Characteristics of Children Diagnosed as Having Coagulopathies Following Posttonsillectomy Bleeding

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Objective: To determine the prevalence of coagulopathy among children presenting with posttonsillectomy bleeding (PTB) and describe risk factors that could indicate the presence of occult coagulopathy.

Design: Retrospective medical chart review.

Setting: Tertiary-care pediatric hospital.

Patients: The study population comprised 182 patients presenting with PTB from January to December 2007.

Main Outcome Measures: Demographics, laboratory studies, type of intervention, transfusion status, need for hematology consultation, type of coagulopathy, and disposition were recorded.

Results: There were 216 emergency department (ED) encounters for PTB. The mean age of the patients was 8.4 years, and 56% were male and 79% were white. Patients presented on mean postoperative day 5.9. Of the 182 children, 34 (19%) presented with abnormally elevated prothrombin time, activated partial thromboplastin time, or platelet function assays (PFAs) for both adenosine diphosphate and epinephrine. Eight patients (4%) ultimately were diagnosed as having a coagulopathy. Differences in mean age (P = .23), sex (P = .47), race (P = .76), number of days posttonsillectomy (P = .34), and higher ED visit frequency (P = .06) between the coagulopathic and noncoagulopathic children were not statistically significant. Coagulopathic children had significantly higher mean activated partial thromboplastin time (P < .001), PFA for adenosine diphosphate (P < .001), and PFA for epinephrine (P = .001). Of the 8 coagulopathic children, 3 (38%) presented with a history of oral bleeding and a normal physical examination.

Conclusions: In children presenting with PTB, activated partial thromboplastin time and PFA studies and hematology consultations are helpful in identifying occult coagulopathies. The definition of PTB should be broadened to include children with any history of oral bleeding, regardless of examination findings.


Tonsillectomy is indicated for patients with chronic or recurrent tonsillitis, peritonsillar abscess, sleep-related breathing disorder or obstructive sleep apnea, and tonsillar hypertrophy. Approximately 287,000 children underwent tonsillectomy or without adenoidectomy in the United States in 1996. Despite advances in surgical technique, posttonsillectomy bleeding (PTB) remains a significant complication, seen in approximately 2% to 5% of all cases. A prior diagnosis of a coagulopathy has been reported as one of several risk factors for PTB. However, existing medical literature discussing the utility of obtaining laboratory studies as a screening tool to identify coagulopathies after an episode of PTB is sparse. Windfuhr et al concluded that obtaining laboratory studies is warranted in cases of PTB for which “copious bilateral bleeding” is observed and fails to resolve with surgery and cannot be definitively attributed to surgical technique or anticoagulant therapy. Prim et al cite multiple sources reporting the “changeable efficacy” and relative insensitivity of bleeding time and other coagulation studies in predicting PTB.

Because the utility of coagulation workup following an episode of PTB has not been explored thoroughly, we first sought to describe the characteristics of children who were evaluated in the emergency department (ED) for PTB over a 12-month period and determined the prevalence of coagulopathy in this population. We then investigated risk factors that could indicate the presence of an underlying bleeding disorder in a child presenting with PTB.
This study was approved by the institutional review board of Cincinnati Children’s Hospital Medical Center (Cincinnati, Ohio). The hospital ED records database was searched using the International Classification of Diseases, Ninth Revision (ICD-9) diagnostic codes 474.8 (other chronic disease of tonsils and adenoids) and 998.11 (hemorrhage complicating a procedure), from January 1, 2007, to December 31, 2007. After a preliminary list of patients was acquired, all medical charts were manually reviewed to identify any additional ED visits for PTB that may have been classified with inaccurate ICD-9 codes.

No distinction was made between (palatine) tonsillectomy and adenotonsillectomy. Exclusion criteria included patients with previously diagnosed cardiovascular or hematologic disorders and those receiving chronic anticoagulative therapy. Consultations for posttonsillectomy epistaxis alone also were excluded for consistency in reporting.

