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General Anesthesia for a Posttonsillectomy and Adenoidectomy Bleed

Cody C. Breinholt, DO*, Clark J. Obr, MD
*Corresponding author: cody-breinholt@uiowa.edu

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Abstract

Introduction: Providers at all levels should have some understanding of the pathophysiology and be able to manage such a patient in the operating room. In addition, any anesthetists providing pediatric care should be able to identify and understand the importance of other comorbid conditions in these patients. This simulation on posttonsillectomy and adenoidectomy hemorrhage in the pediatric patient presents a challenging case usually encountered in some form by most anesthesia residents during training. This simulation's objective is to challenge and further reinforce the knowledge of anesthesiology resident physicians who have completed 1 year of clinical anesthesia and at least 1 month of pediatric anesthesia. **Methods:** The simulation can be delivered in a single session of 1 hour or less. Materials in this simulation include a case template designed to provide facilitators with a general overview, a checklist of critical actions each learner should perform during the scenario, a brief summary to be provided to the learner to reinforce knowledge gained through the activity, and an evaluation form to assess the learner's view of the activity's educational value. **Results:** Learner comments were almost unanimously positive. All learners who returned surveys answered the questions "This simulation enhanced my understanding of how to manage critically ill patients in the perioperative period" and "The content was current and relevant to my practice" with either agree or strongly agree. **Discussion:** The module offers various points to practice troubleshooting skills in the management of difficult IV line placement as well as difficult airway management. In reality, this case could be modified in multiple ways, including management of a more severe hemorrhage with a much more hypovolemic patient.

Keywords

Anesthesia, Rapid Sequence Induction, Bronchospasm, Difficult Airway, Laryngospasm, Aspiration, Intraosseous Access, Pediatric Airway, Bronchial Spasm, General, Difficult Intravenous Access, Posttonsillectomy and Adenoidectomy Bleed, Laryngismus

Educational Objectives

By the end of this simulation, the learner will be able to:

1. Discuss the diagnosis and perioperative management of posttonsillectomy hemorrhage.
2. Identify primary versus secondary posttonsillectomy hemorrhage.
3. Identify expected laboratory abnormalities in an actively bleeding patient.
4. Analyze laboratory data, patient vital signs, and physical exam to diagnose volume status.
5. Propose goals of resuscitation, including correcting hypovolemia through administration of normal saline or lactated ringers solution, albumin, and/or the need for blood transfusion.
6. Discuss and manage comorbid conditions and their perioperative implications.
7. Identify a patient who has a full stomach and is at high risk for pulmonary aspiration and complications.
8. Identify and be prepared to manage a difficult airway.
9. Request appropriate consultation and aid from professional colleagues, such as making sure an ear, nose, and throat surgeon is present on induction.
10. Discuss and demonstrate preparation for emergent surgery in a non-NPO bleeding pediatric patient without an IV who is a difficult IV placement.
11. Identify the need for IV or intraosseous (IO) access prior to induction of anesthesia.

Appendices

A. Simulation Case.docx
B. Supplemental Data.docx
C. Critical Actions Checklist .docx
D. Debriefing Summary.docx
E. Evaluation Form.docx

All appendices are peer reviewed as integral parts of the Original Publication.

12. Describe special pharmacologic considerations for analgesia or light sedation to facilitate IV/IO placement.
13. Select and demonstrate proper use of necessary equipment, including ultrasound for IV access, IO kit, and proper airway equipment.
14. Discuss and demonstrate performing a rapid sequence induction along with a working knowledge of the American Society of Anesthesiologists' (ASA's) difficult airway algorithm.
15. Perform an airway exam in the emergent setting.
16. Demonstrate familiarity with and appropriate use of difficult intubation equipment and the ASA's difficult airway algorithm.
17. Discuss areas of strength and areas for improvement discovered during the simulation.

Introduction

Tonsillectomy is one of the earliest known surgeries performed (50 C.E.). Presently, obstructive sleep apnea (OSA) is the most common indication for adenotonsillectomy, which is the first-line therapy for OSA in otherwise healthy children or, often, for complex patients with comorbidities that place them at higher risk of anesthetic complications.[1] Children with OSA are at risk for postoperative respiratory complications, and children with risk factors should be admitted overnight after surgery.[1] The cure rate of OSA after adenotonsillectomy varies among studies, but in general, it is about 60%.[1] Moreover, it is important to mention that another very common indication for adenotonsillectomy or just plain tonsillectomy (without adenoidectomy) is recurrent tonsillitis.

