Tympanostomy tubes for otitis media: Quality-of-life improvement for children and parents

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Abstract
We measured quality of life issues for both children and their parents on the premise that parental quality of life should be an aspect of cost-effectiveness in otitis media treatment. The patients were less than 18 years of age and had had myringotomy with tube insertion at the head and neck surgery department of a large health maintenance organization. Quality of life for patients, parents, and caregivers was evaluated by telephone survey of parents or caregivers and by retrospective chart review of the number of pre- and postoperative healthcare visits and antibiotic usage. Chart review showed a significant postoperative reduction in the number of clinic visits and in use of antibiotic drugs after insertion of tympanostomy tubes. Improved postoperative hearing was noted, and tympanostomy tube insertion was shown to be safe. The chart-review cost analysis showed that tympanostomy tube insertion is a cost-effective treatment for otitis media in children, and the telephone survey results showed that it improves quality of life for children and their parents or other caregivers.

Introduction
Otitis media is the most common reason for children less than 15 years old to visit a pediatrician. The socioeconomic costs have been estimated at more than $1.0 billion annually in the United States.1 The use of tympanostomy tubes has effectively reduced overall frequency, duration, and severity of otitis media and has corrected conductive hearing loss secondary to otitis media,2-6 but its cost-effectiveness has not been determined. Quality of life of these patients and their parents or caregivers must be considered in the evaluation.

Surveys assessing quality of life have been proposed.7-9 Facione's survey showed fewer visits and less antibiotic use after tubes were inserted, and he concluded that although children's quality of life improved after insertion of tympanostomy tubes, a more accurate count of visits and antibiotic usage is needed to determine the cost-effectiveness of this treatment.8

To determine quality-of-life changes both for affected children and their parents or other caregivers after insertion of tympanostomy tubes, we conducted a retrospective chart review and a telephone survey.

Patients and methods
Using a hospital-procedure–coding database, we identified 379 Kaiser Foundation Health Plan members younger than 18 years old who had had myringotomy with tube insertion at the Kaiser Permanente Medical Center in Oakland, Calif. (KPMC-O) between 1988 and 1994. We collected data from 336 patient charts available for review. Of these 336 patients, we excluded 63 who either did not have a minimum of 1-year of preprocedural visits or postprocedural follow-up at KPMC-O, those who had had prior ear surgery, and those who had had myringotomy with tube insertion as part of a more extensive otologic procedure.

All procedures were done by the head and neck surgery (HNS) department residents or staff.

For the 1-year periods before and after tympanostomy tube insertion, we recorded the number of clinic visits for ear-related problems, the number of courses of oral and topical antibiotics prescribed, and hearing loss as indicated by audiograms. A visit was counted if the presenting complaint was ear-related, if the visit was scheduled for...
Table 1. Telephone survey questions to parent or caregiver of a child who had had myringotomy with tube insertion for otitis media

1. After insertion of tympanostomy ear tubes, were the child’s ear problems: “Better,” “Unchanged,” or “Worse”?
2. After insertion of tympanostomy ear tubes, was the child’s overall quality of life: “Better,” “Unchanged,” or “Worse”?
3. Before insertion of tympanostomy ear tubes, was your burden in caring for the child’s ear problems: “Great,” “Moderate,” or “None”?
4. After insertion of tympanostomy ear tubes, was your burden in caring for the child’s ear problems: “Decreased,” “Unchanged,” or “Increased”?
5. After insertion of tympanostomy ear tubes, was your overall quality of life: “Better,” “Unchanged,” or “Worse”?
6. Please estimate the number of days off work or school per year (0 to 65 days) for you or other caregivers as a result of the child’s ear infections before tympanostomy tubes.
7. Please estimate the number of days off work or school per year (0 to 65 days) for you or other caregivers as a result of the child’s ear infections after tympanostomy tubes.
8. Do you feel that your child benefited from the surgery? (“Yes,” “No,” or “No comment”)
9. Would you recommend this procedure to another parent or caregiver of a child with ear infections? (“Yes,” “No,” or “No comment”)

Table 2. Clinic visits and prescriptions for antibiotics among 273 pediatric otitis media patients before and after insertion of tympanostomy tubes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before tube insertion</th>
<th>After tube insertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of non-HNS clinic visits</td>
<td>8.4</td>
<td>2.4</td>
</tr>
<tr>
<td>No. of HNS clinic visits</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Total no. of clinic visits</td>
<td>10.6</td>
<td>2.8</td>
</tr>
<tr>
<td>No. of routine HNS follow-up visits</td>
<td>N/A</td>
<td>2.5</td>
</tr>
<tr>
<td>No. of prescriptions for antibiotic drugs</td>
<td>5.8</td>
<td>1.9</td>
</tr>
</tbody>
</table>

HNS = Head and Neck Surgery Department; N/A = not applicable.

Results

Chart review. For 273 patients (180 boys, 93 girls) myringotomy with tube insertion was performed for serous (165 patients), recurrent (52 patients), and chronic (56 patients) otitis.

