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Otolaryngology -- Head and Neck Surgery 2011 144: 778 originally published online 31 January 2011
DOI: 10.1177/0194599810393875

AMERICAN ACADEMY OF OTOLARYNGOLOGY–HEAD AND NECK SURGERY FOUNDATION

Otolaryngology–Head and Neck Surgery
144(5) 778–783

DOI: 10.1177/0194599810393875
http://otojournal.org
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Pathologic Evaluation of Routine Pediatric Tonsillectomy Specimens: Analysis of Cost-Effectiveness

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No sponsorships or competing interests have been disclosed for this article.

Received September 10, 2010; revised October 27, 2010; accepted November 19, 2010.

Abstract

Objective. Evaluate the utility and explore the cost-effectiveness of mandatory gross or pathologic analysis of routine tonsillectomy specimens in children.

Study Design. Case series with chart review.

Setting. Tertiary care children's hospital.

Subjects and Methods. Retrospective case series of results of pathologic analysis of tonsillectomy specimens from all pediatric patients who underwent tonsillectomy between 1996 and 2008 (n = 5235). The results of pathologic evaluation of routine and nonroutine specimens were evaluated, and an economic analysis of alternative methods of specimen handling was performed.

Results. Zero cases of unsuspected pathology were identified on planned gross specimen evaluation (n = 4186), resulting in an estimated prevalence of 0 to 0.00088 (95% confidence interval [CI]). Positive pathologic findings on microscopic analysis (n = 1066) were only identified in posttransplant patients (10/63; 95% CI, 0.079-0.27) and cases of surgeon suspicion (8/78; 0.045-0.19). No cases were identified among the 17 undergoing microscopic pathologic analysis on the basis of pathologist suspicion on gross evaluation (95% CI, 0-0.20). From an economic standpoint, microscopic evaluation of routine pediatric tonsillectomy specimens appears to be superior to gross evaluation but with an estimated cost of $766 500 per case of unsuspected lymphoma identified.

Conclusions. This study identifies a very low prevalence of unsuspected pathology on gross pathologic analysis of routine tonsillectomy specimens in children. Exploration of the cost implications suggests that such a practice is not a cost-effective use of limited health care resources. Microscopic examination is appropriate for posttransplantation patients and in cases of surgeon suspicion.

Keywords

tonsillectomy, pathology, surgical, pediatrics, cost-benefit analysis

Tonsillectomy, with or without adenoidectomy, remains one of the most commonly performed surgical procedures. According to data from the National Center for Health Statistics, a total of 418 000 tonsillectomies, either alone or in combination with adenoidectomy, were performed in the United States in 1996.[1] The vast majority of these procedures are indicated on the basis of either adenotonsillar hypertrophy with sleep-disordered breathing or recurrent and/or chronic tonsillitis. Management of the surgical specimens resulting from these "routine" cases has been a frequent topic in the otolaryngology literature, with no clear consensus emerging.

In 1996, Dohar and Bonilla[2] surveyed 111 members of the American Society of Pediatric Otolaryngology. Results from the 65 responding members showed a wide discrepancy in routine handling of adenotonsillectomy specimens, with 56% reporting routine microscopic analysis, 42% reporting gross examination only, and 2% reporting that they discard routine specimens in the operating room. In 2001, Strong et al[3] reported a survey of 4715 members of the American Academy of Otolaryngology inquiring about current and past processing methods of routine tonsil specimens for patients 14 years old and younger. Returned surveys were received from 1583 members, with 38% of respondents reporting microscopic analysis of routine pediatric tonsillectomy and adenoidectomy specimens, 42% reporting gross examination only, and 20% reporting no pathologic analysis. A trend toward decreasing use of microscopic analysis was identified, with 33%

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This article was presented at the 2010 AAO-HNS/F Annual Meeting & OTO EXPO; September 26-29, 2010; Boston, Massachusetts.

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reporting a change in processing practice over the previous 10 years. Cost and literature support were most commonly cited as the reasons for this modification.

Almost 50 years ago, Weibel[4] first questioned the rationale for histological analysis for routine tonsillectomy specimens, recommending that it should only be performed in patients older than age 40 years. Subsequently, Yarington et al[5] concluded that routine histologic analysis should be performed in all cases to identify unsuspected pathology. Sodagar et al[6] reported 2 unsuspected lymphosarcomas out of 718 cases, including one in a 7-year-old boy, and argued that all tonsil specimens should undergo histopathologic analysis. Several series over the past 2 decades have concluded that microsopic analysis of routine adenotonsillectomy specimens is not warranted and have advocated gross evaluation only as the alternative. Arguments in favor of abandoning use of microscopic pathologic analysis of routine adenotonsillectomy specimens have been made on the basis of the low incidence of unsuspected pathologic diagnoses and for economic considerations.[7-10] However, there is little information in the literature regarding the effectiveness of gross evaluation only for identification of unsuspected pathology.

