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None of the editors or contributors have any real or potential conflicts of interest to disclose.

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* This program has been prior approved by the American Association of Nurse Anesthetists for 24 Class A CE credits; Code Number 1033645; Expiration Date 07/31/2019.
**SUCCESS OF INTUBATION RESCUE TECHNIQUES AFTER FAILED DIRECT LARYNGOSCOPY IN ADULTS: A RETROSPECTIVE COMPARATIVE ANALYSIS FROM THE MULTICENTER PERIOPERATIVE OUTCOMES GROUP**

Anesthesiology 2016;125:656-66
DOI: 10.1097/ALN.0000000000001267

**Abstract**

**Purpose** The purpose of this study was to compare the success rate for five rescue techniques after failed direct laryngoscopy in adults. The rescue techniques were:

- video laryngoscopy
- flexible fiberoptic intubation
- intubation through supraglottic airway
- optical stylet
- lighted stylet

**Background** Failed intubation can lead to increased morbidity and mortality. The ASA Difficult Airway Algorithm provides guidance on next steps to take after failed intubation, the most important step being to evaluate adequacy of ventilation and consider placement of a supraglottic airway if ventilation is difficult. If ventilation is adequate, the algorithm suggests considering alternative intubation techniques. Unfortunately, the algorithm does not provide clear guidance on which alternative intubation technique is best.

In recent years video laryngoscopy has become the go-to device for many providers as a rescue device. Furthermore, some studies suggest video laryngoscopy intubation has a higher success rate as a rescue technique. Others suggest intubation through a supraglottic airway device. Further research is needed to determine which rescue intubation technique; video laryngoscopy, flexible fiberoptic intubation, intubation through supraglottic airway, optical stylet, or lighted stylet; has the highest success rate.

**Methodology** This was a retrospective, multicenter study from seven large academic medical centers. It used the Multicenter Perioperative Outcomes Group database to compare differences in success rates with various rescue techniques after failed direct laryngoscopy from 2004 to 2013. Adults >18 years of age were included who had an initial direct laryngoscopy attempt, then a rescue attempt with either:

- video laryngoscopy
- flexible fiberoptic intubation
- intubation through supraglottic airway
- optical stylet
- lighted stylet

An intubation rescue technique was recorded as successful when it resulted in tracheal intubation, regardless of the number of attempts. The rescue technique was considered a failure if the provider switched to another rescue device or back to direct laryngoscopy. A secondary outcome was rescue technique success rates in patients with difficult or
impossible mask ventilation. This was defined as a ventilation score of 3 or 4, narrative indicating “two-hand mask ventilation”, or documentation the patient could not be ventilated by mask. The investigators also examined the rescue technique success rates in patients with hypoxemia (SPO$_2$ <90% for at least 1 minute), anticipated difficult airway (>2 predictors), and those considered “high risk.” High risk was defined as attempts involving either hypoxemia, difficult or impossible mask ventilation, or occurred after two previous direct laryngoscopy attempts. Statistical analysis was appropriate. A P < 0.05 was considered significant.

**Result**

There were N = 1,427 rescue intubations included in the analysis out of 346,681 total intubation attempts. Video laryngoscopy was the most frequently used rescue technique (N = 1,122 out of 1,619 attempts; 69%). The other devices used included flexible fiberoptic (N = 170; 11%), lighted stylet (N = 128; 8%), supraglottic airway conduit (N = 82; 5%), or optical stylet (N = 9; 0.6%). Other airway management techniques included return to direct laryngoscopy (N = 61; 4%), surgical airway (N = 11; 0.7%), using a supraglottic airway to maintain ventilation for the case (N = 26; 2%), waking the patient up followed by awake fiberoptic intubation (N = 8; 0.7%), or case cancelation (N = 2; 0.1%).

Video laryngoscopy had the highest success rate (92%). The lowest success rate was with an optical stylet (67%; P < 0.001; Figure 1). Additionally, video laryngoscopy had higher success rates in patients who experienced hypoxemia, were an anticipated difficult airway, or were considered “high risk” (Figure 1). The GlideScope was the most common video laryngoscopy device used (89%), followed by the Storz DCI or C-MAC® (6%), and Bullard scope (4%). The Pentax (n = 7), McGrath® (n = 1), and Airtraq (n = 1) were used in less than 1% of rescue attempts. The rescue attempt success rate for the three most frequently used video laryngoscopy devices ranged from 90% to 92%. The majority of rescue intubation attempts occurred after a single direct laryngoscopy attempt (68%). There was no difference in successful video laryngoscopy rates across the seven institutions.
included. The frequency of video laryngoscopy use increased from <30% in 2004 to >80% in 2012, while the frequency of flexible fiberoptic use as a rescue device decreased from approximately 30% in 2004 to <5% in 2012.

**Conclusion** Video laryngoscopy was associated with the highest rescue intubation success rate after failed direct laryngoscopy. The GlideScope was the most common rescue device used. Anesthesia providers should consider these results when procuring difficult airway equipment and deciding which device to use after a failed direct laryngoscopy attempt.

