THE ROLE OF ADJUVANT ADENOIDECTOMY AND TONSILLECTOMY IN THE OUTCOME OF THE INSERTION OF TYMPANOSTOMY TUBES

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ABSTRACT

Background Otitis media is the most common medical problem in young children. The usual surgical treatment is myringotomy with insertion of tympanostomy tubes. There is debate about the usefulness of concomitant adenoidectomy or adenotonsillectomy. We examined the effects of these adjuvant procedures on the rates of reinsertion of tympanostomy tubes and rehospitalization for conditions related to otitis media.

Methods Using hospital discharge records for the period 1995 through 1997, we examined the results of surgery for all 37,316 children (defined as persons 19 years of age or younger) in Ontario, Canada, who received tympanostomy tubes as their first surgical treatment for otitis media. We determined the time to the first readmission for conditions related to otitis media and the time to the first reinsertion of tympanostomy tubes.

Results As compared with treatment involving the insertion of tympanostomy tubes alone, adjuvant adenoidectomy was associated with a reduction in the likelihood of reinsertion of tympanostomy tubes (relative risk, 0.5; 95 percent confidence interval, 0.5 to 0.6; P<0.001) and the likelihood of readmission for conditions related to otitis media (relative risk, 0.5; 95 percent confidence interval, 0.5 to 0.6; P<0.001). The risk of these outcomes was further reduced if an adjuvant adenotonsillectomy was performed. The effect was age-related. Children as young as one year appeared to benefit from adjuvant adenotonsillectomy; the benefit of an adjuvant adenoidectomy was apparent in two-year-olds and was greatest for children three years of age or older.

Conclusions Performing adenoidectomy or adenotonsillectomy at the time of the initial insertion of tympanostomy tubes substantially reduces the likelihood of additional hospitalizations and operations related to otitis media among children two years of age or older. (N Engl J Med 2001;344:1188-95.)

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OTITIS media is the most common medical problem for which children in North America see a doctor[1,2] and the most common reason for surgery in children.[3-7] Standard surgical treatment is a myringotomy with insertion of a tympanostomy tube.[8] In several randomized trials adenoidectomy performed in conjunction with the insertion of tympanostomy tubes (adjuvant adenoidectomy) improved outcomes, measured in terms of overall complications, the length of time in which effusion of the middle ear was present, and the need for retreatment.[9-15] Combined adenoidectomy and tonsillectomy (adenotonsillectomy) did not improve outcomes more than adjuvant adenoidectomy alone.[9-12] Adjuvant adenoidectomy was less effective in resolving otitis media among children who were 2 to 2.5 years of age than among older children.[9] A trial comparing the outcomes in children who underwent adenoidectomy or adenotonsillectomy with those in a control group that either did not undergo surgery or received myringotomy without the insertion of tympanostomy tubes found that adenotonsillectomies were slightly more effective than adenoidectomies.[16] These studies each involved 200 to 500 children, and most were performed in tertiary care centers. Therefore, the extent to which the results can be generalized to other groups of children or physicians' practices is uncertain.

We assessed the effect of adjuvant adenoidectomy, tonsillectomy, and adenotonsillectomy on the rates of rehospitalization and reinsertion of tympanostomy tubes after the initial insertion of tympanostomy tubes, using data from all hospitals in Ontario, Canada, for the period from 1995 through 1997 (all years refer to fiscal years, which begin on April 1 and end on March 31 of the following year).

METHODS

Study Subjects

In Ontario, which has over 11 million residents, hospitals are required to report all inpatient and same-day operative procedures, and such procedures account for over 96 percent of all tympanostomy-tube insertions[17] (the remainder are performed in private offices). Universal, comprehensive public health insurance covers all medically necessary services; supplementary private insurance for these services is prohibited. Therefore, surgery is available to all on equal financial terms. For the purposes of this study we defined children as persons who were 19 years of age or younger.

We searched hospital discharge records for 1992 through 1997 for all Ontario residents 19 years of age or younger who had undergone a myringotomy (*International Classification of Diseases, 9th revision* [ICD-9] code 32.09), a myringotomy with the insertion

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of a tympanostomy tube (ICD-9 code 32.01), a tonsillectomy (ICD-9 code 40.1), an adenoidectomy (ICD-9 code 40.5), or an adenotonsillectomy (ICD-9 code 40.2). Records were excluded only if it was not possible to identify the patient's place of residence (true for 0.7 percent of records) or if a valid patient identifier was not available, thereby preventing follow-up (true for 0.9 percent of records).

