



US DEPARTMENT OF DEFENSE  
**BLAST INJURY RESEARCH PROGRAM**  
**COORDINATING OFFICE**

## Neurobehavioral and Psychological Health Outcomes Tympanoplasty Following Blast Injury

Blast-related ear injuries are a concern during deployment because they can compromise situational awareness and impact operational readiness. In this study, the authors report the success rates for tympanic membrane repair following blast-induced perforation. Data was obtained from the Naval Health Research Center's (NHRC) Expeditionary Medical Encounters Database (EMED) on the success rates for initial and revision surgical repair of blast-induced eardrum perforations. Furthermore, this study reports the degree of hearing improvement pre- and post-surgery, the proportion that required ossicular reconstruction, the rate of success based on the size of the perforation (percent total surface area), anatomic location of perforation, and elapsed time between injury and surgery date. The proportion of complications, such as cholesteatoma and lateralized tympanic membrane, are also reported. Success rates for surgical repair and functional hearing outcomes from 350 cases are reported, and the intraoperative surgical details are described. A retrospective chart review was conducted of military personnel in the EMED from October 2005 to July 2014. Overall, 255 patients with blast-related tympanic membrane perforations were identified using the International Classification of Disease, 9th Revision (ICD-9) Clinical Modification diagnostic codes. Study variables included initial and revision success rates for tympanoplasty, frequency of ossiculoplasty and cholesteatoma (minimum one year follow-up), pre- and postoperative audiometric measures (pure tone average [500 Hertz to three kilohertz], air bone gap, speech recognition threshold), perforation size (percent surface area), annulus involvement, and time elapsed between injury and surgery. There were a total of 350 surgeries (300 initial and 50 revisions) amongst 255 subjects. One hundred eighty-three patients had only one surgery, while 72 patients required multiple surgeries. For initial surgery, there was an 81.3 percent success rate (244/300) and for revision cases the success rate was 82 percent (41/50). The mean hearing improvement based on Speech Reception Threshold was 14.35 decibels ( $\pm 12.04$ ). Subsequent cholesteatomas were developed in 12.3 percent (37/300) of patients and 10.7 percent (32/300) required ossicular chain reconstruction. There was no significant effect of the length of time between initial injury and surgery or the perforation size with regard to the rate of successful perforation repair (Table 1). Ear injuries

and auditory hearing impairment are frequent consequences of blast exposure during combat deployment. Success rates for blast-induced perforations are lower than that of other common injury mechanisms. Because of cholesteatoma development rates, close clinical surveillance is required. Results can help guide clinicians in the timing of repair and the expected postoperative outcomes.

**TABLE 1:** Optimal Observation Period

| Healed       |                       | Not Healed   |                       |
|--------------|-----------------------|--------------|-----------------------|
| <3 months    | 56                    | <3 months    | 10                    |
| 3-6 months   | 85                    | 3-6 months   | 19                    |
| 6-9 months   | 47                    | 6-9 months   | 8                     |
| >9 months    | 58                    | >9 months    | 18                    |
| Mean # days: | 191.4 ( $\pm 137.0$ ) | Mean # days: | 228.8 ( $\pm 249.8$ ) |

(t-test was not significant at the 0.05 alpha level,  $t(298) = 1.803$ ,  $p = 0.07$ )

