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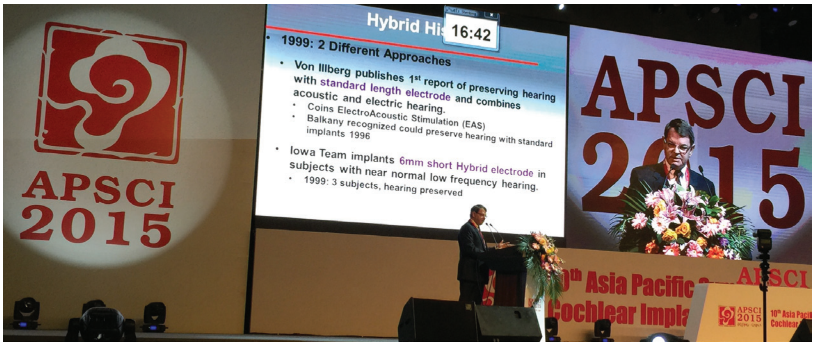
Cochlear Implantation: Asia–Pacific Symposium Is an Emerging Force

By Fan-Gang Zeng, PhD; Shi-Ming Yang, MD, PhD; & Zhiqiang Gao, MD

The 10th Asia–Pacific Symposium on Cochlear Implants and Related Sciences (APSCI 2015) drew about 2,000 professionals to discuss the latest research in Beijing from April 30 to May 3. The number of attendees was unprecedented, the weather cooperative, and the venue splendid, but the science was even better.

One hot topic that consistently came up at the conference was how to narrow the remaining gaps between prosthetic and normal hearing.



Bruce J. Gantz, MD, of the University of Iowa designed special electrodes to produce a hybrid cochlear implant that preserves low-frequency acoustic hearing.

Blake S. Wilson, DSc, DEng, of Duke University reviewed the progress of cochlear implant performance from essentially chance-level success with single-channel devices in the 1980s to today's multichannel devices that even allow most users to carry on cell phone conversations. He also noted a lack of improvement in unilateral cochlear implant performance in the last two decades and suggested that improving unilateral performance serves as a "bedrock" critical to narrowing the gap between prosthetic and normal hearing.

As a means to improve unilateral performance, Ingeborg Hochmair, PhD, of MED-EL advocated the use of deep electrodes to access low-frequency neurons while matching them with appropriate temporal fine structure (*Hear Res* 2015; 322:14-23).

For people with residual low-frequency acoustic hearing, Bruce J. Gantz, MD, of the University of Iowa designed special electrodes to produce a hybrid cochlear implant that preserves low-frequency acoustic hearing, augmenting and enhancing the implant performance.

To achieve a hybrid hearing advantage, acoustic hearing better than 85 dB pure-tone average (PTA) between 125 Hz and 1,000 Hz needs to be preserved, preferably using the short (10-mm) electrodes while saving the long (16- or 20-mm) electrodes for people who are older than 70 and have more than 30 years of profound loss at high frequencies.

Most surgeons also favored atraumatic insertion and structural preservation in cochlear implantation, which are critical to both short-term protection and long-term maintenance of residual acoustic hearing.

Using a biological approach in an animal model, Shi-Ming Yang, MD, PhD, of Chinese People's Liberation Army General Hospital in Beijing demonstrated that stem cells promote auditory nerve growth toward the intra-cochlear electrodes, reducing power consumption while increasing spatial selectivity.

This technique, similar to a gene-therapy approach (*Sci Transl Med* 2014;6[233]:233ra54), may still be years away from human application, but it represents a promising future direction for enhancing the nerve–electrode interface and ultimately the bionic ear performance.

BINAURAL HEARING: SENSITIVE PERIOD

Another major area covered at the conference was understanding and utilizing brain plasticity in cochlear implantation.

Robert Briggs, MBBS, of the University of Melbourne reviewed lessons learned from cochlear implant outcomes in children over the past 30 years, such as the younger the implant age, the better the outcome, particularly for children implanted before their first birthday.

Other significant factors are the child's cognitive status and communication mode, with superior outcomes related to an oral versus a signing environment. A somewhat surprising finding was that children with bilateral implants have better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language outcomes than those with unilateral implants (*Ear Hear* 2014;35[4]:396-409).

Additional studies have indicated a sensitive period for developing functional binaural hearing and a preference for simultaneous bilateral implantation in children (*Brain* 2013;136[pt 5]:1609-1625). Blake Papsin, MD, MSc, from the University of Toronto found abnormally permanent hemisphere dominance contralateral to the stimulated ear in unilaterally implanted children that could not be reversed by sequential bilateral implantation.

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Seung Ha Oh, MD, PhD, of Seoul National University revealed significant differences in brain activation between prosthetic and normal hearing, suggesting that cochlear implant users engage additional brain areas and likely require a higher than normal cognitive load to understand degraded speech (*Hum Brain Mapp* 2015;36[5]:1982-1994).

Overall, these studies suggest that greater plasticity in younger children facilitates improved results.

REGIONAL CONCERNS

A unique aspect of the conference was the in-depth discussion of topics relevant to the Asia–Pacific region.

Researchers presented different ways to improve tone perception, including two eTone strategies that were both based on temporal envelope manipulations but independently devised by Cochlear and Nurotron. Cochlear implants were developed by Western scientists who did not consider the proper transfer of tones, which carry lexical meaning in many Asian languages, such as Mandarin, Cantonese, Thai, and Vietnamese.

However, a recent study found remarkably similar performances of 70 percent to 80 percent speech understanding between tonal and nontonal languages and across devices (*Hear Res* 2015;322:188-199), suggesting a limited need for language-specific processing.

Because most countries in the Asia–Pacific region have limited financial and professional resources, many cochlear implant users have to travel long distances to receive services or simply cannot afford care.

Zhiqiang Gao, MD, of Peking Union Medical College Hospital, which developed a single-channel device in the late 1970s and has since implanted more than 3,000 cases, discussed the progress in as well as the need for objective measures in cochlear implantation, data logging, remote programming, and telediagnosis and tele-evaluation, which will likely overcome the lack of audiologists and, eventually, the distance and cost factors in these less-developed regions.

INDUSTRY IN EVOLUTION

APSCI 2015 revealed several noteworthy industry trends. Up to 2014, about 400,000 people globally had received cochlear implants, including 200,000 pediatric and 60,000 bilateral users, Dr. Hochmair noted.

With 260,984 units sold since 1983, industry leader Cochlear Ltd. had an overall 60 percent market share. However, that share dipped to about 50 percent in 2014 and will likely continue to shrink with strong competition from MED-EL and Advanced Bionics, as well as from newcomers such as Nurotron and Listent, which together have sold thousands of devices and debuted with elegantly designed booths and well-attended workshops at the conference (*Hear Res* 2015;322:188-199).

In addition, China's national cochlear implant assistance project has provided free cochlear implants to 16,865 deaf children over the last five years, and the effort likely will continue or even be expanded (bit.ly/China-CI).

A final surprise at the conference was the rapid and effective adoption of new technology in the Asia–Pacific region. Genetic testing kits can screen for 10 to 150 genes for hearing loss and have been used by about one million people in China alone. In contrast, the United States, a leader in genetic hearing loss research and sequencing (e.g., *J Med Genet* 2013;50[9]:627-634; *Genet Test Mol Biomarkers* 2013;17[8]:581-587), is lagging behind in the deployment of genetic testing for hearing loss.

Author disclosure: As a founder of Nurotron, Dr. Zeng owns stock in the company.