Tympanic Membrane Perforations: Sizes in the Eyes of the Beholders

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Abstract

Background/Objectives: The size of a perforation of the tympanic membrane is commonly described as a percentage of the area of the tympanic membrane: the observer gestalts, or envisions the sum of proportions of involved quadrants of the tympanic membrane. Inter-observer agreements about sizes of perforations are debatably good, but poor in relationship to measured area of perforation. This study addressed the following hypotheses: (1) Otolaryngologists well agree about sizes of perforations. (2) Assessment is usually by gestalt. (3) Agreements are worse if the perforation is foreshortened. (4) Agreement improves with years of clinical experience.

Study design: Survey comparison of otolaryngologists’ opinions, with measured areas of perforation.

Methods: Twenty-one otolaryngologists judged ten digitized Hopkins rod images of tympanic membrane perforations. The images were then measured by digital planimetry. Agreements were assessed by Bland Altman and box plots.

Results: Otolaryngologists greatly over-estimated the areas of perforations, usually by two-fold, in comparison to computerized measurements. For all 10 images, agreement with other otolaryngologists’ estimates was almost always within 20%. Most assessed by gestalt. Neither foreshortened manubrium nor otolaryngologists’ years of experience correlated with perforation size.

Conclusion: Photographs of tympanic membranes with computer measurement are needed to accurately depict perforation size.

Introduction

Accurate determination of a tympanic membrane perforation is of continuing concern. Visual estimates in mm or as percentage of TM area are inaccurate, and quadrant-based techniques neglect that the quadrants appear unequaly sized, particularly if the manubrium is foreshortened.

Previously unaddressed hypotheses:
1. Otolaryngologists well agree with computer assessments of sizes of perforations.
2. Otolaryngologists typically assess size by gestalt.
3. Agreement (estimated, versus computer-measured) is better with more years of clinical experience.
4. Agreement (estimated, versus computer-measured) is worse if the manubrium is comparitively foreshortened.

Materials & Methods

The Emory Institutional Review Board exempted this study (IRB #57806).

Images of ten TMs were presented to 21 otolaryngologists, who assessed each for the size of a perforation as a percentage of TM area. The PGY level and method of estimation (gestalt vs. quadrant) for each participant was recorded.

Digitized copies were measured for TM and perforation areas, manubrium length, and greatest TM diameter. Perforation size as %area and manubrium/diameter ratios were calculated.

Discussion

Otolaryngologists’ estimates of perforation size were always larger than computer-depicted sizes of perforations by approximately twofold. Thus, hypothesis 1 is not supported by the data. The range of otolaryngologists’ estimates rarely exceeded 20% of the tympanic membrane area, indicating that as a group, they agreed to within a perhaps clinically reasonable extent. Interestingly, though inter-observer agreement about perforation sizes was about the same across the spectrum of perforation sizes studied, estimates versus the “gold standard” especially diverged for larger perforations. Indeed, a statistically significant linear relationship between the size of a perforation and the average quantity by which visual reckoning overestimates that size. That is, the larger a TM perforation is, the worse physicians are at accurately estimating its size. Whether this trait holds clinical significance is an avenue for further research.

Gestalt estimation and quadrant analysis were each used by about one-half of respondents. Thus, hypothesis 2 is not supported by the data. Length of clinical experience was not associated with method of size estimation. Hypothesis 3 is not supported by our data.

No consistent trend, positive or negative, in estimation precision as a function of L1/L4 ratio is demonstrated; thus, presence of a foreshortened manubrium does not adversely affect an otolaryngologist’s ability consistently to estimate the size of a perforation. This contravenes hypothesis 4.

Conclusion

Neither the gestalt nor the quadrant method predominated in these otolaryngologists’ assessment of tympanic membrane perforation size. Otolaryngologists overestimate perforation size as a percentage of area, by about twofold, worse for large perforations. Neither additional clinical experience nor foreshortened manubrium correlated with estimates of perforation size. Not even a trend of data endorses any of the four hypotheses addressed. Scientifically, a computer-based system for the measurement of TM perforations is to be endorsed.