ABSTRACT

Wideband Clinical Diagnosis and Monitoring of Middle-Ear and Cochlear Function

A wideband (WB) acoustic test battery has the potential to improve hearing screening and diagnosis of middle-ear and cochlear dysfunction across the age range. The WB test battery addresses current limitations in newborn hearing screening (NHS) and diagnostic programs, and may improve adult programs to identify ototoxic hearing loss and diagnose middle-ear disease in patients receiving middle-ear surgery. The tests measure acoustic responses to sounds presented in the ear canal. The acoustic immittance tests in the battery to assess middle-ear function are an acoustic transfer function (ATF) test and an acoustic-reflex threshold (ART) test. The ATF test provides admittance, absorbance and reflectance responses over frequencies important for speech perception (0.2-8 kHz), and is performed either at ambient pressure or as a WB tympanogram. The ambient-pressure ATF may have advantages for testing newborns in the first months of life, whereas the WB tympanogram may have advantages for testing older infants and adults. The WB ART test objectively measures an infant’s threshold and may improve the accuracy of newborn hearing screen programs to identify sensorineural hearing loss (SNHL) and conductive hearing loss (CHL). The WB click-evoked (CE) otoacoustic emission (OAE) test in the battery assesses cochlear function using an extended bandwidth relative to clinical CEOAE tests. Aim 1 assesses whether adding a WB test battery to the initial and follow-up NHS exams improves the accuracy of detecting SNHL and CHL. More accurate diagnoses would improve follow-up clinical care provided to infants with hearing disorders. Aim 2 evaluates whether middle-ear problems detected by the WB test battery in NHS can predict continued middle-ear dysfunction in the first year of life. No clinical guidelines exist on how to manage these infants, due to a lack of evidence regarding the incidence, duration and importance of CHL associated with NHS referrals. Aim 3 evaluates whether WB immittance tests can detect CHL in infants with cranial-facial anomalies and development delays. An objective physiological test to accurately predict CHL is urgently needed because audiometry in this group is affected by cognitive status. In Aim 4 with adults, the extended bandwidth of the CEOAE at least out to 10 kHz is well suited to detect early hearing loss in cystic fibrosis patients receiving ototoxic medications. Such a test would serve as a complement in medical clinics to a more extensive assessment using behavioral audiometry. Aim 5 would evaluate whether the WB test battery improves the differential diagnoses of otosclerosis and ossicular discontinuity in adults receiving middle-ear surgery. These disorders are difficult to classify using current diagnostic tests, and an accurate physiological test would improve clinical management and post-surgical monitoring of middle-ear function in patients.