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ORIGINAL RESEARCH

Post-tonsillectomy hemorrhage rates: Are they technique-dependent?

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OBJECTIVES: Recent publications have identified different rates of postoperative hemorrhage between "cold" tonsillectomy techniques and "hot" tonsillectomy techniques, generally identifying lower bleeding rates after cold techniques. Data from a prospective institutional review were analyzed to determine the relative risk factors for post-tonsillectomy hemorrhage among different techniques and by different age groups.

MATERIALS AND METHODS: At the co-located John Hunter Hospital and John Hunter Children's Hospital, data were collected prospectively over a period of five years to allow a nonrandom comparison between a nondiathermy dissection technique for tonsillectomy with a monopolar diathermy technique in the management of nonmalignant disease of the tonsils, in children and adults, by determining complications in the first 28 days after surgery.

RESULTS AND CONCLUSIONS: One thousand one hundred thirty-three consecutive cases were analyzed. The primary post-tonsillectomy hemorrhage rate was 0.2% for blunt dissection plus diathermy hemostasis and 0.3% for monopolar diathermy dissection plus hemostasis. Monopolar diathermy had a lower rate of secondary postoperative hemorrhage, requiring readmission (4.2% compared with 5.4% for blunt dissection plus diathermy hemostasis) and a lower rate for readmission for observation alone (2.1% compared with 4.2%) but had a higher risk of returning to surgery (1.6% compared with 1.04%) and a higher risk of blood transfusion (0.49% compared with 0.2%). These differences, however, did not reach statistical significance (Yates χ^2), and neither did the relative risk between the two techniques. Two-way analysis of variance among secondary post-tonsillectomy hemorrhage complications by technique and by age groups shows a highly statistically significant difference by age group (analysis of variance, 3 df, $F = 9.509$, $P < 0.001$), much more so than technique.

Post-tonsillectomy hemorrhage remains the most serious complication of tonsillectomy. Tonsillectomy dissection may commonly be performed by cold steel dissection or by diathermy dissection. Hemostasis may be performed by ligature ties to bleeding vessels, by diathermy, or by a combination of both. Diathermy instruments may be monopolar or bipolar, designed with a single tip or as forceps.

Although reported post-tonsillectomy hemorrhage rates vary with the diligence of postoperative questioning, recently published rates for primary or reactive hemorrhage within the first 24 hours after tonsillectomy vary from 0.3% to 2.1%,[1-3] and secondary bleed rates requiring at least admission to the hospital vary from 2% to 10.3%.[1-4] Several recent publications have identified different rates of postoperative bleeding between "cold" tonsillectomy techniques and "hot" tonsillectomy techniques, generally identifying lower bleeding rates after cold techniques.

The aim of this institutional review and analysis of 1,133 prospective cases over a period of five years was to determine the risk factors for post-tonsillectomy hemorrhage among different techniques and by different age groups.

MATERIALS AND METHODS

A prospective, nonrandomized institutional review at the John Hunter Hospital and John Hunter Children's Hospital, Newcastle, New South Wales, Australia, was commenced April 1, 2000, and was completed on April 1, 2005. These are co-located tertiary-referral teaching hospitals for adults and children. Data were collected by the operating surgeon or registrar, with an independent audit facilitator following up all patients to monitor for complications. Data collected

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Table 1
JHH and JHCH post-tonsillectomy secondary hemorrhage complications by surgical technique

		Observed n (%)	Re-admitted and returned to surgery n (%)	Blood transfusion
Blunt dissection + ties for hemostasis	13 (1.1)	1 (7.7)	0 (0)	0 (0)
Blunt dissection + monopolar diathermy hemostasis	480 (42)	20 (4.2)	5 (1.04)	1 (0.2)
Monopolar diathermy dissection + hemostasis	618 (54)	13 (2.1)	10 (1.6)	3 (0.49)
Not specified	22 (1.9)	2		

prospectively included age, operating surgeon, operation performed, indication for tonsillectomy, technique for tonsillectomy, and complications including reactionary hemorrhage within 24 hours and secondary post-tonsillectomy hemorrhage requiring readmission for observation, readmission and return to the operating room, and/or blood transfusion. A monopolar diathermy instrument was used: either the Tyco monopolar foot switching bayonet forceps with an angled tip (E4107/09-C, Tyco Australia Ltd, 166 Epping Road, Lane Cove, NSW Australia) or the Valleylab Benjamin E1018-A (Valleylab Australia Pty Ltd, Prospect NSW Australia) which has an angled tip tapering to a narrow point, insulated except at the tip. Power settings were typically 15 to 20 watts coagulation and cutting using blend 1 or blend and fulgurate. Progress reports were produced annually. Operating surgeons were consultant visiting medical officers or otolaryngology trainees in their first or second year of advanced training under direct supervision, with a small number performed by nonaccredited senior residents.