Patients had a mean total of 10.6 visits in the 1-year study period before tympanostomy tube insertion. The mean number of visits for ear-related problems in the year after myringotomy and tube insertion was 2.8; that is, 7.8 visits fewer than before surgery (p < 0.001) (table 2). Most visits were to providers outside the HNS department. Patients had a mean of 8.4 preoperative non-HNS visits and a mean of 2.2 preoperative HNS visits. In the postmyringotomy year, patients had a mean of 2.4 non-HNS visits, a mean of 0.4 HNS visits, and a mean of 2.5 routine HNS follow-up visits. Although the male-to-female ratio of patients receiving myringotomy and tube insertion was 2:1, the two groups showed no significant difference between the mean number of visits before and after surgery.

Patients received a mean of 3.9 more prescriptions for antibiotic drugs in the year before surgery than in the year after (p < 0.001) (table 2). This variable also showed no significant difference between boys and girls.

The 114 patients (42%) who had received prophylactic antibiotic therapy before surgery had a mean of 6.3 more preoperative and 1.2 more postoperative visits than those who had received no prophylactic antibiotics (p < 0.001) (table 3). Patients who received prophylactic antibiotics also had a mean of 4.2 more prescriptions for antibiotics preoperatively (p < 0.001) than patients who did not receive prophylactic antibiotics. The postoperative difference (0.5 prescriptions) was not significant.

Audiograms were done preoperatively for 193 (71%)
of the patients and postoperatively for 117 (43%) of the patients; 91 (33%) of the patients received both preoperative and postoperative audiograms. Of the 193 patients who received preoperative audiograms, 165 (85%) showed hearing loss. Of the 91 patients who had both preoperative and postoperative audiograms, 78 (86%) had hearing improvement after the surgery.

Preoperative complications secondary to otitis media included speech delay attributed to hearing deficits (9 patients); multiple adverse reactions to antibiotic drugs (3 patients); febrile seizure (2 patients); and facial paralysis, sensorineural hearing loss, admission for dehydration, learning disability, meningitis, and admission for mastoiditis (1 patient each).

Seven patients had intraoperative complications with no deaths. There were three cases of laryngospasm and one case each of bronchospasm, upper airway edema, and misplaced tube in the middle ear. One procedure was aborted when cholesteatoma was encountered.

Among 135 patients for whom 165 postoperative complications were documented (table 4), 28 patients (21%) had more than 1 complication. The most common complications were persistent tympanostomy tubes requiring a second procedure for removal, and repeat myringotomy with tube insertion (table 4).

Telephone survey. For 202 of the 379 patients (53%) identified in the hospital database, a parent or caregiver was contacted in the telephone survey. Of those contacted, 200 participated in the survey, resulting in a response rate of 53%. Thirty-six respondents could not estimate the number of days off work or school prompted by the child's ear infection, either before or after insertion of tympanostomy tubes.

Most respondents answered that the child's ear problems (93%) and overall quality of life (90%) were better after tympanostomy tube insertion (table 5), and most stated that the child benefited from (96%) and that they would recommend (93%) the procedure (table 5). Ninety-one percent of respondents said that their own quality of life, too, had improved (table 5).

More than two thirds of respondents said that caring for their child with an ear infection was a great burden, and 5% denied having any burden; 90% of respondents stated that their burden had decreased after tympanostomy tube insertion (table 6).

Respondents estimated that the child's ear infections prompted a mean of 14.5 days off work or school before and a mean of 2.4 days off work or school after the myringotomy. This difference of 12.1 days was significant (p < 0.001).

Discussion
Cost-effectiveness is important in today's healthcare environment. Tympanostomy tubes are effective for treating otitis media, but their cost-effectiveness has not been determined.

Based on a decrease in number of office visits and antibiotic usage, as well as the fact that healthy children do not visit a medical care provider, Facione concluded that tympanostomy tubes improve the quality of life for children with otitis media. His results are supported by our chart review, which showed antibiotic usage and numbers of ear-related preoperative and postoperative visits similar to those reported by Facione.

Assuming that an episode of otitis media results in two visits—i.e., the initial visit and the follow-up visit—our
A mean figure of 10.6 total visits in the preoperative year translates into 5.3 patient-episodes of otitis media annually. At an estimated $406 per patient-episode to treat medically, the yearly cost would be $2,152 per child. The estimated cost of myringotomy tubes is $2,174 per patient. Adding the cost of the 2.8 postoperative ear-infection-related visits (i.e., 1.4 patient-episodes of otitis media) results in a yearly cost of $2,742 per child. Managing otitis media with tympanostomy tubes thus costs $590 more than medical therapy alone in the first year after surgery. For the estimated 400,000 tympanostomy tube insertions done each year, $236 million would thus be saved if medical therapy were used instead.

