Thapa N
Na G
Chi F

Department of Otorhinolaryngology, Eye, Ear, Nose & Throat Hospital, Fudan University, China

Correspondence:
Dr. Nirmal Thapa
Department of Otorhinolaryngology, Eye, Ear, Nose & Throat Hospital, Fudan University,83 Fenyang Road, Xuhui District, Shanghai 200031, China

E-mail: chifanglu@yahoo.com.cn

APPLICATION OF HEALON® FOR CONTROLLING OF GUSH IN THE COCHLEAR IMPLANT SURGERY: OUR EXPERIENCE WITH 10 CASES

Objective:
The objective of the study is to present our experience on cerebrospinal gush during cochlear implantation controlled by Healon®injection at cocheostomy site.

Material and Methods:
This is a retrospective review of 10 inner ear anomalies patients encountered gush during cochlear implant surgery.

Results:
CSF gush was stopped within a minute and insertion of cochlear electrode was done easily in a clean surgical field. Finally cochleostomy site was packed with pieces of temporalis muscle. Any signs of CSF leak and other major complications weren't seen on follow up period ranging from 6-27 months on all patients. All postoperative CT scans were available for review, all showing electrodes on scala tympani.

Conclusion:
Injecting healon®at cochleostomy site could be useful simple, early, rapid method to stop CSF gush in addition to facilitate atraumatic deep insertion of active electrodes during cochleostomy.

Keywords: Cochlear Implantation, Inner Ear Anomaly, Hyaluronic Acid (Healon®), Cochleostomy, Cerebrospinal fluid gush

INTRODUCTION:

CSF (Perilymph) gush may occur at cochleostomy during cochlear implant surgery, particularly in patients with congenital cochlear duct malformation in which CSF in the internal auditory meatus is in direct communication with the perilymphatic space in the cochlea. The chance of intraoperative CSF gush from cochleostomy site during cochlear implant is very low (less than 1%). As cochlear implantation in cases with inner ear anomalies have increased.[1,2], CSF gush during cochlear implantation in malformed cochlea have consequently increased too.[1] CSF gush at cochleostomy occurs in approximately 40% of cases with inner ear malformation, with the reported incidence ranging from 15% to 100%.[3-5] Various techniques have been applied to control CSF gush, but the literature is still unclear on the incidence and management of CSF leaks during cochleostomy.[2]

Healon®(sodium hyaluronate) which is used as a lubricant during the cochlear implantation electrode insertion could also be helpful to stop CSF gush. We routinely use Healon®at our center to facilitate atraumatic deep insertion of active electrodes during cochleostomy.

Here we would like to introduce one simple technique to stop CSF gush, which we have been practicing since 2005. All 10 inner ear anomalies patients with gush were effectively controlled with injection of the Healon®before insertion of electrodes at scala tympani at our institute.

MATERIAL AND METHODS:

It is a retrospective review of 725 cochlear implant surgeries performed at Department of Otolaryngology, Eye and Ear, Nose, Throat Hospital Shanghai, China since 2005 to 2011. Cochlear implant surgeries were done on age groups ranging from 2 months of age to 67 years of age. Among 725 cochlear implants performed, 120 patients (16.5%) had inner ear anomalies with the incidence of bilateral EVAS (Enlarged vestibular aqueduct syndrome) in 70% cases. Among 120 patients gush was encountered in 10 patients.

All these patients had bilateral, severe to profound hearing loss and underwent appropriate preoperative imaging (computed tomography or magnetic resonance imaging) to rule out new bone formation, anatomical abnormalities, modiolar defects, and CSF gush during cochleostomy. They all underwent standard transmastoidectomy-facial recess anterior inferior opening of round window techniques. Immediately after making intentional small cochleostomy, jet-like outflow (gush) was encountered. Gentle suction was applied for a few seconds to allow CSF to flow out and a few ml of Healon®was injected at the cochleostomy site. We found that CSF flow was completely stopped within a minute and active electrodes array were inserted in scala tympani. Finally tight packing of the cochleostomy was done with small pieces of temporalis fascia. The surgical incision was closed with standard three layer methods. Immediate postoperative modified Stenver's view verified correct electrode placement in scala tympani. Pressure dressing was removed within 24 hours of surgery. No signs of otorrhea and rhinorrhea or any other complications were seen. Patients were discharged within the same day. All patients with CSF gush were treated with antibiotics for at least 48 hours postoperatively.