A retrospective medical chart review of all qualified patients was then performed. The diagnosis of PTB was defined as any oral bleeding following tonsillectomy or adenotonsillectomy prompting a visit to the ED. Demographic and epidemiologic data, including age, sex, race, and postoperative day at presentation, were recorded. Laboratory values, including hemoglobin, hematocrit, platelet count, prothrombin time (PT), activated partial thromboplastin time (aPTT), and platelet function assays (PFA-ADP, and PFA-EPI), were documented. Data regarding need for intervention, blood transfusion status, patient disposition, hematology consultation, and any newly diagnosed coagulopathies were included. In cases for which laboratory studies were repeated, only the initial set of test results were used in our calculations. Statistical analysis included the t test, χ² test, and analysis of variance (ANOVA) when appropriate. Statistical significance was defined as P ≤ .05.

RESULTS

Hospital-affiliated otolaryngologists performed 3128 tonsillectomies with or without adenotonsillectomy at the study institution over the 12-month period of our study. All tonsillectomies were performed using monopolar electrocautery. A total of 182 patients (5.8%) subsequently presented with 216 episodes of PTB. Of the 182 children, 135 (85%) were seen in the ED only once, while the remaining patients were each seen multiple times. The mean (SD) age of our subjects was 8.4 (4.9) years and 102 patients (56%) were male. There were 144 white patients (79%), 20 black patients (11%), and 18 patients (10%) of other race/ethnicity. There was a bimodal distribution of patients presenting by postoperative day, with 47 cases on postoperative day 0-1 and 54 cases on postoperative day 6-7 (Figure). The mean postoperative day at presentation for all consultations was day 5.9. One-hundred twenty-five ED visits (58%) resulted in hospitalization, while the remaining 91 cases (42%) resulted in discharge to home. Three patients (2%) received blood transfusions at 4 separate visits. Twenty ED visits (9%) required operative intervention, while 70 encounters (32%) did not require any intervention beyond observation.

Of the 182 patients, 34 (19%) demonstrated an abnormally elevated PT, aPTT, or PFA study result over 35 separate ED encounters. Ten children (5%) subsequently received a hematology consultation after these laboratory examinations were repeated, and the results remained abnormally elevated. Three additional patients, despite a lack of abnormal coagulation study results, were evaluated by a hematologist because of multiple episodes of PTB.

Eight children (4%) ultimately were diagnosed as having coagulopathy by a hematologist, including 5 with von Willebrand disease (vWD), 1 with hemophilia A, and 2 with platelet function defects or other bleeding disorders (Table 1). Of these 8 children, 6 (75%) were male, 6 (75%) were white, and 6 (75%) were seen in the ED for only a single PTB episode, for a total of 12 ED visits. Three children (38%) had normal findings on physical examination in the ED. One child received a blood transfusion during hospitalization, and 2 required surgical treatment. An unpaired t test demonstrated no statistically significant difference between the coagulopathic children and the remainder of the cohort in terms of mean age (7.0 vs 8.5 years; P = .22) and postoperative day of presentation (7.4 vs 5.9 days; P = .27). χ² Testing demonstrated no significant difference in sex (P = .47) between the coagulopathic and noncoagulopathic patients. One-way ANOVA testing demonstrated no significant variation in race (P = .76) and in the number of ED visits (P = .06) between these groups of children.

Six of the coagulopathic patients demonstrated abnormally high aPTT or PFA study results, though none had elevated PT or international normalized ratio values or were thrombocytopenic. Though only the mean PFA-ADP was abnormally high in the 8 children with bleeding disorders, they had significantly higher mean aPTT, PFA-ADP, and PFA-EPI levels compared with all of the other children in this study (Table 2).

COMMENT

In the current era of medical cost containment, it has become imperative for the clinician to not only diagnose and treat patients accurately, but also to do so in an efficient and cost-effective manner. Despite the 1999 consensus recommendation by the American Academy of Otolaryngology–Head and Neck Surgery (AAO-HNS) to obtain a basic coagulation panel prior to tonsillectomy only if there is legitimate suspicion of a hemato-
logic or genetic abnormality, there is substantial variation between this guideline and actual practice within the otolaryngology community. The value of conducting a thorough preoperative screening for coagulation disorders prior to tonsillectomy will likely be debated for quite some time. What is less frequently discussed is the need for a full coagulation workup if a previously healthy patient presents with PTB. Hospital-affiliated otolaryngologists at our institution (Cincinnati Children’s Hospital Medical Center) follow the AAO-HNS guideline regarding preoperative hematologic assessment for tonsillectomy patients. However, there are no national standards for coagulopathy workup during evaluation for PTB. Common practice at our hospital includes the routine collection of a complete blood cell count, PT, aPTT, PFA-ADP, and PFA-EPI, unless the patient has no bleeding on examination by an otolaryngologist. A hematologic consultation generally is placed if the child demonstrates elevated PT, aPTT, and/or PFA laboratory values repeatedly or if the patient has had more than 1 episode of PTB.