Identification of Index Surgery

We examined the outcome of each child's first surgical intervention for otitis media. We identified each child's first hospital admission for one of the five relevant ICD codes between 1992 and 1997. We included only first admissions that occurred between 1995 and 1997 in which a tympanostomy tube was inserted. This approach ensured that the insertion of the tubes (with or without adenoidectomy, tonsillectomy, or adenotonsillectomy, hereafter referred to as adjuvant procedures) represented the first surgical treatment for otitis media (Fig. 1). The data indicated that although there could be as much as a three-year gap between otolaryngologic procedures, longer gaps were rare.

Children who had undergone a tonsillectomy or adenoidectomy before receiving their first set of tympanostomy tubes were excluded, because adenoidectomy or tonsillectomy at the time of tube insertion was no longer a treatment option. Children who had moved to Ontario within three years before their index admission were also excluded, because previous surgery, if any, would not be recorded in the Ontario data base (this was true for 3 percent of the records). The analyses were performed on 37,316 index hospitalizations for tympanostomy-tube insertion, performed during the period from 1995 through 1997 at a total of 117 hospitals.

Characterization of the Index Hospitalization

From the discharge records we obtained the following information: age, sex, and nature of residence (rural or urban); additional procedures that the patient underwent during hospitalization; nature of the admission (urgent or elective), nature of the surgery (day surgery or inpatient), the length of stay, and the diagnoses; the type of hospital (teaching or community); and the total number of tympanostomy-tube insertions performed in the hospital during the year of the child's surgery. To assess coexisting conditions, we used an adaptation of the Charlson comorbidity index.[18-20] The index is based on 17 indicators of coexisting conditions, which are weighted and then totaled to give a single value. A value of 0 indicates that there are no serious coexisting conditions. A value of 2, for example, might indicate that a patient had both cardiovascular disease and a respiratory disease, each of which is assigned a weight of 1, or it might indicate that a patient had diabetes mellitus, which is assigned a weight of 2. The maximal weighting for a single cause is 6 and indicates the presence of metastatic cancer or infection with the human immunodeficiency virus.

To control for potential unidentified coexisting conditions, we identified a subgroup of children who were generally healthy except for the presence of otitis media.[21] In this subgroup the children were younger than 14 years at the time of the index hospitalization, underwent elective surgery, stayed no longer than overnight, were discharged according to normal procedures, received tympanostomy tubes alone or in addition to adenoidectomy, tonsillectomy, or both, and had a score of 0 on the Charlson comorbidity index. This otherwise healthy subgroup included 31,463 children (84 percent of the original group). The main reason for exclusion from this subgroup, accounting for 70 percent of the children who were excluded, was the receipt of a procedure other than the five designated otolaryngologic procedures. These procedures included turbinectomy, correction of cleft palate, ear irrigation, lingual frenotomy, puncture of nasal sinus, and intranasal antrotomy.

The study was approved by the ethics review committee of the University of Toronto.

Statistical Analysis

Two outcome measures were examined: the time to the first reinsertion of tympanostomy tubes and the time to the first readmission for a condition related to otitis media. These outcomes were indicated by a diagnosis of otitis media (ICD-9 codes 381.0 through 381.4 or 382.0 through 382.9) in the discharge record or by a repeated myringotomy, with or without tube insertion. The term "readmission" includes both inpatient treatment and same-day surgery. We used proportional-hazards regression analysis to identify factors associated with the outcome measures.[22] Analyses were performed with the use of SAS software, version 6.12.[23] All statistical tests were two-sided.