Previous analyses have not compared the cost-effectiveness of the 3 options commonly employed (no pathology, gross examination only, and microscopic analysis). In the current health care environment, increasingly limited resources demand a pertinent analysis of differential costs. Against this background, we offer our experience from a tertiary pediatric academic practice. The aim of this study is to review the results of gross analysis of routine pediatric tonsillectomy specimens and to present a simple incremental cost-effectiveness analysis comparing the 3 options for pathologic evaluation to better inform decisions regarding pathologic evaluation of routine pediatric tonsillectomy specimens.

Methods

Approval from the institutional review board of the University of Michigan Medical School was obtained to review the records of all patients aged 18 years or younger who underwent tonsillectomy between January 1, 1998, and December 31, 2008, within the University of Michigan Health System, a tertiary academic medical center. Potential cases were identified by querying billing records to identify Current Procedure Terminology (CPT) codes for tonsillectomy (42820, 42821, 42825, and 42826). The type of pathologic analysis performed (gross or microscopic examination), as well as the diagnoses associated with these procedures, was identified by reported CPT and *International Classification of Diseases, Ninth Revision* (*ICD-9*) codes associated with the tonsillectomy. Specimens subjected to microscopic examination also underwent gross examination, with a single diagnostic *ICD-9* code assigned on the basis of both examinations.

According to established protocol active during the study period, specimens resulting from tonsillectomy were submitted for gross examination alone unless specific indications for microscopic analysis existed. These specific indications for microscopic analysis included age ≥18 years, clinical suspicion of malignancy, asymmetry of tonsil size (>2 times variation in greatest diameter), mass, history of hematolymphoid neoplasm, or a history of transplantation. Patients were excluded from the study if the results of pathologic analysis were not available. The medical records of every patient who underwent microscopic examination of the tonsillectomy specimens were reviewed to determine the indication for microscopic analysis, as were the medical records of all patients with a nonroutine pathologic diagnosis. The indication for microscopic analysis was recorded as unspecified if none of the above specific indications existed at the time of surgery, and there was no mention of an indication for microscopic analysis in the surgeon's preoperative evaluation, the operative report, or the gross pathologic description. Routine pathologic diagnoses include the following *ICD-9* codes: 463.x, 472.x, and 474.x. These codes encompass acute tonsillitis, chronic pharyngitis and nasopharyngitis, and chronic disease of tonsils and adenoids, respectively.

For the purposes of the economic analysis, we sought to include all published reports in the English language literature, which described the results of either gross or microscopic analysis of routine pediatric tonsillectomy specimens in children. Consideration of adenoidectomy specimens separately was foregone as many surgeons currently use methods for adenoid removal that do not result in a surgical specimen, such as a microdebrider or suction cautery. Routine tonsillectomy specimens are defined as those in which there was no history of transplantation, no history of hematolymphoid malignancy, and the operating surgeon did not have a preoperative suspicion of pathology. For the purposes of this analysis, the costs considered are limited to the costs of pathologic examination. Costs related to collection and transport of specimens or to ongoing medical care following an unsuspected diagnosis are assumed to be similar regardless of choice of pathologic evaluation and are ignored. The average costs of gross and microscopic evaluation of tonsillectomy are estimated by using 2008 Medicare reimbursement rates (US Department of Health and Human Services, Center for Medicare and Medicaid Services, 2008 Reimbursement Schedule). Hospital charges are not an appropriate measure of true economic cost because of the peculiarities of the medical marketplace. Medicare reimbursement rates are generally considered to more accurately reflect true economic costs than hospital charges. CPT code 88300 is used for gross examination, with CPT code 88304 used for gross and microscopic examination. The Medicare reimbursement rate in 2008 was $22.85 for CPT code 88300 and $61.32 for CPT code 88304. These codes are applied twice if the specimens are separately identified.