With a prevalence of 0.8% to 2%, vWD is the most common inherited bleeding disorder in humans, so one might expect about 30 to 60 children with the disorder in our original study population. Our study revealed only 8 children with a bleeding disorder, including 5 with vWD. Therefore, it is possible that many children in our cohort could have vWD and remained asymptomatic during their intraoperative and postoperative course. Our review further demonstrated that the 8 coagulopathic children on average have significantly higher and/or abnormal PTT and PFA study results compared with the PTB patients without laboratory evidence of a coagulopathy. Elevated aPTT and PFA results both are frequently noted in patients with vWD. Prim et al reported that within a cohort of 1516 cases, 6 of 13 PTB children (46%) were diagnosed as having vWD or a platelet dysfunction after referral to a hematologist, compared with the 8 of 13 children (62%) in our series who were diagnosed after hematologic consultation. While higher aPTT and PFA study results appear to be associated with PTB, age, sex, race, and posttonsillectomy day of presentation did not appear to be significant risk factors in our study. In addition, PT values in the coagulopathic children were neither abnormally elevated nor significantly different compared with their noncoagulopathic counterparts.

An unexpected finding of this study was that 3 of 8 coagulopathic children (38%) had a normal physical examination result at the time of evaluation in the ED, with only an abnormal coagulation test result to indicate that there might be an underlying bleeding disorder. This suggests that uncovering an occult coagulopathy is not solely dependent on a worrisome clinical examination requiring either ED or operative intervention. These results should represent a paradigm shift in

### Table 1. Epidemiological Data of All 8 Patients With Confirmed Coagulopathies

<table>
<thead>
<tr>
<th>Patient No./ Sex/Age, y</th>
<th>Race</th>
<th>Ethnicity</th>
<th>No. of ED Visits</th>
<th>POD, No.</th>
<th>ED Intervention ⁸</th>
<th>Surgical Intervention</th>
<th>Elevated aPTT</th>
<th>Elevated PFA</th>
<th>Blood Transfusion</th>
<th>Disposition From ED</th>
<th>Bleeding Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/F/3</td>
<td>H</td>
<td>Single</td>
<td>7</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>IP</td>
<td>Platelet function defect, factor XII deficiency</td>
</tr>
<tr>
<td>2/M/7</td>
<td>W</td>
<td>Multiple</td>
<td>0, 16</td>
<td>N, N</td>
<td>N, N</td>
<td>DNO, Y</td>
<td>DNO, Y</td>
<td>N, N</td>
<td>OP, IP</td>
<td>vWD type 1</td>
<td></td>
</tr>
<tr>
<td>3/M/7</td>
<td>W</td>
<td>Single</td>
<td>11</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>IP</td>
<td>vWD type 1</td>
</tr>
<tr>
<td>4/M/7</td>
<td>W</td>
<td>Single</td>
<td>8</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>IP</td>
<td>Hemophilia A</td>
</tr>
<tr>
<td>5/M/6</td>
<td>W</td>
<td>Single</td>
<td>8</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>IP</td>
<td>vWD type 1</td>
<td></td>
</tr>
<tr>
<td>6/M/5</td>
<td>W</td>
<td>Single</td>
<td>7</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>IP</td>
<td>vWD type 1</td>
</tr>
<tr>
<td>7/M/13</td>
<td>B</td>
<td>Single</td>
<td>5</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>OP</td>
<td>vWD (unknown type)</td>
</tr>
<tr>
<td>8/F/6</td>
<td>W</td>
<td>Multiple</td>
<td>1, 3, 7, 16</td>
<td>Y, N, N</td>
<td>N, Y, Y</td>
<td>N (all visits)</td>
<td>N (all visits)</td>
<td>N (all visits)</td>
<td>IP (all visits)</td>
<td>Platelet function defect</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: DNO, did not obtain; Y, yes; N, no; OP, outpatient; IP, inpatient; POD, postoperative day; vWD, von Willebrand disease.