RESULTS

One thousand, one hundred, thirty-three cases (1,133) of tonsillectomy alone (575, 51%) or adeno-tonsillectomy (554, 49%) were recorded (not specified in four). The number of operations per year remained constant, at just over 200 annually.

Clinical indications for operation were more than four episodes of recurrent acute tonsillitis in the prior 12 months (42.6%), airway obstruction with sleep-disordered breathing (45.4%), and other or not specified (12%). Of the 483 patients with recurrent tonsillitis as their primary indication, 52 had a second indication. Of the 515 patients with airway obstruction as their primary indication, 139 had a second indication. Airway obstruction as an indication was more common in the younger age group.

Age ranged from less than 12 months to 69 years (mean, 11.2 years), with 308 (27%) under five years old and 238 (21%) over 18 years old. The operating surgeon chose the surgical technique in a nonrandomized way. Monopolar diathermy for dissection and hemostasis had a small predominance over blunt dissection with monopolar diathermy for hemostasis.

Of the series of 1,133 tonsillectomies with or without adenoidectomy, four had a primary/reactionary tonsillar bleed (0.3% for monopolar diathermy dissection plus hemostasis and 0.2% for blunt dissection plus diathermy hemostasis). Fifty-five secondary hemorrhage complications were recorded in 52 patients (4.5% of the series); 3.1% were admitted for observation, 1.3% were returned to surgery, and 0.4% required blood transfusion (three patients were returned to the operating room and also had a blood transfusion). The results for post-tonsillectomy secondary hemorrhage complications at John Hunter Hospital (JHH) and John Hunter Children's Hospital (JHCH) by technique of tonsillectomy are shown in Table 1.

In this institutional review, the numbers for blunt dissection plus ties for hemostasis are too small to analyze. Monopolar diathermy had a lower rate of readmission for postoperative bleeding episodes (4.2% compared with 5.4%) for blunt dissection plus diathermy hemostasis but had a higher risk of needing to return to surgery (1.6% versus 1.04%) and a higher risk of blood transfusion. These differences between the two operative techniques, however, did not reach statistical significance (Yates χ^2 for bleed and observation, 3.269, $P = 0.071$; for return to the operating room, 0.307, $P = 0.580$; and for blood transfusion, 0.063, $P = 0.802$). The relative risk between the two techniques and their 95% confidence intervals—0.995 to 3.94, 0.22 to 1.87, and 0.045 to 4.11, respectively—are not statistically significant. If a post-tonsillectomy bleed requiring admission to the hospital did occur in an individual, then a diathermy technique was associated with a greater risk of needing to return to theatre (39% versus 19%) and a higher risk of blood transfusion (12% versus 4%). However, these differences between the two operative techniques also failed to reach statistical significance (Yates χ^2 for return to the operating room, given a bleed occurred, 1.499, $P = 0.221$; and for blood transfusion, given a bleed occurred, 0.001, $P = 0.979$).

Stratifying by age group (Table 2) identifies age as a highly statistically significant risk factor for a secondary post-tonsillectomy hemorrhage ($\chi^2 = 26.98$, 3 df, $P < 0.001$). Two-way analysis of variance (ANOVA) among

Table 2
John Hunter Hospital/John Hunter Children's Hospital Secondary bleed complications by age group

Age group	n	Secondary bleed complication
0 to 4 years	308	2 (0.6%)
5 to 9 years	369	14 (3.73%)
10 to 17 years	218	12 (5.5%)
18 years and over	238	24 (10.1%)

secondary post-tonsillectomy hemorrhage complications by technique and by age group shows a highly statistically significant difference by age group (ANOVA, 3 df, $F = 9.509$, $P < 0.001$), much more so than technique (ANOVA, 3 df, $F = 0.044$, $P = 0.834$).

DISCUSSION

Indications for tonsillectomy vary throughout the world. Surgeons in our institution approved the guidelines, and 89% of the patients in this series met the criteria for the procedure. Reporting of compliance with guidelines in the literature is limited. Faulconbridge et al[5] used a questionnaire to examine the compliance with guidelines for tonsillectomy with or without adenoidectomy and found that although 80% approved the use of guidelines, only one third actually complied with them. van Staaij et al[6] claimed that only 35% of children operated on met the criteria of frequent tonsillitis or obstructive sleep apnea.

Post-tonsillectomy hemorrhage remains the most serious complication of tonsillectomy. Although neither the Cochrane Collaborative review[7] nor a more recent systematic literature review[8] identified a difference in the rate of secondary hemorrhage after different techniques for tonsillectomy, there have been recent papers suggesting a higher bleed rate after diathermy techniques compared with cold steel techniques.