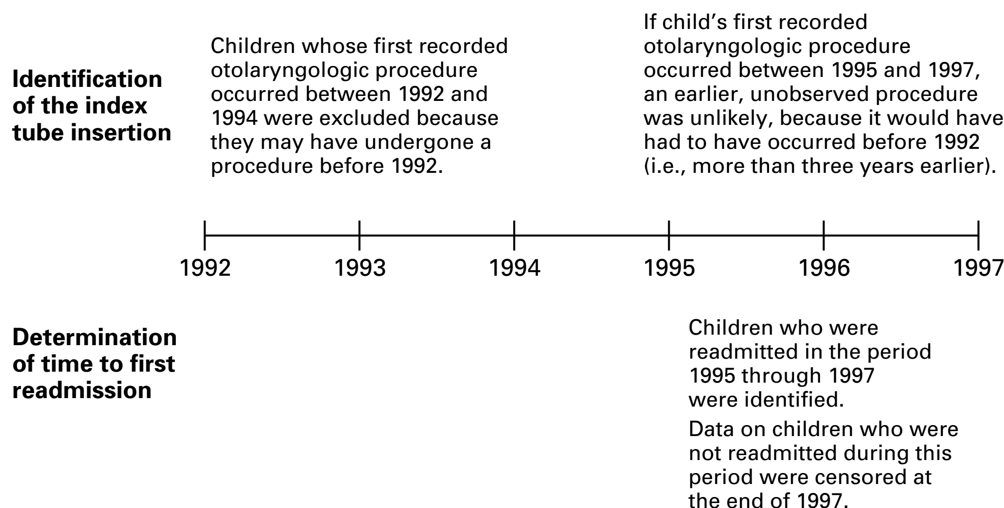

Figure 1. Method of Identifying the Initial (Index) Insertion of Tympanostomy Tubes and the Time to Readmission for Problems Related to Otitis Media.

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RESULTS

Characteristics of the Children

The characteristics of the children are summarized in Tables 1 and 2. As compared with children who received tympanostomy tubes alone, the children who underwent adjuvant surgery were older and more likely to have been treated at a community hospital in which the number of tympanostomy-tube insertions performed per year was lower (Table 1). Although children who underwent adjuvant surgery were more likely to have been treated on an inpatient basis, almost all were released within one day. These differences persisted in the subgroup of children who were otherwise healthy except for otitis media.

Benefit of Adjuvant Procedures

The factors that influenced the risk of a first reinsertion of tympanostomy tubes and of readmission for conditions related to otitis media are shown in Table 3 and Table 4, respectively. An adenoidectomy during the index hospitalization significantly decreased the risk of reinsertion (relative risk, 0.5; 95 percent confidence interval, 0.5 to 0.6) and readmission (relative risk, 0.5; 95 percent confidence interval, 0.5 to 0.6); an adenotonsillectomy provided additional benefit. Although the number of children who underwent tympanostomy-tube insertion and adjuvant tonsillectomy was small, the reduction in risk was similar to that with adjuvant adenoidectomy, with a much wider confidence interval (Tables 3 and 4).

The effect of adjuvant adenoidectomy in the children who were otherwise healthy at the time of the initial hospitalization for the insertion of tympanostomy tubes is shown in Figure 2. Within the first year, 10 percent of the children in this group who received tympanostomy tubes alone were readmitted, as compared with 4 percent of the children who underwent adjuvant adenoidectomy; within two years, 24 percent and 12 percent, respectively, were readmitted. For the

TABLE 1. CHARACTERISTICS OF THE CHILDREN WHO RECEIVED TYMPANOSTOMY TUBES ALONE AND OF THOSE WHO UNDERWENT ADJUVANT SURGERY.*

CHARACTERISTIC	ALL CHILDREN (N=37,316)	TYMPANOSTOMY-TUBE GROUP (N=26,714)	ADJUVANT-SURGERY GROUP (N=10,602)	P VALUE†
Patients				
Age (yr)				<0.001
Median	3	2	4	
25th percentile, 75th percentile	1, 5	1, 5	3, 6	
Male sex (%)	60	61	59	<0.001
Residence in urban area (%)	65	64	67	<0.001
Charlson comorbidity index of 0 (%)‡	98	99	99	1.00
Hospitalization				
Same-day surgery or inpatient surgery involving only an overnight stay (%)	98	98	98	0.72
Inpatient surgery (%)	8	2	22	<0.001
Elective admission (%)	99	99	97	<0.001
Diagnosis of otitis media or chronic disease of tonsils and adenoids most important reason for hospitalization (%)	97	97	96	<0.001
Percentage of children who also underwent a nonotolaryngologic procedure	11	11	11	0.20
Year of index surgery (%)				<0.001
1995	38	37	40	
1996	32	32	30	
1997	31	31	30	
Hospital				
Community hospital (%)	80	78	85	<0.001
Annual volume of tympanostomy-tube insertions				<0.001
Median	403	437	363	
25th percentile, 75th percentile	224, 604	244, 676	207, 544	

*Adjuvant surgery consisted of adenoidectomy, tonsillectomy, or adenotonsillectomy. Because of rounding, not all percentages total 100.

