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Should Water Precautions Be Recommended for Children With Tympanostomy Tubes?

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BACKGROUND

For decades, many otolaryngologists have instructed parents to avoid aural water exposure in their children with tympanostomy tubes. This recommendation is usually based on the premise that water will pass through the tube into the middle ear, creating a moist environment. Organisms such as *Pseudomonas* grow favorably in such environments, and their presence in the middle and external ear commonly results in otorrhea. Although protection of the ears may be a worthwhile strategy, some families face the extraordinary challenge and expense of maintaining earplugs or waterproof headbands, while children prohibited from the pool may be delayed in their acquisition of swimming skills. The clinician is left to determine whether these precautions are reasonable in order to reduce the cost and nuisance associated with treatment of suppurative drainage from the ear.

LITERATURE REVIEW

Recommendations regarding swimming, other water exposures, and the need for water precautions vary widely among otolaryngologists and primary care providers, from no precautions to absolute abstinence from water exposure. A 2008 survey of 150 otolaryngologists in the northwestern United States found that 4% did not allow children with tympanostomy tubes to swim at all.[1] Of those who permitted swimming, 51% required either ear protection or prophylactic drops. Many otolaryngologists limited the depth of swimming (no submersion of ears=7%; surface swimming only=30%; depth less than 2 feet=35%; no restrictions=28%). While these data suggest a relaxation of restrictions compared to earlier surveys, they still suggest a lack of consensus regarding best practices.

The incidence of a single event of post-tympanostomy otorrhea, based largely on case series, varies in the literature from 3% to 83%. Most of these investigations did not distinguish the events by season or by association with upper respiratory infection. Among those that did, conclusions differ regarding the prevalence of otorrhea in summer versus winter, but most suggest a higher association with upper respiratory infection than with water exposure.

The notion that swimming or bathing can precipitate an episode of otorrhea has been addressed in both in vitro and in vivo studies. In vitro investigations have estimated the pressure required for water to traverse a tympanostomy tube to be 12 cm to 23 cm H_20, a level achieved at water depths of less than 1 foot. Such studies have also confirmed that water contamination of the middle ear is significantly greater at depths greater than 2 feet than at the surface. Additionally, these studies suggested that soap added to water lowers the surface tension on a tympanostomy tube, allowing water to enter more easily. However, the models used may not have accurately reflected the anatomy of the ear and the multitude of biological and biophysical factors, such as the variable opening pressure of the Eustachian tube, the role of cerumen, and the hydrophobic nature of tube materials that affect water accessing the middle ear.

Most in vivo studies also have suggested that ears with tubes need not be protected from water. Prior to 2005, at least 14 studies failed to demonstrate statistical improvement in otorrhea rates in children abstaining from swimming or in children using earplugs or prophylactic otic drops. Although many of these studies suffered design flaws, including lack of randomization, blinding, checks of compliance, and small sample sizes, two meta-analyses have supported this conclusion.[2,3] A recent report by Goldstein et al., designed to eliminate these flaws, studied 172 children randomized to swimming with or without ear plugs.[4] They noted no significant difference in the rates of otorrhea (47% and 56%, respectively); however, children using ear plugs had a lower incidence of otorrhea (0.07 episodes per month)

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compared with those without ear plugs (0.10 episodes per month). Despite this small statistical difference, these data equate to only 0.36 infections per child-year. Stated differently, a child would need to wear earplugs for 2.8 years to prevent a single episode of otorrhea.

Swimming depth may be an important factor in tympanostomy tube otorrhea. As depth below the surface increases, so does the water pressure upon the tube and the likelihood of water entering the tube. The resulting moist environment in the middle ear is one in which certain bacteria thrive, resulting in otorrhea. The in vitro studies previously mentioned suggested an increased risk of otorrhea with increased depth. Unfortunately, investigators in most in vivo studies prohibited patients from diving. In one of the few relevant studies, Lounsbury et al. found that diving deeper than 6 feet was associated with a six-fold increase in otorrhea risk,[5] although it should be noted that most of these children were swimming and diving in lakes or ponds. Sample sizes for divers in other studies were too small to be conclusive; however, the majority of the available data suggested that diving or deeper underwater exposure increases the rate of otorrhea.

Water type is also thought to influence the likelihood of otorrhea. Animal studies have demonstrated middle ear inflammation due to water exposure only in the presence of bathwater. This is consistent with the in vitro studies that found soap in the water lowered the pressure at which water traversed a tympanostomy tube. Most studies reported insufficient statistical power to find significant increases in rates of otorrhea among patients swimming in pools or ocean; however, one study reported an increased rate of otorrhea with lake swimming.

In all but the Goldstein study presented above, swimmers wearing ear plugs had a higher overall rate of otorrhea compared to swimmers without ear plugs or those using antibiotic ear drops, although the difference was not statistically significant. This may be explained by studies demonstrating increased bacterial counts in the external auditory canal after occlusion, as well as the fact that few devices can completely prevent water from reaching the tympanic membrane. The use of antibacterial eardrops was compared to swimming without eardrops in only two studies, both of which demonstrated no reduction in otorrhea using ototopical medications.

BEST PRACTICE

Based on the available literature, children with tympanostomy tubes appear to be at minimal increased risk of developing otorrhea from swimming, providing they are restricted to surface exposure. Neither earplugs nor prophylactic eardrops are necessary for most children who swim at the surface in pool water and ocean water.

The risk of otorrhea appears to increase with the depth of swimming below the surface, as well as with exposure to soapy water and lake water. Therefore, diving while swimming and head dunking in the bathtub are probably best avoided. Ear protection is a reasonable alternative for children who will inevitably engage in these activities, particularly older children who have a higher likelihood of diving and a larger ear canal volume. Parents of these children should be advised of the importance of cleansing occlusive devices between uses to reduce the risk of bacterial colonization.

For children whose families emphasize the importance of water activities, the mild discomfort and nuisance associated with an episode of otorrhea may not justify the imposition of restrictions or the maintenance of earplugs. Others may experience greater discomfort and recurrence of their otorrhea; these children may derive greater benefit from the institution of water precautions. Ultimately, the decision to recommend water precautions should be individualized for each child with tympanostomy tubes.

LEVEL OF EVIDENCE

Studies regarding water precautions for tympanostomy tubes vary considerably in design, quality, and level of evidence. The available literature consists of level 2 to level 4 evidence, including two meta-analyses. Only the article by Goldstein et al. meets the criteria for level 1 evidence.[4]

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