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Postoperative tonsillectomy bleeding complications in children: A comparison of three surgical techniques

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ABSTRACT

Objective & hypothesis: Stated in the Null form: There will be no difference in primary or secondary hemorrhage rate in children undergoing tonsillectomy or adenotonsillectomy across three surgical techniques: PEAK Plasmablade, electric monopolar cautery, coblation.
Study design: Retrospective chart analysis.
Setting: Academic Medical Center: Children's Hospital.
Subjects & methods: Electronic chart data were collected from patient's age 2–18 years who underwent tonsillectomy, with or without adenoidectomy, at a tertiary pediatric hospital between June 2011 to May 2013 by electric monopolar cautery, coblation, or PEAK PlasmaBlade. Treatment outcomes following each of these surgical approaches, relative to rate of post-operative primary and secondary bleeding, hospital admission, and emergency department visits were compared.
Results: A total of 1780 patients that had tonsillectomy or adenotonsillectomy were evaluated. There was a significant difference in bleed rate by age with older patients having more bleeding post-procedure than their younger counterparts. There was also a difference in bleeding frequency by diagnosis. Patients with a diagnosis of OSA were less likely to experience a postoperative bleed than children with either recurrent tonsillitis or both. Significance was evident between post-op hemorrhage rate and instrumentation ($\chi^2 = 11.17$, df = 2, p = 0.004). The majority of bleeds occurred with coblation (58.9%), while PEAK had only 17.8% and cautery 23%.
Conclusion: The null hypothesis was rejected. That is, PEAK PlasmaBlade was safe and effective, with statistically less postoperative bleeding and ED visits, especially when compared to coblation techniques. Coblation patients had the highest rates of postoperative bleeding.

1. Introduction

Tonsils and adenoids are lymphoid tissue in the oropharynx and nasopharynx. These structures are often removed secondary to recurrent infections and airway obstruction [1]. Tonsillectomy and adenoidectomy include use of a variety of surgical instruments such as cold dissection, electric monopolar cautery, bipolar cautery, harmonic scalpel, bipolar radiofrequency (coblation), and PEAK PlasmaBlade (Medtronic). PEAK engages an electrically conductive cloud that is created when radio frequency energy contacts tissue. This form of energy uses high frequency pulses, which allow lower operating temperatures and thus less thermal damage. PEAK's average temperature is 40–100°Celsius. Average temperature of electro-cautery is 200–600°C and that of coblation is 60–160°C [2–7]. Each surgical technique requires a slightly different surgical approach and is generally based on surgeon preference, experience, and instrumentation availability [5,8,9]. Each system claims benefits ranging from decreased post-operative pain and intraoperative bleeding, increased surgical speed, and less risk of post-surgical hemorrhage [5,8–10].

The most common reasons for adenotonsillectomy in the pediatric population include history of recurrent tonsil infection, including peritonsillar abscess (PTA), and tonsil hypertrophy with associated sleep disordered breathing (SDB) and obstructive sleep apnea (OSA). Guidelines for tonsillectomy in both categories are published by the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS) and include recurrent infections (≥7 in 1 year, ≥5 in 2 years, ≥3 in 3 years), recurrent infections with PFAPA

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syndrome (periodic fever, apthous stomatitis, pharyngitis, cervical adenitis), or recurrent PTA [11]. The aforementioned guidelines recommend that if at least one of the following conditions are present, postoperative hospital admission should be considered: 1) age <3 years; 2) severe sleep apnea with apnea-hypopnea index (AHI) > 10; 3) oxygen desaturations <80%; or 4) medical comorbidities [11,12].

Bleeding after adenotonsillectomy is a known complication and experienced by ~5% of patients (reported range = <1%–20%) [1,6,9,14]. The wide range of reported bleeding found in the literature is due to a variety of ways hemorrhage is defined in research. When post-surgical hemorrhage occurs it is separated into two groups: 1) primary bleeding, which arises in the first 24 h postoperatively, or 2) secondary bleeding, which presents greater than 24 h after surgery. There is still a lack of agreement as to what constitutes a significant post-operative bleed. Some researchers have suggested using both subjective and objective measures of bleeding rates, others recommend only including bleeding episodes that require medical or surgical intervention [13–15]. In addition to post-operative bleeding, other known complications associated with adenotonsillectomy include dehydration, fever, poor oral intake, and pain [1,5,6,8,16].