In May 2005, the United Kingdom National Prospective Tonsillectomy Audit (NPTA) released its final analysis of 33,921 tonsillectomy operations (with or without adenoidectomy) performed between July 2003 and September 2004.[2] Age ranged from less than one year old to 83 years old. Sixty-three percent were younger than 16 years, 15% were younger than five years, and 14 children were younger than 18 months. Among reported indications for surgery, 76% were due to recurrent acute tonsillitis, 7.5% had chronic tonsillitis, and nearly 10% had "pharyngeal obstruction" as the indication for surgery. Twenty-seven percent of patients had adenoidectomy with tonsillectomy.

The NPTA examined hemorrhage and other complications of tonsillectomy in the first 28 postoperative days. The results for post-tonsillectomy hemorrhage by technique are in Table 3. Overall, 0.6% of the series of 33,921 had a primary/reactionary tonsillar bleed, and 3% of the series had a secondary bleed.

Cold steel dissection plus hemostasis by means of ties or packs had the lowest risk of post-tonsillectomy bleed. If the odds ratio for a post-tonsillectomy bleed with this technique is set at 1, then cold steel dissection plus hemostasis by means of monopolar or bipolar diathermy had a 1.6 times greater risk for hemorrhage (adjusted odds ratio). Monopolar or bipolar diathermy dissection and hemostasis had a 2.5- to 3.2-times greater risk for a bleed. All reached statistical significance. An exclusively diathermy technique had a lower risk for a primary bleed than other techniques. Except for the coblation technique, there was no statistically significant difference in the adjusted odds ratios for return to surgery among the techniques for tonsillectomy. The NPTA study also recognized an increasing hemorrhage rate with increasing age group: 1.9% under five years old, 3% 5 to 15 years old, and 4.9% over 15 years old (adjusted odds ratio increasing with age, $P = 0.002$). It is not clear whether age was more significant than technique.

O'Leary and Vorrath prospectively compared another large series of 3087 cold tonsillectomies (dissection by cold steel and hemostasis by either ties or monopolar diathermy), with 1557 tonsillectomies by means of diathermy dissection and hemostasis.[4] Age ranged from 5 to 49 years (mean, 22 years). Data were recorded over a period of 2.5 years. In this

Table 3
National Prospective Tonsillectomy Audit rates of post-tonsillectomy bleeding by surgical technique[2]

	n	Post-op bleed %	Return to surgery %
Cold steel dissection and ties/packs for hemostasis	4285 (13%)	1.7	0.8
Cold steel dissection and monopolar diathermy haemostasis	1772 (5%)	2.9	0.8
Cold steel dissection and bipolar diathermy hemostasis	11,956 (35%)	2.7	0.7
Monopolar diathermy forceps	452 (1%)	6.6	1.6
Bipolar diathermy forceps	10,240 (30%)	4.6	1.0
Bipolar diathermy scissors	2322 (7%)	5.1	1.3
Coblation	1565 (5%)	4.6	1.8
Other	1329 (4%)	4.1	1.4

study, the cold dissection and diathermy/ligation hemostasis technique was complicated by a secondary hemorrhage in 57 of 3087 cases (1.85%), whereas the monopolar diathermy dissection and hemostasis techniques were complicated by a secondary hemorrhage in 37 of 1557 cases (2.38%). Although these differences did not reach statistical significance (95% confidence interval for relative risk of bleeding after diathermy tonsillectomy, 0.88 to 1.93), the diathermy technique was associated with a significantly greater volume of blood lost—in excess of 500 mL in 43% of diathermy tonsillectomy bleeds compared with 16% of cold-dissection bleeds. This study also found that the rate of reactionary bleeding was greater in the dissection tonsillectomy group (χ^2, $P < 0.02$), whereas the diathermy group had more secondary bleeds, especially between days four and seven (χ^2, $P < 0.001$). Three patients were reported to have required transfusion, but it was not reported which group they came from. From their data, inter-surgeon differences in bleed rates were considerable and in fact appear to have been more significant than the technique chosen for tonsillectomy. The influence of age was not determined.

Lee et al[1] prospectively compared 145 nonrandomized, bilateral tonsillectomies performed with the use of cold dissection plus hemostasis by means of bipolar diathermy, ligatures, or both, with 192 bilateral tonsillectomies by means of bipolar diathermy dissection plus hemostasis. Adults and children were included, with mean age 16.7 years. Data were collected only for the first 10 postoperative days. One patient had a primary/reactive hemorrhage, and 32 had had secondary hemorrhages (9.2%) (one patient had both). In this study, the cold dissection and diathermy/ligature hemostasis technique was complicated by a secondary hemorrhage in eight of 145 cases (5.5%), whereas the bipolar diathermy dissection and hemostasis technique was complicated by secondary hemorrhage in 24 of 192 cases (12.5%). The difference in post-tonsillectomy bleed rate was reported to be statistically significant (χ^2, $P < 0.05$); however, the calculated Yates χ^2 is 0.049, so the difference only just reaches significance at 0.05. It found no difference between experienced and trainee surgeons. The influence of age was not determined.

