Nicardipine, pressors, propofol)
14. Postoperative imaging (CT, interventional neuroradiology)

H) Any Additional Requests and Concerns from the Team

EKG, electrocardiogram; etCO2, end-tidal carbon dioxide; ETT, endotracheal tube; LMA, laryngeal mask airway; etO2, end-tidal oxygen; IV, intravenous; TIVA, total intravenous anesthesia; ERAS: Enhanced Recovery After Surgery; TXA, tranexamic acid; FFP, fresh frozen plasma; PCA, patient-controlled analgesia; BiPAP, bilevel positive airway pressure; PACU, post-anesthesia care unit; ICU, intensive care unit; IR, interventional radiology; TCD, transcranial doppler; SSEP, somatosensory evoked potentials; MEP, motor evoked potentials; EEG, electroencephalogram; EMG, electromyogram; TEE, transesophageal echocardiography, ICP, intracranial pressure; EVD, external ventricular drain; PaCO2, arterial pressure of carbon dioxide; CT, computed tomography

Some neurosurgical patients have a history of prior cervical spine surgeries, making neck extension for direct laryngoscopy limited; other patients may have trauma that requires in-line cervical stabilization. These patients typically require video laryngoscopy or fiberoptic intubation.[4] Endotracheal tube (ETT) must be selected as well, such as a suctioning ETT for possible intensive care unit (ICU) admission, or neuromonitoring ETT if recurrent laryngeal nerve monitoring is expected, such as the anterior approach to the cervical spine. Other induction considerations include elevated intracranial pressure (ICP), which is a contraindication for medications such as succinylcholine and ketamine, or neuromonitoring, which precludes the use of long-acting neuromuscular blockers, as they interfere with the measurements.[5,7]

Following induction and positioning, the anesthesiologist must prepare for intraoperative use of navigation systems and imaging, as the equipment can share the space with the breathing circuit, IV lines, and monitor cords, which must be secured to prevent accidental dislodgement. Cases that require neuromonitoring or cerebral vasoconstriction may require total IV anesthesia (TIVA) as opposed to inhalational anesthesia with neuromuscular blockade.[6] Surgeons may have specific preferences regarding end-tidal CO_2 and blood pressure parameters, and some cases may require therapeutic hypothermia for neuroprotection. Many cases require administration of neurosurgery-specific medications, such as high-dose steroids, antiepileptics (levetiracetam, phenytoin), osmodiuretics (mannitol), or 3% hypertonic saline. Finally, the anesthesiologist should tailor the anesthetic plan for post-operative considerations, such as need for early neurological assessment.

CONCLUSION

Checklists have been demonstrated to improve safety and efficacy in delivery of anesthesia. They are particularly important early in training when residents lack the experience to take into consideration every aspect of a complex and challenging case. We believe that organizing typical neuroanesthetic concerns into a checklist could prove beneficial for residents, standardize operating room setups prior to cases, decrease missed items that would have to be retrieved later in the case, and improve patient safety by reducing common mistakes.

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