Whereas varying post-operative bleed rate differences have been reported between electro-cautery and coblator [6,9,17], to our knowledge no comparison of electro-cautery, coblator, and PEAK has been conducted in a large pediatric cohort. The purpose of this study was to compare post-operative hemorrhage in children who underwent tonsillectomy or adenotonsillectomy via electro-cautery, coblation, or PEAK. Stated in the null form, our study hypothesis was that there will be no difference in hemorrhage rate in children across these three surgical intervention procedures.

2. Materials and methods

2.1. Study Design

Permission was obtained from the Detroit Medical Center and Wayne State University Institutional Review Boards. A retrospective cohort study was subsequently performed. Electronic medical records from Children's Hospital of Michigan were analyzed using current procedural terminology (CPT) codes to identify patients who underwent tonsillectomy or adenotonsillectomy between 2011 and 2013.

2.2. Sample

The subjects in this sample were children (N = 1780) who underwent extracapsular tonsillectomy, with or without adenoidectomy, after meeting the AAO-HNS Clinical Practice Guidelines [11] for such surgery in children. All subjects were treated between June 2011 and April 2013 (Table 1). Potential subjects were excluded if 1) <2 years or >18 years of age; 2) surgical approach utilized was not electro-cautery, coblation, or PEAK; 3) history of bleeding disorder; 4) adenoidectomy only; 5) incomplete records.

2.3. Methods

Following identification of subjects who met the study criteria the following data were extracted from the electronic medical record: 1) patient demographic characteristics (e.g. age, gender), 2) attending surgeon, 3) surgical approach, 4) reason for hospital admission, and 5) frequency of ED visits (21 days post-procedure), including the purpose for each visit.

Recorded bleeding rates were modeled after the methods of Liu and colleagues [13] to include both subjective and objective bleeding. Post-operative bleeding was defined as any bleeding from the mouth, including hematemesis, hemoptysis, or spitting clots [13,14]. Both primary and secondary bleeding was examined based on aforementioned criteria. Intervention for any bleeding complaint was collected and coded as either 1) none required, 2) bedside chemical cautery with silver nitrate, or 3) hemorrhage controlled in the OR.

Table 1
Subject demographics relative to underlying tonsil tissue pathology (ie., hypertrophic and/or recurrent disease) and associated pathophysiology (ie., obstructive sleep apnea [OSA]/sleep disordered breathing [SDB]), expressed in percentages of occurrence.

Patient characteristics (N = 1780)	
	%
Gender (% female)	48.5
Procedure	
Adenotonsillectomy	97.3
Tonsillectomy	2.7
Instrument	
Electric monopolar Cautery	25.1
Radiofrequency coblation	43.3
PEAK plasmaBlade	31.6
Diagnosis	
OSA	67.6
Recurrent	21.1
Both	11.3
PEAK plasma	31.6

In addition to the above variables, other data were collected as potential covariates. Patients less than 3 years old were routinely admitted postoperatively and this was not listed as a complication. OSA patients with AHI scores >10 or oxygen desaturation levels <80% were also routinely admitted overnight [8]. Table 2 shows reasons for ED and hospital admissions: 1) age (<3 years), 2) fever (subjective or objective), 3) bleeding, 4) dehydration, 5) vomiting, 6) pain (any type), 7) pneumonia, 8) poor oral intake (PO), 9) epistaxis, 10) breathing difficulties (i.e. post-operative oxygen desaturations, elevated AHI, history of OSA), and 11) "other" (e.g. sickle cell disease, developmental delays, diarrhea, upper respiratory infection, etc.).

2.4. Data quality

To ensure data reliability two physicians who were unfamiliar with the subjects for this investigation independently performed all medical chart extractions. For acceptable inter-rater reliability, judges had to achieve 100% consensus for all entries listed in Tables 1–3. To control for intra-rater reliability we required the judges to re-examine 25% of the charts several weeks after their initial reviews. For acceptability on this measure we required the

Table 2
Postoperative complications leading to emergency room visitations and hospital admissions, expressed in percentages of occurrence.

ED visit & admission reasons		
Reason	%	%
	ED visit	Admitted
Fever	1.8	1.1
Bleed	4.7	4.0
Dehydration	3.3	2.5
Vomiting	1.9	1.2
Pain	4.3	0.8
Desaturations	0.0	5.8
Pneumonia	0.6	0.4
Decreased PO	0.1	0.6