**Comment** Video laryngoscopy has revolutionized our approach to the difficult airway. Many providers now use it as their primary technique in the anticipated difficult airway. In this study the investigators demonstrated that video laryngoscopy is now the “go-to” rescue device after a failed direct laryngoscopy attempt, with the most frequent device utilized being the GlideScope. What I think is most encouraging from these results is that in 68% of cases in this study, anesthesia providers switched to a rescue device after the first failed attempt, rather than trying multiple attempts at direct laryngoscopy. Decreasing multiple attempts reduces the risk of airway edema and difficult or impossible mask ventilation, as well as airway trauma. And, one note on the study itself. While this study does demonstrate the effectiveness of the video laryngoscope for rescue intubations, the low frequency of use of the other devices does not allow one to draw the conclusion that video laryngoscopy is the single best device for rescue intubation based upon the information in this study.

If you do not have a video laryngoscopy device at your institution, you should get one. If you have one, make sure you are proficient with the device.

**Dennis Spence, PhD, CRNA**

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
Pediatric Anesthesia

Adenotonsillectomy Complications: A Meta-analysis

Pediatrics 2015;4:702-18
DOI: 10.1542/peds.2015-1283

Abstract

Purpose The purpose of this study was to describe the type and frequency of complications after adenotonsillectomy, and to compare differences in complication rates between pediatric patients with and without Obstructive Sleep Apnea (OSA).

Background The prevalence of OSA in children ranges from 1% to 5%. Adenotonsillectomy is one of the most common treatments for OSA. It is also used to treat recurrent tonsillitis. The most common complications after adenotonsillectomy include pain, nausea, vomiting, and dehydration. More serious complications include hemorrhage, respiratory complications, subglottic stenosis, and death. Some investigators have found differences in adenotonsillectomy postoperative complication rates between OSA and non-OSA patients. Not surprisingly, higher rates of respiratory complications have been found in pediatric patients with OSA, whereas those without OSA have higher hemorrhage rates, which may be related to increased risk of bleeding due to recurrent infections. This meta-analysis described complication rates after adenotonsillectomy and compared complication rates in those with and without OSA.

Methodology The investigators conducted a systematic review and meta-analysis of clinical studies that evaluated postoperative complications within 3 weeks after adenotonsillectomy in children aged 0 years to 18 years with and without OSA. A complication was defined as any deviation from the usual postoperative course that required intervention. The authors excluded studies that included patients with genetic syndromes (e.g., Down’s Syndrome), coagulation disorders, or cerebral palsy. Two investigators used the Meta-Analysis of Statistics Assessment and Review Instrument to evaluate the quality of each study selected for review. Statistical analysis was appropriate.

Result A total of 23 studies were included in this meta-analysis. Of these 23 studies, only 4 met inclusion criteria for comparison of patients with and without OSA. Study sample sizes ranged from 102 to 9,023 patients. Reported complications included:

- respiratory complications
- hemorrhage
- pain
- nausea
- vomiting
- refusal to drink
- inadequate oral intake
- dehydration
- fever
- dysphagia
- cardiac complications
The overall complication rate after adenotonsillectomy in pediatric patients was 19% (N = 13,357). The most common complication was respiratory (9.4%, N = 3,148 cases; Figure 1). Primary hemorrhage rate (within first 24 hours) was 2.4%. The secondary hemorrhage rate (after 24 hours) was 2.6%.

There were 371 patients in the analysis comparing respiratory complications in children with (n = 184) and without (n = 187) OSA. Children with OSA were almost five times more likely to experience a respiratory complication than children without OSA (OR = 4.9, P < 0.05; Figure 2). Examples of respiratory complications included:

- desaturation
- laryngospasm
- need for supplemental oxygen
- supraglottic obstruction
- need for oral or nasal airway
- pulmonary edema

In examining bleeding complications, there were 360 patients with OSA and 294 without. Meta-analysis confirmed that bleeding rates were significantly lower in children with OSA (OR = 0.4, P < 0.05; Figure 2).

**Conclusion** The most common complications after adenotonsillectomy were respiratory complications and delayed hemorrhage. Pediatric patients with known or suspected OSA had a five-fold higher rate of respiratory complications. Non-OSA patients had a higher rate of postoperative hemorrhage.

**Comment**

When I was learning anesthesia, a mentor of mine taught me to always ask the surgeon why the child was having a tonsillectomy. Was it for recurrent tonsillitis or OSA? If it was OSA we would limit our fentanyl administration to 1 µg/kg; if not we might give upwards of 3 µg/kg fentanyl. The reason, which should not be surprising to any, and as demonstrated by this study, is that children with OSA have significantly higher rates of respiratory complications after adenotonsillectomy. Patients with OSA are more sensitive to the respiratory depressant effects of opioids. Postoperatively, adenotonsillectomy patients can have copious nasal secretions and reactive, postsurgical edema in the adenoid and tonsillar beds. Therefore, it is essential that anesthesia providers...
attempt to determine the severity of OSA and work with the surgeon to develop a postoperative plan that reduces the risk of complications. If the child has known or suspected severe OSA, then one should consider minimizing opioids and overnight admission for respiratory monitoring.