Posttonsillectomy bleeding is a surgical emergency that can occur within the first 24 hours due to inadequate surgical hemostasis (primary) or 5 to 10 days after surgery when the eschar retracts (secondary). About 75% of postoperative tonsillar bleeding occurs within 6 hours of surgery. In 67% of cases, bleeding originates in the tonsillar fossa, 27% in the nasopharynx, and 7% in both.[2] Primary bleeding is typically more serious than secondary because it is usually more brisk and profuse. This surgical complication is responsible for converting tonsillectomies from an outpatient surgery to a hospital admission in 1.6% of cases.[3]

A bleeding tonsil situation can be challenging even for the most experienced pediatric anesthesiologist. Challenges include, but are not limited to, anxious parents; impatient surgeon; frightened anemic, hypovolemic child with a stomach full of blood; and difficult intubation due to airway swelling and blood obscuring a clear view. In addition, these patients, as discussed, are commonly being treated for OSA and often have associated obesity, which poses additional challenges, such as IV placement. As a result, this simulation was created to assist learners in developing the skills and confidence to assist with management of an emergent posttonsillectomy bleed and difficult IV access.

In creating this simulation for anesthesiology resident physicians in training, our personal experiences and those of other faculty members of the pediatric anesthesia department were used to create a framework for the proposed scenario. Anesthetic strategies for safe induction and maintenance of anesthesia in a posttonsillectomy bleed[3-6] and surgical techniques[1-2] were identified in the literature, and these publications were utilized as a framework for construction of the simulation, including details of pathophysiology and proposed management strategies.

This simulation was instituted at the University of Iowa Hospitals and Clinics for resident physicians within the Department of Anesthesiology. Residents within the program complete an intern year, which includes 1 month of neonatal intensive care unit/pediatric intensive care unit and another month of pediatric surgery training prior to the beginning of clinical anesthesiology specialty training. As first-year anesthesia residents (CA-1s), they also complete a minimum of 1 month of pediatric anesthesia prior to their second clinical anesthesia year. The results are resident physicians who are expected to have a baseline level of knowledge of the pathophysiology, associated comorbidities, and management associated with a posttonsillectomy hemorrhage.

This simulation is designed to be no longer than a 1-hour session using the SimMan (Laerdal Medical, Stavanger, Norway) medical simulator connected to standard monitors. The simulation can be proctored by a single instructor with the help of a technician for the high-fidelity medical simulator. Vital signs are provided throughout the simulation via the monitors connected to the simulator; laboratory results are provided to the learner by the instructor. The SimMan provides practical, real-time vital signs and enables troubleshooting that cannot be provided by a problem-based learning style question-and-answer session.[7]

Methods

Educational Approach

Along the path of every medical and health care professional's journey, medical training will transform into a live patient. Moreover, patient safety and quality of care are paramount and are being evaluated and stressed more and more in an ever-evolving health care environment. Balancing these two areas can result in an ethical dilemma, and simulation-based medical education can help mitigate this tension by developing and fine-tuning health care professionals' knowledge, skills, and attitudes all while protecting patients from unnecessary harm or risk. Recently, both US federal policy agenda and the international patient safety movement have become much more receptive to simulation-based medical education. They stress that there is an ethical imperative to first do no harm in the face of verified, large epidemiological studies that describe unacceptable preventable injuries to patients from medical mismanagement.[8]

For the majority of anesthesiology residents, experiencing the stress of a high-acuity emergency situation in an obese pediatric patient with a primary posttonsillectomy and adenoidectomy bleed and a difficult IV access through this simulation is of high value and additive to the knowledge gained through didactic sessions, textbook reading, and real-life experience of this critical scenario. Because of the facilities and resources available at the University of Iowa Hospitals and Clinics Department of Anesthesiology, this core simulation was intended and designed to provide experiential learning regarding posttonsillectomy and adenoidectomy hemorrhage in an otherwise low-risk simulation environment.

Equipment/Environment

This simulation (Appendices A & B) is designed to be implemented on a high-fidelity simulator for improved efficiency and realism, so access to a SimMan or other comparable medical simulator would be advantageous. To make the simulation optimal and as realistic as possible, we have included real-time vital sign monitoring with noninvasive as well as invasive arterial blood pressure monitors; capnography; pulse oximetry; electrocardiography; temperature probe; airway supplies including conventional laryngoscopes, videoscopes, supraglottic airways, and endotracheal tubes for securing the pediatric airways; and a variety of pre-prepared syringes labeled propofol, succinylcholine, rocuronium, fentanyl, lidocaine, ketamine, etomidate, midazolam, ephedrine, atropine, and glycopyrrolate to simulate medication administration. The environment is set up to mimic that of an operating theatre with all associated supplies, again to impart a degree of realism to the simulation.