The literature was reviewed to identify relevant articles to estimate the prevalence of unsuspected significant pathologic diagnoses when routine tonsillectomy specimens in children were examined with gross and/or microscopic pathologic analysis. The age requirement for definition of a pediatric population varied across the studies. To be inclusive of the existing literature, any articles reporting results for patients aged 21 years and younger were included. Point estimates and exact binomial 95% confidence intervals for the prevalence of

Table 1. Results of Microscopic Evaluation of Specimens by Indication

Indication for Histopathology	No. of Specimens	No. of Pathologic Findings (%)
Posttransplant	63	10 (15.9)
Pathologist suspicion	17	0 (0)
Asymmetry	53	0 (0)
Hematolymphoid neoplasm	6	0 (0)
Surgeon mass	9	5 (55.6)
Lymphoma suspicion	9	3 (33.3)
Other[a]	87	0 (0)
Unspecified	822	0 (0)

[a]Other includes friable (7), aged 18 years (63), history of immunodeficiency (1), branchial apparatus (1), hemorrhagic tonsillitis (2), epidermolysis bullosa (1), and quinsy (12).

unsuspected diagnoses for both gross and microscopic analysis were calculated using the statistical software package Stata 10 (StataCorp, College Station, Texas).

Incremental cost-effectiveness ratios as recommended by the Panel on Cost-Effectiveness in Health and Medicine were then calculated, comparing no pathologic analysis, gross examination only, and microscopic analysis.[11] Sensitivity analysis was performed, varying the estimated prevalence of unsuspected diagnoses to the extremes of the 95% confidence intervals, to evaluate the stability of the findings.

Results

A total of 5265 tonsillectomy specimens were reviewed by the pathology department during the study period. Thirty patients were excluded because of missing or incomplete medical records (n = 5235). Of the patients in this database, 4169 underwent gross pathologic analysis only, whereas 1066 underwent histopathological analysis. No pathologic abnormalities were identified in the specimens undergoing gross analysis only (95% confidence interval [CI] for estimated prevalence of unsuspected pathology, 0%-0.088% or 0-8.8 per 10 000). **Table 1** shows the frequency of pathologic findings by indication for histologic analysis. The indication for histologic analysis was not recorded for 822 specimens. We suspect that many of these were performed because of errors in specimen submission or processing, although we cannot exclude the possibility that a clinical indication existed and was not documented in the medical record. Seventeen gross specimens were deemed suspicious by the pathologist and subsequently underwent histopathologic analysis. No pathologic abnormalities were identified on this histopathologic analysis. Of the 5 pathologic specimens identified by the surgeon as a mass at the time of surgery, 2 were inflammatory polyps and 3 were squamous papillomas. Of 9 specimens submitted for histology because of suspicion for lymphoma, 3 were diagnosed as infectious mononucleosis, and the others were negative for lymphoma. Ten of the 63 patients with a history of transplantation were positive for posttransplantation lymphoproliferative disorder (15.87%). There were no unsuspected malignancies identified on either gross or microscopic pathologic analysis.

Table 2 presents a summary of the studies in the literature that provide an estimate of the prevalence of unsuspected significant pathologic diagnoses when routine tonsillectomy specimens in children were examined with microscopic pathologic analysis.[2,3,9,10,12-21] In the 15 studies, including 19 045 children (all aged 21 years or younger) who underwent either tonsillectomy or adenotonsillectomy, there were a total of 41 pathologic diagnoses reported, of which all but 8 were suspected preoperatively. Of the unsuspected diagnoses, 4 required additional treatment. These included 1 unsuspected glycogen storage disorder and 3 unsuspected lymphomas. The prevalence of unsuspected diagnoses requiring additional treatment was therefore 0.021% or 2.1 per 10 000 (95% CI, 0.57 per 10 000 to 5.4 per 10 000).

Table 2. Published Rates of Pathologic Findings on Routine Pediatric Tonsillectomy Specimens Evaluated by Microscopic Pathologic Analysis

Reference	No. of Subjects	Positive	Positive Unsuspected	Rate	Unsuspected Rate
Ridgway et al[17]	1100	0	0	0	0
Dohar and Bonilla[2]	2012	2	1	0.000994	0.000497
Strong et al[3]	1583	0	0	0	0
Younis et al[9]	2099	0	0	0	0
Harley[16]	258	0	0	0	0
Williams and Brown[18]	2238	3	0	0.00134	0
Garavello et al[15]	1123	2	2	0.001781	0.001781
Erdag et al[14]	2217	0	0	0	0
Dost[13]	166	0	0	0	0
Dewil et al[12]	2058	0	0	0	0
van Lierop et al[20]	172	2	0	0.0116279	0
Papouliakos et al[19]	753	1	0	0.001328	0
Sturm-O'Brien et al[10]	348	9	1	0.0057636	0.0028818
Verma et al[21]	1852	4	4	0.00216	0.00216
Nelson et al 2010 [current study]	1066	18	0	0.016886	0