†All P values are for the comparison of the group that received tympanostomy tubes with the group that received adjuvant surgery. Wilcoxon's rank-sum test was used for the comparisons of age and annual volume of tympanostomy-tube insertions, and Fisher's exact test was used for the remainder of the comparisons.

‡A value of zero on the Charlson comorbidity index indicates that there are no serious coexisting conditions.

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TABLE 2. CHARACTERISTICS OF THE CHILDREN WHO UNDERWENT ADJUVANT SURGERY.*

CHARACTERISTIC	ADENOIDECTOMY GROUP (N=4125)	TONSILLECTOMY GROUP (N=330)	ADENOTONSILLECTOMY GROUP (N=6147)	P VALUE†
Patients				
Age (yr)				<0.001
Median	4	5	4	
25th percentile, 75th percentile	3, 6	4, 8	3, 6	
Male sex (%)	60	54	58	0.02
Residence in an urban area (%)	67	50	68	<0.001
Charlson comorbidity index of 0 (%)‡	98	94	98	<0.001
Hospitalization				
Same-day surgery or inpatient surgery involving only an overnight stay (%)	99	96	99	<0.001
Inpatient surgery (%)	9	44	30	<0.001
Elective admission (%)	99	97	95	<0.001
Diagnosis of otitis media or chronic disease of tonsils and adenoids most important reason for hospitalization (%)	97	95	95	<0.001
Percentage of children who also underwent a nonotolaryngologic procedure	11	12	11	0.60
Year of index surgery (%)				0.16
1995	39	42	40	
1996	31	29	29	
1997	30	29	30	
Hospital				
Community hospital (%)	84	80	85	0.04
Annual volume of tympanostomy-tube insertions				0.27
Median	385	332	363	
25th percentile, 75th percentile	207, 547	220, 501	207, 544	

*Because of rounding, not all percentages total 100.

†P values are for the comparison of all three groups. The Kruskal–Wallis (nonparametric) test was used for the comparisons of age and annual volume of tympanostomy-tube insertions, and Fisher's exact test was used for the remainder of the comparisons. (The traditional Fisher's exact test applies only to two-by-two cross-tabulations, but SAS software includes an exact test for larger tables.)

‡A value of 0 on the Charlson comorbidity index indicates that there are no serious coexisting conditions.

entire group of patients, the plots for tube reinsertion and for adjuvant adenotonsillectomy rather than adjuvant adenoidectomy were similar.

As compared with adjuvant adenoidectomy, adjuvant adenotonsillectomy was associated with a relative risk of the reinsertion of tympanostomy tubes of 0.8 (95 percent confidence interval, 0.7 to 1.0; P=0.02) and of readmission for conditions related to otitis media of 0.8 (95 percent confidence interval, 0.7 to 0.9; P=0.002). Thus, adding a tonsillectomy to an adenoidectomy was beneficial. The effect of adjuvant tonsillectomy was similar to that of adjuvant adenoidectomy or adenotonsillectomy. The reported risks were adjusted for the child's age, type of admission, place of residence, and sex; the number of tympanostomy-tube insertions performed in the hospital in the same year; and the type of hospital.

The decrease in rehospitalizations after adjuvant surgery may have occurred because physicians thought further surgery would not be useful in children who had both received tympanostomy tubes and undergone adjuvant surgery. If so, adjuvant surgery would reduce elective readmissions more than it would reduce the number of urgent or emergency readmissions. However, the relative risk of elective readmission after adjuvant adenoidectomy was 0.5, and the relative risk of urgent readmission after adjuvant adenoidectomy was 0.6; the corresponding relative risks associated with adjuvant adenotonsillectomies were 0.4 and 0.5.

