

First auditory brainstem implant in the Czech Republic

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Abstract

In the Czech Republic, the first implantation of a stimulation electrode into the brainstem was performed on 11 January 1999 in the Department of ORL, Head and Neck Surgery, The First Medical Faculty, Charles University in Prague, University Hospital Motol.

The selected patient was a 40-year-old woman with neurofibromatosis type 2 (NF2) who had previously undergone bilateral vestibular schwannoma surgery. Both tumours had been radically removed, the left-sided tumour in 1987, the right-sided one in 1988. She had been completely deaf since the last operation, i.e., for 11 years. The surgery was realized by the international cooperation of three teams. Placement of the electrode pad of the Nucleus CI21+1M system on the ventral and dorsal cochlear nuclei was performed. Electrically evoked auditory brainstem responses (EABRs) proved the correct position of the electrode array.

The post-operative course was uneventful. Six weeks after the surgery the patient received her speech processor. Since that time, the patient already absolved several sessions of a speech processor tune-up. She uses the device as an aid in lip-reading. No adverse or pathological side effects have been observed. The patient was the 45th person in Europe to receive an ABI and the first in the Czech Republic.

Key words: Brain Stem; Prosthesis Implantation; Neurofibromatosis 2; Neuroma, Acoustic; Hearing Loss, Sensorineural; Czech Republic

Introduction

In the year 1979, House and Hitselberger partially restored hearing for the first time in a female patient with neurofibromatosis type 2 (NF2) after bilateral vestibular schwannoma removal and hearing nerves transection. This was achieved by electrical stimulation of the hearing nucleus in the brainstem with a special neuroprosthetic device.¹ The first similar surgery in Europe was performed by Sollmann and Laszig in 1992.² Further development resulted in a multichannel device based on a cochlear implant, Nucleus of the Cochlear Corporation.³ The pilot study using the 20-channel device realized in Europe by Laszig proved that the device enabled hearing sensation and environmental sound detection.^{4–7} Current results of the multicentric research, during which there have been 52 auditory brainstem implants in Europe by 1999,⁸ established indications for surgery: adult patients with a total lesion of both hearing nerves occurring most often in NF2 or vestibular schwannoma with contralateral hearing nerve dysfunction of different origin, eg. traumatic. Congenital agenesis or dysfunction of the hearing nerves represents a contra-indication for surgery.

Methods and case history

The implantation centre in the Department of Otorhinolaryngology, Head and Neck Surgery in the First Medical Faculty of Charles University in Prague was founded in the year 1988. So far, nearly 50 deaf patients, both children and adults, have been operated upon for cochlear implants.

The first implantation of a stimulation electrode into the brainstem of a patient in the Czech Republic was performed here on 11 January, 1999.

A 40-year-old woman with neurofibromatosis 2 after bilateral vestibular schwannomas surgery was chosen as a candidate for the first ABI. Both tumours had been radically removed – the right-sided tumour in 1987 in the Neurosurgical Department in the city of Plzeň (by Z. Mraček), the left-sided one in 1988 in the Neurosurgical Department, The First Medical Faculty, Charles University in Prague (by E. Zvěřina). The function of both facial nerves remained intact, as well as – at least anatomically – the statoacoustic nerve on the left side. In spite of that, she had been completely deaf since the last surgery, i.e., for 11 years. According to magnetic resonance imaging (MRI) there was a marked gliosis in the region of the right-sided

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cerebellar hemisphere and the lateral recess of the 4th ventricle, i.e., indicating ABI surgery on the left side.

It was realized by the international cooperation of three teams. The surgery was performed by neurosurgeons Professor W.-P. Sollmann (Braunschweig) and Professor E. Zvěřina (Prague). Intra-operative monitoring of the cranial nerves was performed by D. Urgošfk (Prague), electrically evoked ABR by B. Nevison (London) and T. Tichý (Prague) with co-workers.

After 11 years of vestibular schwannoma removal, there were only slight arachnoidal adhesions in the left pontocerebellar angle. Cranial nerves VII, IX, X and XI remained anatomically intact with good function as proven by electrostimulation. The VIIIth nerve was partially preserved.

Identification of the entrance into the lateral recess of the fourth ventricle (foramen Luschkae) was relatively easy, since no schwannoma had to be removed. This was also due to a cerebrospinal fluid leakage. Placement of the electrode pad of the Nucleus CI21+1M system on the ventral and dorsal cochlear nuclei was quite simple. Electrically evoked auditory brainstem responses showed that the electrode array was in the correct position. The whole surgery including fixation of the receiver-stimulator into the temporal bone lasted five hours.

Results

The post-operative course was uneventful, a small cerebrospinal fluid pseudocyst, which occurred in the wound, was solved by one-time instillation of a fibrin glue. Native radiograms and computed tomography (CT) scans showed proper placement of the electrode pad.

Six weeks after surgery the patient was tuned up by a team consisting of P. Morris (London) and T. Tichý with co-workers (Prague). Since that time, the patient already absolved three sessions of speech processor adjustments. In spite of good contact of the majority of electrodes with the cochlear nuclei, she is using only three electrodes with two channels per electrode. The device is used all day long as an aid to lip-reading; the suprasegmental discrimination is unfortunately very low. No adverse or pathological effects have been observed.

Discussion

Electrical stimulation of the cochlear nucleus in the brainstem as a substitution for missing peripheral input and a method of hearing restoration represents one of the most up-to-date treatments of sensory deprivation. This is a new branch standing in the very beginning of its clinical research and application. In the beginning of the year 1999, in Europe there were 52 implanted patients. All the results, including our patient, are mostly worse than those of cochlear implants. Nevertheless, cochlear implants cannot be used in subjects with bilateral lesions of the VIIIth nerves. So far, it has been proven that an auditory brainstem implant is safe and without any risk for patients. An experienced multidisciplinary

team consisting of neurosurgeon, otosurgeon, electrophysiologist, anaesthetist, speech therapist and psychologist is a must for a successful realization of the ABI programme. Previous experience with cochlear implants is also important. The condition of an adequate surgeon's qualification is at least 100 performed vestibular schwannoma surgeries, experience with cochlear implants, brainstem surgeries and per operative cranial nerves monitoring.⁸

Conclusion

The first auditory brainstem implant surgery in the Czech Republic and the 45th in Europe was performed on 11th January, 1999 in the Department of Otorhinolaryngology, Head and Neck Surgery, The First Medical Faculty, Charles University in Prague, Institute for Postgraduate Medical Education, Faculty Hospital Motol, which is a statutory centre for cochlear implants. The surgery took place 11 years after the previous removal of a vestibular schwannoma. No serious complication occurred during surgery nor in the post-operative period. The first results of the auditory brainstem implant surgery are encouraging, nevertheless only time will show a more permanent benefit of the device.

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