Unplanned Intraoperative Extubations in Pediatric Neurosurgery

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Conflicts of interest

• No financial disclosures
Unintentional Intraoperative Extubations

- Unintentional intraoperative extubations (UIEs) are rare, high-risk complications.
- UIEs should be “never” events, although there is a paucity of literature.

<table>
<thead>
<tr>
<th>Risk factors</th>
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<tbody>
<tr>
<td>Younger patients</td>
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<tr>
<td>Movement/manipulation</td>
</tr>
<tr>
<td>Procedures</td>
</tr>
<tr>
<td>Inadequately secured ETTs</td>
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Unintentional Intraoperative Extubations

• Neurosurgical procedures are unique
• Complex patient positioning
• Proximity of operative field to anesthesia

• Root cause analysis must be performed for each event to prevent future occurrences.

<table>
<thead>
<tr>
<th>Quality &amp; Safety</th>
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<tr>
<td>Prolong OR time</td>
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<tr>
<td>Require additional procedures</td>
</tr>
<tr>
<td>Increase infection risk</td>
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<tr>
<td>Potential cardiopulmonary collapse</td>
</tr>
<tr>
<td>Does not add value</td>
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Unintentional Intraoperative Extubations
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- Unintended extubations are PICU and NICU quality improvement metrics
- Correlates with longer hospital stay

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Unintentional Intraoperative Extubations

- Root cause analysis has reduced incidence of unintentional extubations in the ICU setting
  - Implementation of staff education
  - Practice guidelines

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Unintentional Intraoperative Extubations

- Unfortunately, no such quality improvement measures exist in the peri-operative setting.

- The pediatric anesthesiology service reviewed UIEs in surgical cases at Texas Children’s Hospital, a Level 1 trauma center.

- Subcategorization of neurosurgical cases were evaluated for opportunities for improvement.
Methods

• UIEs over the course of 18 months (December 2014-May 2016) were retrospectively reviewed using a single institution pediatric anesthesia department quality improvement database and a pediatric neurosurgery surgical database.

• Anesthesia departmental metrics were collected by voluntary self-reporting.

• The hospital’s “Safety Scoop” reporting system was also cross-referenced for UIEs.
Results

• Over 18 months, three cases of UIE in pediatric neurosurgical cases were identified, an event rate of less than 0.3%
Results

• Case 1
  • 16 year old pinned in lateral decubitus position for craniotomy
  • ~5 hours into surgery there was loss of end-tidal CO2
  • ETT untaped, several cm out from original position
  • Desaturation to 90%, LMA placed
  • ENT assisted with fiberoptic placement of new ETT
  • No hemodynamic instability or further complications, but an additional hour of operating time
Results

• Case 2
  • 2 month old in sphynx position for craniosynostosis repair
  • ~40 minutes after incision, loss of end-tidal CO2 noted
  • Ioban placed over incision, patient turned supine
  • ETT visualized above the glottis, easily repositioned
  • No desaturations or hemodynamic instability
Results

• Case 3
  • 11 month old in prone position for evacuation of subdural hematoma
  • Inadvertently extubated after procedure while turning from prone to supine
  • Patient ventilated with bag mask until emergence from anesthesia
  • No desaturations or hemodynamic instability
Results

• Two events occurred in patients less than 1 year of age.
• Root cause analysis identified varied etiologies of UIE
  • 2 were attributed to inadequate endotracheal tube (ETT) securement
  • 1 occurred while repositioning a patient from prone to supine at the end of the surgery
Results

Table 1: Demographics, characteristics and outcomes of UIEs at TCH

<table>
<thead>
<tr>
<th>Age</th>
<th>Position</th>
<th>Procedure</th>
<th>Method of Detection</th>
<th>Steps Taken to Reestablish Airway</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 yrs</td>
<td>Three-quarter Prone</td>
<td>Occipital Craniotomy, respective surgery</td>
<td>Loss of End-Tidal CO2</td>
<td>Placement of LMA, otolaryngology consultation, replacement of ETT through LMA</td>
</tr>
<tr>
<td>2 mos</td>
<td>Sphinx</td>
<td>Endoscopic Sagittal synostosis</td>
<td>Loss of End-Tidal CO2</td>
<td>Sterile drapes placed, patient turned supine, ETT repositioned</td>
</tr>
<tr>
<td>11 mos</td>
<td>Prone</td>
<td>Subdural hematoma evacuation</td>
<td>Visualized</td>
<td>Mask ventilated until emergence from anesthesia</td>
</tr>
</tbody>
</table>