### Table 2. Laboratory Testing Results of All Coagulopathic Children vs All Other Children in the Study Cohort ⁹

<table>
<thead>
<tr>
<th>Laboratory Test [Reference Range]</th>
<th>Coagulopathic Patients</th>
<th>All Other Patients</th>
<th>No. ¹</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin, g/dL [11.5-13.5 g/dL]</td>
<td>12.7</td>
<td>13.3</td>
<td>151</td>
<td>.33</td>
</tr>
<tr>
<td>Hematocrit, % [34%-40%]</td>
<td>38.2</td>
<td>39.0</td>
<td>151</td>
<td>.62</td>
</tr>
<tr>
<td>Platelet count, ×10⁹/µL [135-466 ×10⁹/µL]</td>
<td>444</td>
<td>359</td>
<td>148</td>
<td>.03</td>
</tr>
<tr>
<td>PT, s [12.6-14.5 s]</td>
<td>13.0</td>
<td>13.2</td>
<td>145</td>
<td>.46</td>
</tr>
<tr>
<td>aPTT, s [25.9-35.6 s]</td>
<td>34.4</td>
<td>28.9</td>
<td>145</td>
<td>.001</td>
</tr>
<tr>
<td>PFA-adenosine diphosphate binding time, s [68-112 s]</td>
<td>145</td>
<td>86</td>
<td>140</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>PFA-epinephrine binding time, s [75-199 s]</td>
<td>175</td>
<td>119</td>
<td>141</td>
<td>.001</td>
</tr>
</tbody>
</table>

Abbreviation: aPPT, activated partial thromboplastin time; PFA, platelet function assay; PT, prothrombin time.

⁸Emergency department intervention is defined as the following: silver nitrate cautery, topical vasoconstrictive agent application, and/or direct pressure.

¹This patient had 2 hematology consultations placed at separate ED visits.

²Note that any PFA laboratory value above 300 was defined as exactly 300 in order to calculate results.

³Number of noncoagulopathic children with a given laboratory study.
how otolaryngologists define and workup PTB in 2 ways. First, our study uses a very inclusive definition of PTB in that any patient with a history of oral bleeding after tonsillectomy, regardless of examination findings, qualifies as having had an episode of PTB. Using this definition, we have identified occult coagulopathies in patients who would have been overlooked using a more stringent characterization of PTB. Second, these findings suggest that a basic coagulation panel (consisting of aPTT and PFA tests) should be obtained from all children presenting with PTB, including those with a normal physical examination result and only a reported history of oral bleeding.

There are inherent limitations to the retrospective nature of this study. Many patients underwent multiple blood draws, and only the first set of laboratory study findings were included in data analysis. As many children’s laboratory study results normalized on a second coagulation panel, the mean of the noncoagulopathic children’s coagulation study results may have been overestimated. However, by overestimating these values, we were less likely to overlook coagulopathic children who otherwise would have been excluded based on a normalized second laboratory panel. In addition, not all patients presenting to our center with PTB underwent laboratory studies. These numbers are relatively low, and with the large number of patients in this study, we do not suspect that ascertainment bias is present.

In conclusion, there were no statistically significant risk factors for coagulopathy in the PTB population evaluated in this study. However, during initial presentation of PTB, coagulopathic children demonstrated markedly higher aPTT and PFA results. Findings from aPTT and PFA studies and hematologic consultations are helpful in identifying underlying bleeding disorders in the PTB population, especially in patients who only presented with a recent history of oral bleeding and no positive examination findings. Therefore, the definition of PTB should be broadened to include all children with any history of oral bleeding after tonsillectomy regardless of examination findings. We recommend that these children undergo aPTT and PFA testing as part of their initial workup.

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Author Contributions: All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Sun, Harmych, Gonzalez del Rey, Myer, and Greinwald. Acquisition of data: Sun and Dickson. Analysis and interpretation of data: Sun, Harmych, Gonzalez del Rey, and Greinwald. Drafting of the manuscript: Sun, Harmych, and Myer. Critical revision of the manuscript for important intellectual content: Sun, Harmych, Dickson, Gonzalez del Rey, and Greinwald. Administrative, technical, and material support: Myer and Greinwald. Study supervision: Dickson, Gonzalez del Rey, Myer, and Greinwald.

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REFERENCES