Older children were less likely than younger children to have tympanostomy tubes reinserted or to be rehospitalized for conditions related to otitis media (Tables 3 and 4). The year in which the index hospitalization occurred, the length of stay, the Charlson comorbidity index at the time of admission, and the inclusion of a diagnostic code for otitis media in the discharge record did not have a significant effect on

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TABLE 3. FACTORS AFFECTING THE RISK OF REINSERTION OF TYMPANOSTOMY TUBES.*

VARIABLE	ALL CHILDREN (N=37,316)		OTHERWISE HEALTHY CHILDREN (N=31,463)	
	RELATIVE RISK (95% CI)†	P VALUE	RELATIVE RISK (95% CI)†	P VALUE
Adjuvant adenoidectomy	0.5 (0.5–0.6)	<0.001	0.5 (0.5–0.6)	<0.001
Adjuvant tonsillectomy	0.6 (0.4–0.9)	0.01	0.5 (0.3–0.8)	0.003
Adjuvant adenotonsillectomy	0.4 (0.4–0.5)	<0.001	0.4 (0.4–0.5)	<0.001
Urgent or emergency admission (vs. elective admission)	1.4 (1.1–1.7)	0.01	—‡	
Age (per year of age)	0.9 (0.9–0.9)	<0.001	0.9 (0.9–0.9)	<0.001
Residence in a rural area (vs. residence in an urban area)	1.2 (1.1–1.3)	<0.001	1.2 (1.1–1.3)	<0.001
Male sex	1.1 (1.1–1.2)	<0.001	1.1 (1.1–1.2)	0.001
Annual volume of tympanostomy-tube insertion (per each increase by a factor of 10)§	1.2 (1.1–1.3)	<0.001	1.1 (1.0–1.2)	0.004
Community hospital (vs. teaching hospital)	1.2 (1.1–1.3)	<0.001	1.3 (1.2–1.3)	<0.001

*Among the entire group of children there were 5277 readmissions for the first reinsertion of tympanostomy tubes, and among the subgroup of children who were otherwise healthy except for otitis media, there were 4396 reinsertions. Data were censored at the end of 1997 for 86 percent of the children in each group.

†The reported relative risks are adjusted for the other variables in the table. Values of less than 1 indicate a decreased risk of tympanostomy-tube reinsertion; values of more than 1 indicate an increased risk. CI denotes confidence interval.

‡One of the enrollment criteria for this group was elective surgery.

§The values for the annual volume of tympanostomy-tube insertions were log-transformed (base 10) because the volumes were skewed, with values ranging from 1 to 1578. Therefore, the reported relative risk reflects the increased risk of tympanostomy-tube reinsertion for each increase by a factor of 10 in the hospital's annual rate.

the risk of rehospitalization. The rates of rehospitalization were not affected by whether or not the child underwent a nonotolaryngologic procedure during the index hospitalization.

Influence of Age on the Effectiveness of Adjuvant Surgery

Although guidelines recommend against the use of adenoidectomy for the treatment of otitis media in children three years of age or younger and against the use of tonsillectomy in children of all ages,[24,25] both procedures were used in young children. Five percent of the one-year-old children in the subgroup of otherwise healthy children underwent adjuvant adenoidectomy, and 2 percent underwent adjuvant adenotonsillectomy. Thirty-five percent of three-year-old children in this subgroup underwent either an adenoidectomy (13 percent) or an adenotonsillectomy (22 percent) in conjunction with their index tympanostomy-tube insertion. Tonsillectomies were rare, occurring in fewer than 1 percent of the children in this subgroup who were three years of age or younger.

To examine whether the benefits of adjuvant procedures differed according to age, we analyzed age as a categorical variable and included interactions between age and the type of adjuvant surgery in the analysis. In the subgroup of children who were otherwise healthy, among those who were at least two years of age, adjuvant adenoidectomy decreased the risk of readmission for conditions related to otitis media to about half that associated with the insertion of tympanostomy tubes alone (relative risk, 0.6; 95 percent confidence interval, 0.4 to 0.8; P<0.001). The benefit of adjuvant adenotonsillectomy over the insertion of tympanostomy tubes alone was apparent in children as young as one year of age (relative risk, 0.5; 95 percent confidence interval, 0.3 to 0.8; P=0.007), was greatest for children three years of age or older, and was greater than the benefit of adjuvant adenoidectomy. The results were similar in the analysis of the time to reinsertion of tympanostomy tubes in the subgroup of otherwise healthy children and in the analysis of the risk of reinsertion of tubes or readmission in the group as a whole.