Looking at the following year, if there continued to be only 1.4 patient-episodes of otitis media with tympanostomy tubes in place, the cost for that year would be $568 dollars per child with tubes. For that year, there would be a $1,584 savings for a child with tubes, assuming that a child without tubes would continue to have a mean of 5.3 patient-episodes of otitis media per year at a cost of $2,152. For 400,000 myringotomy patients annually, about $634 million is thus saved during the second year after tympanostomy tube insertion, showing the procedure to be more cost-effective than medical therapy. (This calculation did not consider that some tubes would have extruded during the year and that some children would have “outgrown” their ear problems.)

To further reduce the cost, we have instituted a telephone follow-up appointment system that replaces the routine postoperative office visit with a scheduled telephone call from a physician or a trained nurse at 4 to 10 days after surgery and every 6 months thereafter. Parents or other caregivers can choose a convenient time and location to receive the call. Preliminary surveys have indicated high parental satisfaction with these telephone visits, which are supplemented by a pediatrician’s assessment of tube status at routine well-child visits. A more extensive survey is under way to further evaluate these telephone visits.

Rosenfeld et al. found in their quality-of-life survey that parental concern is important. Most of our telephone survey respondents reported feeling greatly burdened in caring for the child with otitis media. Ninety percent of parents and other caregivers reported that their burden was decreased after tympanostomy tube insertion and that their overall quality of life had improved. Part of this improvement can be attributed to the dramatic decrease from an estimated 14.5 days off work or school required before tube placement to only 2.4 days off required after their insertion. Parents and other caregivers expressed great satisfaction with tympanostomy tube insertion, and most would recommend the procedure. Our results also indicated that from the parents’ or other caregivers’ viewpoint, the child’s ear problems and overall quality of life improved after tympanostomy tube placement.

In our chart review, we found only 9 cases in which a physician or a speech pathologist documented in the chart that a speech problem was a direct result of hearing impairment secondary to otitis media. The AHCPR stated that the effects of otitis media on speech and language development have been difficult to assess because of ethical problems in designing randomized, prospective studies and because no consistent instrument exists for measuring speech and language development. Similarly, the long-term effects of otitis media on speech and language development after treatment are as yet undetermined and must be defined for more accurate determination of cost-effectiveness. If untreated otitis media can lead to permanent deficits in speech and language development, the resultant socioeconomic impact on society will be great.

| Table 5. Results of telephone survey: Quality of life and satisfaction after child’s myringotomy with insertion of tympanostomy tubes (n = 200 parents or caregivers) |
|---------------------------------|-----------------|-----------------|-----------------|
| Postoperative variable          | Better          | Unchanged       | Worse           |
| Child’s ear problems            | 186 (93)        | 8 (4)           | 6 (3)           |
| Child’s overall quality of life | 180 (90)        | 16 (8)          | 4 (2)           |
| Parent/caregiver quality of life| 181 (91)        | 15 (8)          | 4 (2)           |
| Child benefited                 | Yes             | No              | No comment      |
| Parent/caregiver would recommend procedure | 191 (96) | 3 (2) | 6 (3) |
|                                  | 185 (93)        | 4 (2)           | 11 (6)          |

| Table 6. Results of telephone survey evaluating self-reported burden on 200 parents or other caregivers |
|--------------------------------------------------|----------------|----------------|----------------|
| Burden on parent/caregiver                       | No. (%) of responses giving evaluation |
| Before tubes                                     | Great | Moderate | None |
| Decreased                                       | 135 (68) | 55 (28) | 10 (5) |
| Unchanged                                       | Decreased | Unchanged | Increased |
| Increased                                       | 180 (90) | 14 (7) | 6 (3) |

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Our chart review supported the safety of tympanostomy tubes. Even though there appeared to be a relatively high complication rate, the complications themselves were relatively minor in nature and often could be addressed with clinic procedures. We perform many of our persistent tube removal and myringoplasty procedures for smaller perforations in the clinic with patients under local anesthesia.

More than 40% of the patients in our study had received prophylactic antibiotic treatment, which can be considered to have failed for these patients because they ultimately required insertion of tympanostomy tubes. We found that patients who had a history of prophylactic antibiotic use had many more office visits before and after tube placement than patients who had not received prophylactic antibiotics. This difference could be a result of selection bias, since we considered only patients referred for tube insertion. Another factor may be that those patients with a history of prophylaxis were more sick (i.e., they had more infections and visits, thus prompting prophylactic antibiotic therapy). Intuitively, patients receiving prophylactic antibiotics should have fewer infections and thus fewer visits, because prophylaxis is intended to reduce the frequency of infection.

On the other hand, our finding that prophylactic antibiotic therapy did not reduce the frequency of infection may be explained by bacterial resistance, as is found increasingly in organisms cultured in the United States from middle ear effusions. If this trend continues, then bacterial resistance will have an increasing role in determining cost-effective treatment for otitis media.

Conclusions
Our cost analysis suggests that tympanostomy tube insertion is cost-effective treatment for otitis media. These tubes can improve the quality of life for affected children and their parents/caregivers and greatly reduce the caregiving burden. Our findings emphasize that parental quality-of-life issues need to be included in validated instruments designed for evaluating the cost-effectiveness of treatment for otitis media.

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References