Cochlear implantation for profound deafness

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Ear is a vital organ of a human being for self protection and communication, composing a very sophisticated tiny structure and its function is far more exceeded than the recent technology can simulate. Ear can perceive sound wave and cause the ear drum to vibrate. The vibration is passed to the middle ear, consisted of three small bones, which amplify and conduct the vibration to the inner ear. The inner ear consists of an organ called cochlear, which is shaped like a snail's shell. It contains tiny cells called hair cells which move in response to the vibration. Their movement will generate electrical signals that are transmitted to the brain for interpretation through the 30,000 fibers of auditory nerve. Any impairment along this pathway by any causes may lead to some degree of hearing loss or deafness.

The possible causes include mechanical blockage, bacterial or viral infection (mumps and measles), acoustic trauma (injury from loud noise to the hair cells), tumor, degeneration, drugs, stroke or even congenital deaf from genetics.

Hearing loss can be divided into two basic types, called conductive and sensorineural hearing loss. Conductive hearing loss is caused by any thing that interfere the transmission of sound from the ear drum to the inner ear. The sensorineural hearing loss is due to the damage of hair cells in the inner ear or the degeneration of auditory nerve fibers which is in able to produce the electrical impulses to the brain. This type of damage likely accounts for most of the people with profound deafness.

The severity of hearing loss or deafness can be measured in decibels hearing level. A normal person can hear sounds across the range of frequencies at 0 to 20 dB. Profound deaf people cannot hear sounds quieter than 95 dB and usually communicate using sign language or lip reading. Mild to moderate hearing loss may use the hearing aid which can amplify the sound wave to the brain, provided that the hair cells still

efficiently work. However, when the hearing aid does not give a significant amplification, a new technology device called cochlear implant may help.

According to Dr. Samut Chongvisal, Department of Oto-Rhinolaryngology, Faculty of Medicine Siriraj Hospital, multi-channel cochlear implantation is a new high-technology surgery that allows profoundly bilateral deaf patients (who cannot benefit from conventional hearing aids) to hear again.

Cochlear implant device has two parts. The external part consists of a small microphone that resembles a hearing aid, attached to the ear pinna. Sound is received by this telephone and is sent to speech processor with its size of sound-about. The speech processor analyzes and digitizes the sound waves into electrical code signals externally and sends to the transmitter which will further sends the codes across the skin into the internal part. The internal part consists of a small electronic device that is implanted to the mastoid bone adjacent of internal ear with an electrode array that is tunneled into cochlea next to the auditory nerve. This will bypass a series of analyzed electrical impulses directly to the hearing nerve that is still functioning to the brain.

To implant the device is not a problem technically, but to rehabilitate postoperatively including the process of programming and sound mapping are of essential prelude to sound reception and speech recognition. Since the electrical impulses appreciated by the brain do not totally match the natural voices. Therefore, the ability of the cochlear implant users to learn the auditory information and practice how to talk is of importance. This can be accomplished only by the support of a multidisciplinary team of experts including psychiatrists, well-trained audiologists, speech therapists and surgeons as well as the supportive role of parents and family.

Dr. Samut says candidates who are beneficial with the cochlear implants are adults with acquired bilateral profound hearing loss who can no longer function with a hearing aid. However, prerequisite assessment with relevant tests is needed before surgery.

The cochlear implants can also partially valuable for deaf children when they implanted around the age of two or three (prelingual hearing loss), the time when language skills are developing fastest. The implantation will turn these disabled children

to develop a normal learning and language skills in a normal educational environment once again.

One drawback of the cochlear implant is the relatively expensive cost of the device. Around eight hundred thousand baht is needed for one operation. Since the prevalence of profound congenital deafness is estimated at 1 in 1000 births, about 54,000 Thai people would be prelingually deaf (1999). Some of these may be beneficial to the implantation. However, if there is no funding support or donation from the community, only affordable patients can enjoy the procedures.