Table. 1 Summary of 10 inner ear anomalies patients with CSF gush during cochlear implantation.

Patients	Age at CI (Months)	CT finding	Surgical technique	Gush	Postoperative Complications	Followed up (Months)
1	36	Isolated IP	Transmastoidectomy facial recess	Present	No CSF leak	27
2	16	B/L Mondini and Modiolar defect	Transmastoidectomy facial recess	Present	No CSF leak	10
3	36	B/L EVAS	Transmastoidectomy facial recess	Present	No CSF leak	22
4	132	Isolated IP	Transmastoidectomy facial recess	Present	No CSF leak	6
5	12	Isolated IP	Transmastoidectomy facial recess	Present	No CSF leak	6
6	7	B/L EVAS	Transmastoidectomy facial recess	Present	No CSF leak	10
7	48	Isolated IP	Transmastoidectomy facial recess	Present	No CSF leak	6
8	5	CC	Transmastoidectomy facial recess	Present	No CSF leak	9
9	24	Isolated IP	Transmastoidectomy facial recess	Present	No CSF leak	10
10	19	Isolated IP	Transmastoidectomy facial recess	Present	No CSF leak	18

IP Incomplete partition of cochlea; EVA Enlarged Vestibular aqueduct; CC Common Cavity; CI Cochlear implantation; B/L Bilateral.

RESULTS:

Gush was stopped and insertion of cochlear electrode was done easily in a clean surgical field. No signs of CSF leak and other major complications were seen during follow up period, which ranged from 6-27 months in all 10 patients. The results are summarized in Table 1. None of them required complete packing of middle ear cleft and Eustachian tube, lumbar tube drainage or revision surgery.

Fig.1. Preoperative computed tomography temporal bones scan showing an incomplete partition, with a cystic appearance of the cochlea, lacking the entire modiolus and a cystic vestibule.

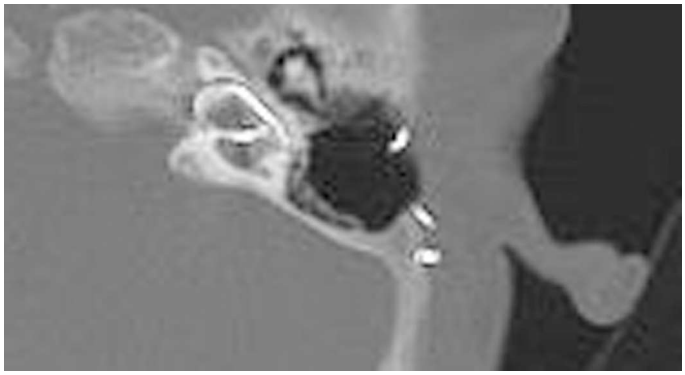


Fig.2. Postoperative computed tomography temporal bone scan of same patient with electrodes of cochlear implant.

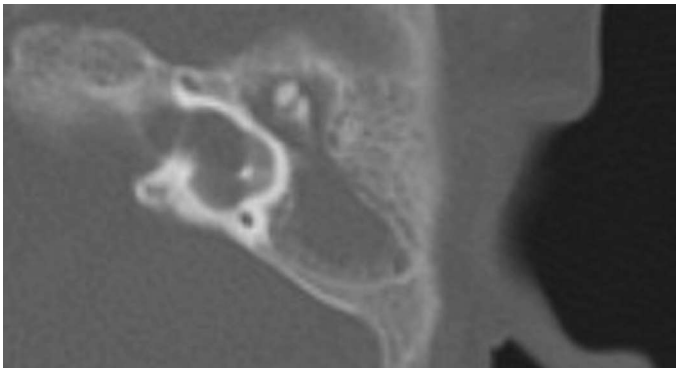
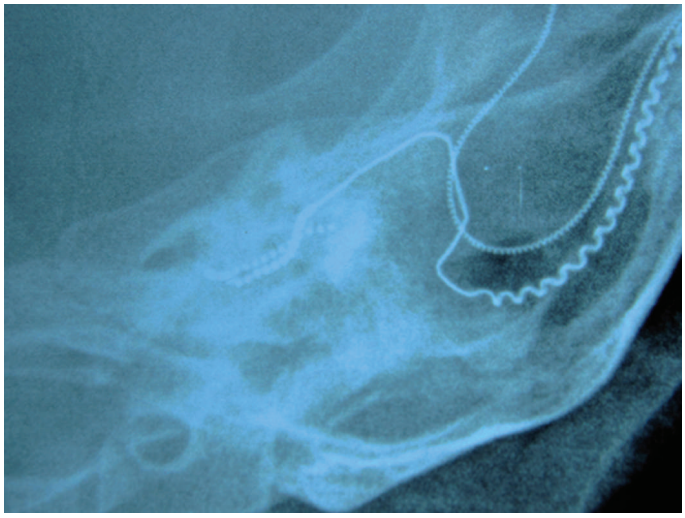