Two single-technique studies were examined, one "cold" and the other "hot." Using an exclusively cold dissection technique (scissors, raspatory, or snare) with hemostasis by means of suture ligation only, without any electrosurgical instrumentation, Windfuhr et al[9] retrospectively reviewed 7132 patients ranging in age from five months 93 years (mean, 22 years; median, 18 years) who underwent tonsillectomy with or without adenoidectomy. In 24%, the indication was immediate abscess tonsillectomy or infectious mononucleosis, but neither was associated with an increased rate of bleeding. In this study, post-tonsillectomy hemorrhage was defined as return to surgery; nothing less was recorded as a hemorrhage. Of the 204 patients returned to surgery (2.86% of the series), 77% followed a primary bleed, at a mean 247 minutes after surgery. Eight patients required ligation of the external carotid artery and one child died of hemorrhage.

A prospective audit exclusively using a Benjamin monopolar diathermy technique for dissection and hemostasis (supplemented by ties when required) was commenced in January 1994, and data were initially reported in 1999.[10] In this audit, the 12-year period to June 2005 includes 1328 consecutive tonsillectomies: 471 tonsillectomy alone (35.5%) and 857 adeno-tonsillectomy (64.5%). Age range was from 0.68 to 17 years old (mean, 6.3 years old; median, 5.6). Of the series of 1328 tonsillectomies with or without adenoidectomy, two (0.15%) were returned to surgery for a primary/reactionary tonsillar bleed. Twenty-nine secondary hemorrhage complications were recorded in 28 children (2.1% of the series): 1.4% were readmitted for observation alone, 0.8% were returned to surgery, and 0.08% underwent blood transfusion. Stratifying by age group, the 0- to four-year-old group had a secondary bleed complication rate of 1.3%; the five- to nine-year-old group had a rate of 2.8%; and those 10 to 16 years old had a rate of 2.9%.

The NPTA study, based on a 2.5- to 3.2-times greater risk for a post-tonsillectomy bleed with the use of diathermy compared with cold steel plus ties, concluded that surgeons using a diathermy technique for tonsillectomy should consider using an alternative technique. This is not the conclusion reached by the institutional review here. The most direct comparison is the NPTA bleed rate after a diathermy (monopolar plus bipolar) technique of 4.7% compared with 2.8% for cold steel dissection plus diathermy (monopolar plus bipolar) hemostasis (odds ratio, 1.7); versus the JHH/JHCH bleed rate after a diathermy (monopolar) technique of 4.2% compared with 5.4% for blunt dissection plus diathermy (monopolar) hemostasis (odds ratio, 0.78).

The differences among papers with respect to bleed rates after tonsillectomy with different techniques need to be examined. One explanation for higher post-tonsillectomy bleed rates after diathermy techniques may be related to greater thermal damage as the result of excessively high power settings or excessively frequent or prolonged application of diathermy. Philosophically, in our institution, if diathermy is being used for hemostasis but bleeding continues, then a tie is placed for control, whereas in the NPTA study, it appears that diathermy is used when ties are ineffective in arresting bleeding. As experience grows, the surgeon will recognize that further diathermy is not going to control the bleeding point without an unacceptable thermal injury, and a tie should be placed. As a point of technique during monopolar diathermy dissection, the tip of the instrument should be deliberately turned toward the tonsil whenever possible and the tonsil dissected out of the surrounding tissues. Thus the diathermy energy is directed toward the tonsil not the underlying tonsillar fossa. This avoids a charred tonsillar fossa, with the potential for necrosis and delayed healing. Although delayed healing is thought to cause a greater risk of infection, and it is the

infection that causes a secondary bleed, there is no objective evidence for this sequence.

In the institutional series reported here, age was a highly significant contributor to the variability in post-tonsillectomy secondary hemorrhage; much more so than technique for tonsillectomy. Published series that do not include age stratification may not recognize the contribution of age rather than technique to rates of post-tonsillectomy hemorrhage.

Definition of secondary hemorrhage in different institutions vary, as do criteria reported in the literature. Thresholds for readmission will vary from institution to institution. However, as each institution is likely to be internally consistent with reporting of secondary hemorrhage, it is important that they maintain an ongoing audit of secondary hemorrhage rates after tonsillectomy. Thus, a change in incidence can bring about further investigation.

Regardless of the technique used for tonsillectomy, teaching trainee surgeons the placement of ties to control bleeding points remains important.

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