Journal Review

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The Role of Mastoidectomy in Outcomes Following Tympanic Membrane Repair: A Review

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Introduction

- Tympanoplasty is a commonly performed surgical procedure to close perforations of the tympanic membrane.
- The results of tympanic membrane repair, based on multiple factors
  - including infection, eustachian tube dysfunction, and variations in operative technique.
- The contribution of mastoid pneumatization remains controversial
  - the role of mastoidectomy in treating tympanic membrane perforations continues to be debated, particularly in cases of chronic suppurative otitis media **in the absence of cholesteatoma.**

- Many otolaryngologists continue to routinely perform mastoidectomy with tympanoplasty, arguing that surgical aeration of the mastoid will improve outcomes by providing a reservoir of air that can buffer pressure changes in the middle ear according to Boyle's law.
  - mastoidectomy can allow surgical debridement of infected and devitalized tissues that can lead to persistent middle ear disease.
  - Others argue that performing mastoidectomy in these patients is unnecessary, does not improve surgical outcomes, and subjects patients to increased risks.

- Some current retrospective studies have been frequently affected by selection bias including the presence of cholesteatoma, infection severity, and varying selection criteria for performing mastoidectomy.

MATERIALS AND METHODS

- Literature Search and Study Selection
  - Pubmed
- Study Classification
  - Level 1 studies included RCTs.
  - Level 2 studies included prospective cohort studies and poor quality or inhomogeneous random trials.
  - Level 3 studies included both retrospective cohort and case-control trials.
  - Level 4 studies were single-armed case series without controls.
  - Level 5 evidence represented expert opinion.
- Data Synthesis and Analysis

Data Synthesis and Analysis

- Wherever possible, the criteria used when selecting patients in which to perform mastoidectomy, a large potential source of bias in the results, were identified
- Outcome measures varied widely between studies but Three primary outcome measures were identified and separately analyzed:
  - tympanic membrane repair success rate
  - improvement in otorrhea and infections
  - hearing outcomes.
- Following analysis of the primary outcomes, studies were examined for other variables that might be relevant to mastoidectomy selection.

RESULTS

- Search of the literature identified 26 articles that met the inclusion criteria for this review
  - 3 studies met criteria for level 1 evidence (RCT), 2 studies consisted of level 2 evidence ; 14 studies consisted of level 3 evidence 7 studies of level 4 case series
- Age of patients varied widely, included both pediatric and adult pts
- Mean follow-up durations: 3 months to 15 years.
- The indication for surgical intervention was a tympanic membrane perforation with chronic otitis media (COM) or chronic suppurative otitis media (CSOM) in all cases.
  - Some included more specific criteria, including chronic granulation, revision cases, or staphylococcal infection.
  - Exclusion criteria varied widely, with some studies specifically excluding active infection, ossicular abnormalities

- The indication for performing mastoidectomy was particularly important in the cohort and case-control studies
  - it represented a potentially large source of bias between study arms.
- Mastoidectomies were generally performed with worse disease, as suggested by
  - the presence of infection
  - extensive inflammation
  - a sclerotic middle ear or mastoid

Perforation Repair Success

- Success rates were generally good (>80%) for all studies, regardless of whether a mastoidectomy was performed or not.
  - 7 studies (44%) showed higher success rates with tympanoplasty + mastoidectomy
  - 9 (66%) showed better success with tympanoplasty alone
  - None of the differences were statistically significant. (2 RCTs showed small increases in the mastoidectomy)

- Results of the retrospective studies were more variable.
  - Many of these studies actually reported **worse outcomes in patients undergoing mastoidectomy.** → more pronounced disease prior to surgery(were therefore likely at higher risk for surgical failure than those undergoing tympanoplasty alone.

- McGrew et al.
  - increase in the rate of subsequent otologic procedures in patients undergoing tympanoplasty alone compared to those in which mastoidectomy

TABLE II.
Success Rate for Perforation Repair.