Personnel

In addition to the facilitator who is instructing the simulation, it is favorable to have a technician for the medical simulator to provide changes in patient status and vital signs in real time as the simulation is being played out. It is recommended that the instructor and technician discuss the case in its entirety before the simulation is performed to improve communication and coordination between team members.

Assessment

Trainees during the simulation should be evaluated on items that are critical and essential for safe anesthetic care. This includes, but is not limited to, identifying that the patient has a full stomach and needs a rapid-sequence induction. IV placement prior to induction is paramount, and being prepared and putting into practice the American Society of Anesthesiologists' difficult airway algorithm is vital. It will be imperative for the trainee to recognize and avoid critical pitfalls during the anesthetic. The critical actions checklist (Appendix C) was generated as a guide in the evaluation process for this simulation. The

objective is to identify essential steps in caring for the simulated patient. The checklist is meant to be a guide, and the clinical judgment of the facilitator should direct any modifications based on institutional protocols.

Debriefing
At the conclusion of this case, we suggest the learner first be given the opportunity for self-reflection and a chance to ask the facilitator questions. Afterwards, we encourage the instructor to discuss the critical action checklist with the trainee, with periodic breaks to ask questions about pathophysiology, which will encourage discussion and further learning. Once the discussion is completed, the debriefing summary (Appendix D) can also be presented to the learner as a handout for supplemental reading. The evaluation form (Appendix E) can be used to assess learner knowledge after the simulation.

Results

During the 2015-2016 academic year, several anesthesiology residents from the Department of Anesthesiology at the University of Iowa Hospitals and Clinics were able to experience the content of this simulation (12 in total). The simulation was presented by or with the assistance of the core simulation faculty physician within the Department of Anesthesiology.

These eligible learners (including four CA-1s, four CA-2s, and four CA-3s) experienced this simulation content directly in person. Comments were almost unanimously positive, including “challenging, but very relevant,” “a great review for troubleshooting difficult IV access,” and “a perfect replication of an emergent situation.” All learners who returned surveys regarding the simulation answered the questions “This simulation enhanced my understanding of how to manage critically ill patients in the perioperative period” and “The content was current and relevant to my practice” with either agree or strongly agree (4 or 5 out of 5).

Discussion

This simulation was created in order to provide trainees the opportunity to manage an emergent, bleeding pediatric patient in a simulated, low-risk environment. The creation of this experience was inspired by previous real-life case experience, how commonly adenotonsillectomy surgeries are performed, and an almost complete lack of experience and lack of familiarity amongst a majority of anesthesia trainees with using an intraosseous access kit. The module offers various points to practice troubleshooting skills in the management of difficult IV line placement as well as difficult airway management. In reality, this case could be modified in multiple ways, including management of a more severe hemorrhage with a much more hypovolemic patient.

The case was chosen due to recent exposure to a case of a posttonsillectomy and adenoidectomy bleed. We felt that providing this simulation would be valuable to all residents within the Department of Anesthesiology. Given the resounding positive feedback we have received from trainees who have gone through this simulation, we have now made it a regular part of our curriculum. This simulation is one of many on a list that are chosen at random by the anesthesia faculty for trainees who are at the CA-1 class level or higher.

Based on learner and faculty feedback, the simulation was improved or modified in a number of ways. One example is that the original case did not include the learner having to remember the critical step of decreasing the FiO2 (fraction of inspired oxygen) prior to electrocautery use; however, even knowing that this is not meant to be a summative simulation, leaving that step out would have allowed for the setting of a potentially disastrous airway fire that is avoidable. Another example of feedback used to modify the curriculum was from criticism from a more senior-level learner (CA-3). He had made the critical analysis that gastric decompression by suctioning at the end of the case prior to extubation would lower the potential of postoperative nausea and probability of aspiration on extubation by evacuating any remaining, highly irritating blood that had remained in the stomach. Although not an exhaustive list, these examples

do illustrate the process by which the curriculum has been modified based on learners' feedback, reflection, and critical analysis. These and other pieces of feedback were obtained via discussions during and after the simulation as well as by way of written feedback after a learner had completed the simulation and had time for reflection and comments. Overall, this simulation has proven to be a valuable learning experience for trainees of all levels within the Department of Anesthesiology at the University of Iowa Hospitals and Clinics.

Cody C. Breinholt, DO: Fourth-year Resident, Department of Anesthesiology, University of Iowa Carver College of Medicine

Clark J. Obr, MD: Clinical Associate Professor of Anesthesiology, University of Iowa Carver College of Medicine

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