**Dennis Spence, PhD, CRNA**

The views expressed in this article are those of the author and do not reflect official policy or position of the Department of the Navy, the Department of Defense, the Uniformed Services University of the Health Sciences, or the United States Government.
Trauma

**Massive transfusion protocols: a survey of academic medical centers in the United States**

Anesth Analg 2017;124:277–81
DOI: 10.1213/ANE.0000000000001610
Treml AB, Gorlin JB, Dutton RP, Scavone BM

**Abstract**

**Purpose** The purpose of this study was to survey USA academic medical centers on the characteristics of their massive transfusion protocols.

**Background** Massive transfusion is defined as administration of >10 units of packed red blood cells (PRBCs) within 24 hours. Military research studies have found an association between early administration of both fresh frozen plasma (FFP) and platelets and a reduction in morbidity and mortality in combat casualties. Many academic medical centers around the USA have developed massive transfusion protocols, which incorporate 1:1 PRBC to FFP ratios in their protocols.

**Methodology** This study surveyed the experiences of USA academic medical centers with massive transfusion and described the details of their protocols. The survey included 107 academic medical centers with pathology residency programs. Survey questions elicited information about:

- hospital size
- trauma level status
- obstetric delivery rates
- years since massive transfusion protocol implementation
- modifications since implementation
- target PRBC:FFP ratios
- frequency of activation
- massive transfusion protocol effectiveness
- activation procedure
  - who activates
  - who delivers blood
  - how blood delivered
  - how blood checked

Descriptive statistics were used to analyze the results.

**Result** The survey response rate was 52% (N = 56). Most hospitals were >500 beds (74%), level 1 trauma centers (77%), and had an obstetric unit (91%). A majority of centers reported making modifications to the massive transfusion protocol since implementation (67%). Close to 70% of the centers reported their target PRBC:FFP ratio was 1:1. Nine percent used a 1.5:1 ratio, 9% used a 2:1 ratio, and 9% some other ratio. Overall, 64% of centers provided ≥6 units of PRBCs in the first massive transfusion protocol pack and 81% included ≥4 units of FFP. Most centers (64%) included an apheresis unit of platelets in the first massive transfusion protocol pack. A majority of centers provided the same product ratios with subsequent massive transfusion protocol packs (57%).

The massive transfusion protocol was activated 2-5 times per week in 39% of centers, 1 time per week in 2% of centers, and <1 time per week in 38% of centers. The massive transfusion protocol was
believed to be effective by 82% of respondents. Very few centers incorporated antifibrinolytics (tranexamic acid) in their protocol (22%). Most units (84%) send a runner from the unit to pick up the massive transfusion protocol packs in a cooler. Each blood product is usually (73%) checked individually when it arrives. Very few centers (14%) required staff to check laboratory values at set intervals.

Thromboelastography was used to guide resuscitation in 30% of centers. Thawed plasma was available at 48 hospitals (86%), and 52% stored uncrossmatched type O PRBCs outside the blood bank, typically 4 units in the operating room.

**Conclusion**

All centers that responded reported having a massive transfusion protocol in place. Most centers’ massive transfusion protocol used a target ratio of PRBC:FFP of 1:1.

**Comment**

Combat casualty trauma survival is at the highest level ever. One of the factors that has contributed to high survival is implementation of damage control resuscitation principles and clinical practice guidelines which recommend a 1:1:1 PRBC:FFP:Platelet massive transfusion protocol. At my institution we developed a massive transfusion protocol several years ago based on review of obstetrical hemorrhage cases. We also have implemented a standardized oxytocin protocol in which we give a 3 unit bolus after delivery over 3 minutes, and then repeat it x1 if there is still uterine atony. Then we start an infusion of 300 mU/min for one hour; thereafter we run the oxytocin at 60 mU/min for four hours. If after two oxytocin boluses the patient still has atony, we start administering other uterotonics. We also train our staff and trainees (Obstetric and Anesthesia) to not be afraid to activate a massive transfusion protocol. It not only gets you blood, but it gets you additional personnel and resources needed for the resuscitation. We have also incorporated biannual massive transfusion protocol simulation training for all Obstetric and Anesthesia staff and trainees. The combination of an oxytocin protocol, massive transfusion protocol, and simulation training has significantly improved outcomes at our institution.

It was surprising to me that most centers do not include tranexamic acid in their massive transfusion protocol. Large trials support its use. Anecdotally, I have found it really helps decrease blood loss; however, for it to be helpful, you have to give it early in the resuscitation. Ideally tranexamic acid should be given within the first 15 minutes of the resuscitation, but definitely within the first hour. It does not increase the risk of thrombosis. If you do not have it included on your massive transfusion protocol, I recommend considering adding it.

**Dennis Spence, PhD, CRNA**

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