Table 3. Published Rates of Pathologic Findings on Routine Pediatric Tonsillectomy Specimens Evaluated by Gross Pathologic Analysis

Reference	Population	Number	Positive	Positive Unexpected	Rate	Unsuspected Rate
Alvi and Vartanian[22]	Children	173	0	0	0	0
Sturm-O'Brien et al[10]	Children	7490	0	0	0	0
Nelson et al 2010 [current study]	Children	4169	0	0	0	0

Table 4. Cost-Effectiveness of Routine Pathologic Analysis

Method of Analysis	Prevalence	Cost per Case
No Pathology	0	0
Gross examination	0 per 10 000 (0-3.1 per 10 000)	Infinite ($147 000 to infinite)
Microscopic examination	2.1 per 10 000 (0.57-5.4 per 10 000)	$584 000 ($227 000 to $2 150 000)

Table 5. Incremental Cost-Effectiveness Analysis

Method of Analysis	Prevalence	Cost	Incremental Cost	Incremental Effect	ICER
No pathology	0	0	0	0	Infinite
Gross examination	0	$45.70	$45.70	0	Infinite
Microscopic examination	2.1 per 10 000	$122.64	$76.94	2.1 per 10 000	$584 000

Table 3 presents a summary of the studies in the literature that provide an estimate of the prevalence of unsuspected significant pathologic diagnoses when routine tonsillectomy specimens in children were examined with gross pathologic analysis alone.[10,22] In the 3 studies, including 11 832 patients aged 18 years or younger who underwent either tonsillectomy or adenotonsillectomy, there were no reported unsuspected significant pathologic diagnoses. The estimated prevalence of unsuspected pathologic diagnoses on gross examination ranges from 0.0% to 0.031%, or 0 to 3.1 per 10 000.

For economic analysis, it was assumed that surgical specimens are routinely separately identified, labeled, and sent to pathology when pathologic analysis is performed. The calculated cost per case of unexpected significant pathology from microscopic examination is estimated at $584 000 (95% CI, $227 000 to $2 150 000). Considering lymphoma alone, the calculated cost per unsuspected case identified is estimated at $766 500 (95%, CI $267 000 to $3 720 000). The calculated cost per case of unexpected significant pathology identified on gross examination is estimated to be infinite (95% CI, $147 000 to infinite; **Table 4**). **Table 5** presents the incremental cost-effectiveness analysis for the 3 options.

Discussion

With the ever increasing understanding that medical care is provided in an environment of limited resources, economic analyses will continue to play an increasing role in optimizing delivery of care. Multiple studies over the past 2 decades have shown the very low incidence of unsuspected significant histopathology (ie, malignancy) of routine tonsillectomy specimens in the pediatric population. Our data are consistent with previously reported series of pathologic analysis of routine tonsillectomy specimens. We identified no significant unexpected pathology in a large cohort of children undergoing tonsillectomy. Reflecting this low incidence, as well as increasing consideration of health care expenditures, more surgeons seem to be moving away from routine histologic analysis in favor of gross analysis or no analysis at all.[3] Without a true analysis of the alternatives of no pathology, gross pathology only, or histopathology, it would be difficult to argue for comprehensive or meaningful policy changes in regard to handling of routine pediatric tonsillectomy specimens.

Few previous reports in the literature have specifically addressed the incidence of unsuspected pathology identified on gross analysis only. Alvi and Vartanian,[22] in their review of gross analysis of tonsil specimens, noted no significant pathology in 173 patients. Sturm-O'Brien et al[10] recently reported on their series of 7837 patients, using criteria similar to ours to determine which cases would warrant histologic analysis. They identified 2 malignancies, only one of which was suspected preoperatively. The unsuspected malignancy was not identified on gross evaluation but was identified from banked tissue after suspicion arose because of delayed healing. In our study population, 4189 patients underwent gross pathologic analysis only, with no significant pathology identified on gross analysis. This includes the 17 cases examined microscopically because of pathologist suspicion.