EET = endotracheal tube; LMA = laryngeal mask airway; TCH = Texas Children’s Hospital; UIE = unplanned intraoperative extubation.
Results

• Post-operative outcomes for these patients were not different from expected
• No CPR or other aggressive measures were needed
• One patient received an additional consult from otolaryngology for replacement of the ETT
Discussion

• Ing et al reviewed 30,000 pediatric anesthesia events over three years
  • 8 inadvertent extubations (0.27%)
  • Generally during manipulation of ETT or during procedures like trans-esophageal echocardiogram

• Lee et al reviewed >150,000 anesthesia events in adults
  • 25 inadvertent extubations (0.017%)
  • Significantly less common in adults

• As with our series, age seems to inversely correlate with incidence of UIE
Unintentional Intraoperative Extubations

Crisis Checklists for the Operating Room: Development and Pilot Testing


BACKGROUND: Because operating room crises are rare events, failure to adhere to critical management steps is common. We sought to develop and pilot a tool to improve adherence to lifesaving measures during operating room crises.

STUDY DESIGN: We identified 12 of the most frequently occurring operating room crises and corresponding evidence-based metrics of essential care for each (46 total process measures). We developed checklists for each crisis based on a previously defined method, which included literature review, multidisciplinary expert consultation, and simulation. After development, 2 operating room teams (11 participants) were each exposed to 8 simulations with random assignment to checklist use or working from memory alone. Each team managed 4 simulations with a checklist available and 4 without. One of the primary outcomes measured through video review was failure to adhere to essential processes of care. Participants were surveyed for perceptions of checklist use and realism of the scenarios.

RESULTS: Checklist use resulted in a 6-fold reduction in failure of adherence to critical steps in management for 8 scenarios with 2 pilot teams. These results held in multivariate analysis accounting for clustering within teams and adjusting for learning or fatigue effects (11 of 46 failures without the checklist vs 2 of 46 failures with the checklist; adjusted relative risk = 0.15, 95% CI, 0.04–0.60; p = 0.007). All participants rated the overall quality of the checklists and scenarios to be higher than average or excellent.

CONCLUSIONS: Checklist use can improve safety and management in operating room crises. These findings warrant broader evaluation, including in clinical settings. (J Am Coll Surg 2011;213:212–219. © 2011 by the American College of Surgeons)
Discussion

• Two of three events happened in patients less than one year of age, suggesting an inverse correlation between patient age and risk for UIE

• All events happened in complex positions or during positioning, suggesting manipulation or patient movement as risk factors

• Meticulous attention to securing the ETT, as well as streamlined coordination between the surgical and anesthesia teams during high-risk parts of the procedure (turning, positioning, etc) decreases the risk of UIEs

• From this experience, we developed an operative checklist for the intraoperative emergency of UIE
Figure 1: Flowsheet for re-establishing an airway after UIE
Wake Up Safe (WUS)

- Pediatric anesthesia quality improvement initiative
- While UIE are not currently a metric, many centers are recording data to evaluate for modifiable risk factors

Suggestions for improvement

1. Nasal intubation
2. Visualization of the ETT with fiberoptic scope
3. Suturing or using adhesives to secure the ETT in place
4. Minimize patient manipulation
Discussion

- Method of securing the ETT has come under particular scrutiny
- No evidence suggesting one method to be superior
  - Tape often becomes wet with secretions and ineffective
  - Plastic devices/holders more bulky, may interfere with surgical field (especially neurosurgical procedures)
  - Sutures add risk for mobility if ETT gets caught and pulled, and also increase tissue damage
- TCH protocol includes a padded base for the ETT to rest on the patient’s chin, Mastisol and Tegaderm for additional security
Conclusion

• While rare, UIEs are emerging as a trackable perioperative complication and are a quality metric.

• Protocols for risk reduction are establishing best practices for ensuring patient safety when events do happen.

• With increased awareness, collaborative planning, and evaluation of the causes of UIEs, the incidence of UIE should further decrease.

• The ultimate goal is to prevent these events from occurring, thus increasing safety for pediatric patients.