Complications and Early Readmissions

Complications were assessed from the diagnostic codes in the hospital discharge records. Complications were noted for 0.2 percent of the children who received tympanostomy tubes alone, 0.5 percent of the children who also underwent an adenoidectomy, 0.5

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TABLE 4. FACTORS AFFECTING THE RISK OF READMISSION FOR CONDITIONS RELATED TO OTITIS MEDIA.*

VARIABLE	ALL CHILDREN (N=37,316)		OTHERWISE HEALTHY CHILDREN (N=31,463)	
	RELATIVE RISK (95% CI)†	P VALUE	RELATIVE RISK (95% CI)†	P VALUE
Adjuvant adenoidectomy	0.5 (0.5–0.6)	<0.001	0.5 (0.5–0.6)	<0.001
Adjuvant tonsillectomy	0.6 (0.4–0.9)	0.009	0.5 (0.3–0.8)	0.002
Adjuvant adenotonsillectomy	0.4 (0.4–0.5)	<0.001	0.4 (0.4–0.5)	<0.001
Urgent or emergency admission (vs. elective admission)	1.6 (1.3–2.0)	<0.001	—‡	
Age (per year of age)	0.9 (0.9–0.9)	<0.001	0.9 (0.9–0.9)	<0.001
Residence in a rural area (vs. residence in an urban area)	1.2 (1.1–1.3)	<0.001	1.2 (1.1–1.3)	<0.001
Male sex	1.1 (1.1–1.2)	<0.001	1.1 (1.0–1.2)	0.004
Annual volume of tympanostomy-tube insertion (per each increase by a factor of 10)§	1.2 (1.1–1.3)	<0.001	1.1 (1.0–1.2)	0.012
Community hospital (vs. teaching hospital)	1.2 (1.1–1.2)	<0.001	1.2 (1.1–1.3)	<0.001

*Among the entire group of children, there were 5811 readmissions for conditions related to otitis media, and among the subgroup of children who were otherwise healthy except for otitis media, there were 4796 readmissions. Data were censored at the end of 1997 for 84 percent and 85 percent of each group, respectively.

†The reported relative risks are adjusted for the other variables in the table. Values of less than 1 indicate a decreased risk of readmission for conditions related to otitis media; values of more than 1 indicate an increased risk. CI denotes confidence interval.

‡One of the enrollment criteria for this group was elective surgery.

§The values for the annual volume of tympanostomy-tube insertions were log-transformed (base 10) because the volumes were skewed, with values ranging from 1 to 1578. Therefore, the reported relative risk reflects the increased risk of readmission for conditions related to otitis media for each increase by a factor of 10 in the hospital's annual rate.

percent of the children who also underwent a tonsillectomy, and 2.6 percent of the children who also underwent an adenotonsillectomy. The most common complications were nausea and vomiting, hemorrhage, and the nonspecific diagnosis of "other complications of procedures" (each of which occurred in 0.1 percent of all children in the study).

Only 91 children were readmitted to the hospital within 30 days after discharge. The rate was higher among children who had not undergone adjuvant surgery than among those who had undergone adjuvant surgery (0.3 percent vs. 0.1 percent), because early rehospitalizations were more common among children who were one year old or younger. These very young children accounted for 28 percent of all patients, but 43 percent of those who were rehospitalized within 30 days after discharge, and these children typically did not undergo adjuvant surgery. There were no deaths among the children in this study, either during the index hospitalization or within 30 days after discharge.

DISCUSSION

Of the 37,316 children who received tympanostomy tubes as their first surgical treatment for otitis media, 28 percent underwent adjuvant surgery (11 percent underwent adenoidectomy, 1 percent tonsillectomy, and 16 percent adenotonsillectomy). Approximately 25 percent of the children who did not undergo adjuvant surgery were rehospitalized within two years after their index insertion of tympanostomy tubes. After adjustment for other factors, adjuvant adenoidectomy or tonsillectomy nearly halved the risk of rehospitalization. These results are consistent with evidence from clinical trials[9-16] and demonstrate that the trial results reflect practice in the broader medical community. We found an additional benefit from adjuvant adenotonsillectomy, over that provided by adjuvant adenoidectomy alone. This finding contrasts with the results of one clinical trial[9-12] but is consistent with the results of another.[16]

The finding that reinsertion of tympanostomy tubes was more common among children who were initially treated in hospitals with a high annual volume of tympanostomy-tube insertions contrasts with the common wisdom that surgical outcomes are better in high-volume hospitals. We suspect that in the case of tympanostomy-tube insertion, higher volumes correlate with a perception among physicians at these hospitals that the procedure is an effective treatment for otitis media.