We attempted to address the economic implications of differing methods of pathologic analysis of routine specimens. Our best estimate for the cost per case of unsuspected pathology

identified by microscopic analysis is roughly $584 000. As we were unable to identify any cases of unexpected significant pathology, our best estimate for the cost per case identified by gross analysis is infinite. From an economic perspective, an alternative is said to be weakly dominated when the incremental cost-effectiveness ratio (ICER) comparing it to the next less expensive option is larger than the ICER comparing the next more expensive option to the option in question. In this case, the ICER comparing gross pathologic analysis to no pathology is larger than the ICER comparing microscopic analysis to gross analysis. In other words, if spending economic resources for identification of unsuspected pathology is thought to be a good use of resources, it would be better from an economic standpoint to perform microscopic rather than gross examination. Varying the estimated prevalence of unsuspected pathology identified by gross pathology, we find that gross pathologic analysis is no longer weakly dominated at a prevalence of 0.78 per 10 000. As this prevalence is within our 95% confidence interval, we have some uncertainty regarding our conclusion that gross examination is economically inferior to microscopic examination.

Although the economic analysis presented in this article provides a basis for comparison of the 2 methods of pathologic analysis, it remains incomplete in terms of its ability to inform policy decisions. An estimated cost of nearly $766 500 per unsuspected lymphoma diagnosis in a tonsillectomy specimen cannot be directly compared to the cost of other medical interventions. As has been pointed out by others, a cost-utility analysis, including the cost of pathologic analysis per quality-adjusted life year (QALY) gained from such analysis, would be more helpful in this regard.[15] However, such an analysis would require information on the impact of a delayed diagnosis of unsuspected lymphoma on quality of life, information that is not currently or likely to become available. However, we can provide a very rough estimate. The most likely malignancy to be missed in a pediatric routine tonsil specimen would be non-Hodgkin lymphoma (NHL). When all subclassifications of NHL are considered, the 5-year survival for children and adolescents is roughly 80% with late-stage disease.[23] Let us assume that all unsuspected diagnoses made on pathologic analysis are cured and live to age 65 with no decrement in quality of life, whereas the 20% mortality for those with missed diagnoses occurs in the first year. If patients undergo tonsillectomy at age 5, there would be a difference of 12 QALYs saved by microscopic analysis, at a cost of $766 500 or $63 875 per QALY ($2250 to $310 000). By general consensus, a cost of roughly $50 000 to $60 000 per QALY is thought to be economically reasonable. Thus, our best estimate is that microscopic examination of routine tonsillectomy specimens is not cost-effective, although we acknowledge that the range of plausible values for the cost per QALY is wide and includes costs that would certainly be considered cost-effective.

This current economic analysis would tend to support a decision to either forego pathologic analysis of routine tonsillectomy specimens in children or to perform microscopic analysis routinely. However, policy decisions can and should continue to be made at the hospital level by tissue committees. These decisions should be informed not only by this type of economic analysis but also by value decisions regarding factors such as the training of pathologists and the acceptability of any missed diagnoses.

It should be noted that conclusions drawn from this study should be limited to cases where there is no preoperative suspicion of pathology. In contrast to the sentiment expressed by some authors, the decision to forego pathologic analysis of routine specimens is not equivalent to "blindly discarding" the specimen.[24] Regardless of the type of pathologic analysis requested of tonsillectomy specimens (if any), the surgeon continues to have a responsibility to identify patients at increased risk of significant pathology and to request appropriate evaluation from their consulting pathologist. Specimens from children with a history of transplantation or other immunosuppression, a history of a hematolymphoid system malignancy, or with other clinical features suspicious of malignancy (fevers, chills, neck mass, rapid adenotonsillar hypertrophy occurring either bilaterally or unilaterally not due to acute infection) are not considered routine and should undergo complete histopathologic analysis. A number of authors have examined the incidence of malignancy in patients with otherwise asymptomatic tonsillar asymmetry, with most concluding that the risk of malignancy is low and observation of these patients is reasonable. In fact, in many cases, the clinical finding of asymmetry has been shown to be spurious following surgical removal.[16,20,25]

Conclusion

This current economic analysis would tend to support a decision to either forego pathologic analysis of routine tonsillectomy specimens in children or to perform microscopic analysis routinely. Decisions regarding the role of pathologic analysis of routine tonsillectomy specimens in children, if any, should be informed by this type of economic analysis. Surgeons should continue to remain vigilant for signs and symptoms suggestive of an underlying pathologic diagnosis and request appropriate pathologic analysis when indicated.

Author Contributions

Marc E. Nelson, conception and design, acquisition, analysis, drafting, and revision, **T. J. Gernon**, conception and design, acquisition, and revision; **Joseph C. Taylor**, conception and design, acquisition, and revision; **Jonathan B. McHugh**, conception and design, and revision; **Marc C. Thorne**, conception and design, acquisition, analysis, drafting, and revision.

Disclosures

Competing interests: None.

Sponsorships: None.

Funding source: None.

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