Author	Year	Study Type	Number of Patients	Success Rate		
				Tympanoplasty + Mastoidectomy	Tympanoplasty Alone	P-value
Albu et al.	2012	RCT	140/142	82.8%	76%	0.15
Ramakrishnan et al.	2010	RCT	31/31	93.5%	97.8%	1
Bhat et al.	2009	RCT	35/33	82.9%	81.8%	0.63
Krishnan et al.	2002	Rand Coh	76/44	94.7%	81.8%	no stats
Toros et al.	2010	Ret Cohort	46/46	78.3%	76.1%	0.80
Mishiro et al.	2009	Ret Cohort	34/179	94.1%	96.1%	0.6
Yoon et al.	2007	Ret Cohort	20/43	100.0%	93.0%	>0.05
Mutoh et al.	2007	Ret Cohort	21/28	85.7%	75.0%	>0.05
McGrew et al.	2004	Ret Cohort	131/297	91.6%	90.6%	>0.05
Mishiro et al.	2001	Ret Cohort	147/104	90.5%	93.3%	0.62
Balyan et al.	1997	Ret Cohort	28/295	82.1%	85.1%	>0.05
Chandrasekhar et al.	1995	Ret Cohort	42/226	89.4%	92.9%	>0.05
Vartiainen	1992	Ret Cohort	142/314	76.0%	88.5%	no stats
Prescott and Robartes	1991	Ret Cohort	16/82	75.0%	80.5%	no stats
Gibb and Chang	1982	Ret Cohort	58/307	86.6%	88.5%	>0.5
Pratt	1976	Ret Cohort	18/32	55.5%	100.0%	no stats
Webb and Chang	2008	Case Series	0/150		92.9%	
Rickers et al.	2006	Case Series	47/0	78.7% (65.6)*		
Ruhl and Pensak	1999	Case Series	135/0	90.4%		
Vartiainen and Kansanen	1992	Case Series	221/0	73.2%		
Jackler and Schindler	1983	Case Series	82/0	86.6%		
Palva and Virtanen	1981	Case Series	61/0	100.0%		

Chronic Otorrhea and Infections

- Rates of persistent infection and drainage were only reported for a small number of studies. (>90% control in most cases.)
- Infection control rates were also noted to be better than perforation closure rate in all studies.
- Rates of persistent otorrhea ➔regardless of the mastoidectomy
  - cleaning out the middle ear space and establishing an intact tympanic membrane may be sufficient to eradicate most chronic infection, and that directly removing the disease in the mastoid air cells is often unnecessary. (Except mucosal disease)

Hearing Improvement

- Hearing outcomes are presented with three different measures:
  - the postoperative air- bone gap (ABG)
  - the mean residual gap
  - the improvement of the ABG
  - the rate of acceptable ABG, generally <20 dB. In studies without ABGs ➔ PTA
- Mean ABGs were generally good after tympanoplasty, ranging between 10 and 20 dB.
- Patients undergoing mastoidectomy showed universally worse
- In the study by Toros et al., the mastoidectomy ABG increase was over 6 dB and was statistically significant (P .007). Other showed no significant finding and conclued no benefit with mastoidectomy

- Rates of good hearing only between 55% and 90%.
  - undergoing mastoidectomy. Only 2 studies showed improved hearing rates for patients, and 7 showed worse hearing rates.
  - The only RCT reporting Ramakrishnan et al., showed no differences
- McGrew et al. → better hearing rates with tympanoplasty with mastoidectomy than without (79% vs. 70%, $P < .05$).
  - There was no significant difference in absolute postoperative ABG (14.4 vs. 16.4, $P > .05$) or ABG improvement (11.4 vs. 17.6dB, $P > .05$).
- Chandrasekhar et al. demonstrated worse hearing rates in patients undergoing mastoidectomy (69% vs. 88%, P .006)
  - although this study was limited to pediatric patients, and preoperative hearing was not reported.

- Overall, these results failed to show any systematic differences in hearing outcomes after tympanoplasty with or without mastoidectomy, and all patient groups exhibited net improvements in hearing.
- However, hearing outcomes
  - dependent on more than just elimination of middle ear disease and restoration of an intact tympanic membrane.
  - The status of the ossicles and the need for ossicular reconstruction also play an important role regardless of the mastoid.

Effect of Active Infection

- Unsurprisingly, patients with active discharge, in general, had worse outcomes than those with dry ears.
- Graft success rates ➔ worse for active disease in 6 studies & better in 2
  - Only one study reported a significantly worse rate, Gibb and Chang.
- Hearing outcomes were generally similar.
  - One study by Webb and Chang reported a better improvement in ABG for patients with active disease (9.7 vs. 5.4 dB, P 1⁄4 .01), but a similar postoperative ABG (17.7 vs. 17.9 dB)➔ poorer preoperative hearing in patients with active disease.
  - Other studies report no difference between active and dry ears at surgery.
  - Balyan et al. performed mastoidectomies only for active disease and found **slightly worse** outcomes than for tympa- noplasties performed on either draining or dry ears
  - Mishiro et al. found nonsignificant improvements with mastoidectomy for draining ears, but worse outcomes for quiescent ears. but no long-term impact on hearing