The increase in complexity and the duration of an-

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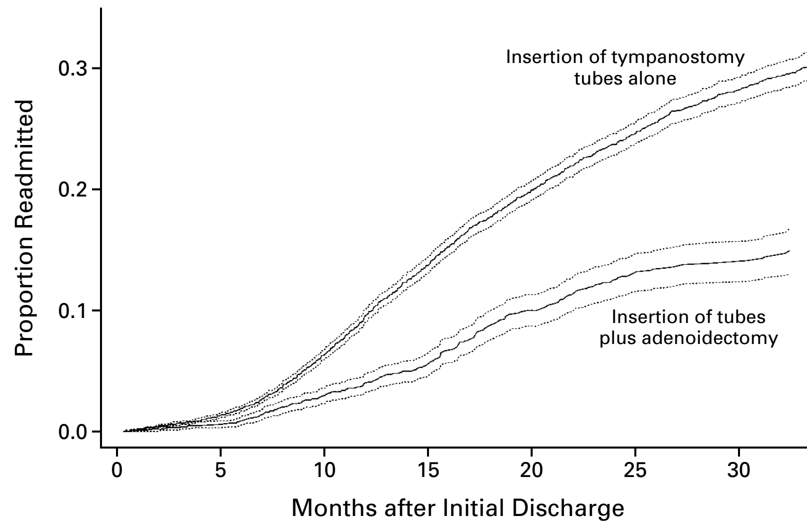

Figure 2. Estimated Mean Time to Readmission for Conditions Related to Otitis Media among Children Who Were Otherwise Healthy at the Time of the Index Insertion of Tympanostomy Tubes Alone or in Conjunction with Adenoidectomy, 1995 through 1997.

Data were not adjusted for other covariates. Solid lines indicate means, and dotted lines 95 percent confidence intervals.

esthesia required by adjuvant surgery increases the risk of complications. A study of 9400 children who underwent adenoidectomy, tonsillectomy, or adenotonsillectomy[26] found that hemorrhage occurred in 0.2 percent of the children who underwent adenoidectomy and in 2 percent of those who had a tonsillectomy or adenotonsillectomy; overall, 6 percent of the children in the study had a fever or persistent emesis and 1 percent of the children remained in the hospital after their scheduled date of discharge.

Our findings should not be interpreted as a recommendation for the routine addition of adenoidectomy to the surgical treatment of otitis media. They are intended to inform physicians and parents who are weighing the extra risk associated with additional surgery against a reduction in the likelihood of the reinsertion of tympanostomy tubes or readmission for conditions related to otitis media. We emphasize that the question of which children would benefit most from adjuvant adenoidectomy remains unresolved.

There are limitations inherent in the use of administrative data. Discharge records do not include information on characteristics that may contribute to various outcomes — for example, the size of adenoids, the duration and severity of otitis media, the presence or absence of allergies, and whether or not the children attended a day-care facility.[8,11,27-29] Also, the reinsertion of tympanostomy tubes and rehospitalization are not the only outcomes of interest. Although they may be useful proxies for outcomes such as the duration of effusion, they do not address other issues, such as hearing loss, which cannot be addressed exclusively through the use of administrative data.

In summary, adjuvant surgery at the time of the initial insertion of tympanostomy tubes decreased the risks of reinsertion and readmission for conditions related to otitis media, after adjustment for other patient characteristics, especially in children who were three years of age or older. On the basis of our data, one could predict that eight adjuvant adenoidectomies would be required in order to avoid a single instance of rehospitalization over a two-year period. However, each avoided readmission probably represents a larger reduction in the number of episodes of otitis media, including those in children who were not readmitted. Efforts should be directed toward determining which children benefit most from adjuvant surgery, so that the procedures can be used in those who will benefit most, without subjecting the majority of children to additional risk.

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