Effect of Middle Ear or Mastoid Inflammatory Tissue

- Overall, there were worse outcomes in the presence of extensive mucosal inflammation; however, this was not statistically significant.
- Mishiro et al. reported a non-significant improvement in repair success and hearing with mastoidectomy regardless of mucosal condition.
- Their follow-up study demonstrated a significant effect mucosal disease had on hearing using univariate regression (OR, 2.57; 95% CI, 1.26-5.23) but not for graft outcomes (OR, 1.12; 95% CI, 0.27-4.62).
- Prominent mucosal inflammatory disease
  - Worse overall outcomes for patients
  - But no definitive benefit in undergoing mastoidectomy has been demonstrated.

Effect of Age on Outcomes

- None of these studies demonstrated poorer outcomes in younger patients. (slight in younger child)
  - with and without mastoidectomy showed no significant of poorer outcome
- Some studies suggest slightly larger mastoid effects in children
  - perhaps worse disease in children undergoing mastoidectomy.

Effect of Perforation Size

- Habib et al.
  - slightly worse in larger perforations, especially in patients undergoing tympanoplasty alone
  - slightly better with mastoidectomy in these large perforations, but no statistics were reported.
  - Improvement in the ABG, however, was significantly enhanced by mastoidectomy for medium and larger perforations.
- The benefit of mastoidectomy in the presence of larger perforations, therefore, remains unclear.

Effect of MRSA Infection

- Mutoh et al. They compared MRSA and methicillin-susceptible S aureus (MSSA) outcomes
- with and without mastoidectomy
  - poorer outcome in MRSA infected ears
  - but that this is improved with mastoidectomy
  - particularly for actively discharging ears.
- MRSA represents a more aggressive infection
  - might benefit from mastoidectomy with a tympanoplasty to eradicate hidden reservoirs of infection.

Complications

- A mix of wound infections, facial paresis, and inner ear traumas were reported.
- Cholesteatomas reported were 6 for tympanoplasty with mastoidectomy and 6 for tympanoplasty alone.
- The one facial nerve damage reported was a delayed paresis, interestingly for tympanoplasty alone.
- One sensorineural hearing loss and one semicircular canal fistula without hearing loss were reported following mastoidectomies.

DISCUSSION

- The primary goals of tympanoplasty
  - a stable intact tympanic membrane
  - eradicate middle ear disease from COM
  - improve hearing.
- Mastoidectomy may improve these chances by
  - creating a reservoir of aerated bone to buffer pressure changes in the middle ear
  - eradicating residual mucosal disease hidden in the mastoid air cells.
- In our reviewed literature
  - **None** of these supported mastoidectomy as improving outcomes in tympanic membrane repair.

- These studies all suffered from a large potential bias based on the criteria with which patients were selected to undergo mastoidectomy
- No significant differences between tympanoplasty and tympanoplasty with mastoidectomy
  - success of the tympanic membrane repair.
  - successful control of chronic otorrhea
  - hearing outcomes
- Overall, there was little evidence to suggest that performing a mastoidectomy for most patients with **uncomplicated COM** .

- Infections status at surgery found **worse results** with actively draining ears(OR: 2 in graft success Albu et. al)
- Mutoh et al
  - population of MRSA-infected ears and found a small benefit, though non-significant, for mastoidectomy in MRSA compared to MSSA.
- Whether or not this sort of extensive inflammation in the absence of cholesteatoma or active discharge should be an indication for mastoidectomy, therefore, remains controversial.

- Revision surgery is known to be associated with *higher graft failure rates* in tympanoplasty.
  - Whether or not a mastoidectomy could improve this, however, remains unknown.
- About complication of performing mastoidectomy
  - Available data showed no obvious increasing complication

CONCLUSION

- The available data show no additional benefit to performing mastoidectomy with tympanoplasty for uncomplicated perforations.
- **Ears with more complicated disease**, including active drainage, mucosal inflammation, or repeat perforations show worse outcomes and may potentially benefit from mastoidectomy.
  - However, there is insufficient evidence to make recommendations for these patients.
- We suggest that further investigation using prospective randomized trials are needed to examine the effects of mastoidectomy in these higher-risk populations.

Thank you for listening