Fig.3. Postoperative modified stenver's view x-ray with electrodes of Nucleus®24k.CI24R(ST).



DISCUSSION:

Healon®, is a substance of high viscosity and high molecular weight found in connective tissue of animals and humans e.g. in the synovia, eye, skin and cartilage.[6] Hyaluronic acid (Healon®) has been used as a lubricant to facilitate the insertion of the electrodes array in cochlear implant surgery. Lehnhardt[7] showed that Healon®reduces trauma associated with the insertion of the cochlear implant array into the scala tympani while Donnelly[8] reported that the use of hyaluronic acid enables deeper insertion of electrodes. De Iaco PA et al[9] demonstrated the efficacy of ACP gel (hyaluronic acid derivative called Crosslinked hyaluronan solution) in the prevention of postsurgical adhesions after laparoscopy surgery. ACP is a new biomaterial; it is highly viscous, adhesive, and therefore conformable to the uterine and abdomino-pelvic surfaces, and it remains adherent to the tissue, even in a vertical position, for a suitable period of time before degradation. Cacciatori et al[10] reported that sodium hyaluronate 2.3% was found to be a useful adjunct in the management of highly myopic macular hole retinal detachment. Because the edges of the macular hole are covered by sodium hyaluronate 2.3% the retina remains flat and thus allows the surgeon to perform peeling of the epiretinal membrane (ERM) on a flat retina during vitrectomy. Gush, an intraoperative finding immediately after making cochleostomy, seen in approximately 40% of inner ear anomalies cases has a reported incidence ranging from 15 % -100%.[3-5] Cerebrospinal fluid gush (Pouring, jet like outflow) is usually a result of defect in the osseous interscalar septum, modiolus, cribriform plate or absence of lateral wall of internal auditory canal. Cerebrospinal fluid oozer (slow-well type of fluid flow) is the result of abnormally patent cochlear aqueduct.[6] Jackler and Hwang[11] and Graham et al[12] have incriminated a defect in the lamina cribrosa rather than enlargement of the cochlear aqueduct. In general, CSF gush is encountered with more severe degree of malformation whereas a lesser degree of CSF leak is encountered with less severe inner ear malformation. With either a gusher or an oozer, both have direct communication between the subarachnoid space and the cochlea so it should be properly managed to prevent postoperative CSF leak, meningitis, and revision of surgery and for cost-effectiveness. CSF oozer was stopped by electrode insertion itself but gusher can't be stopped itself by electrode insertion so different methods have been used to stop a CSF gush. These methods include; cochleostomy packing with temporalis muscle, fascia or pericranium with fibrin glue. Herbert W. Marks[13] also reported the simple technique of gush sealing by the bone-waxed silk suture. Wotten et al[2] reported a stepwise algorithm (flow chart) for management of gushers performed at Vanderbilt University Medical Center (Nashville, Tennessee) and Virginia Mason Medical Center (Seattle, Washington). No authors have reported control of gush by Healon®. Kiefer and coworkers[14] used healon®to seal the steroid solution within the cochleostomy site and preserved residual hearing to within 20 dB of preoperative thresholds in 12 to 14 patients. At our center Healon®was injected routinely in every patient during cochlear implantation before insertion of active electrode to facililate electrode arrays deep insertion and prevent trauma to cochlea. And it was found that the Healon®could also be helpful to stop CSF gush and has been used as a simple and effective method to prevent CSF gush since 2005. We are still unclear about how Healon®could be able to stop the gush during cochlear implantation? One reason could be as Healon®being a highly viscous and adhesive biomaterial, it could adherent to the tissue and the edges of the hole thus capable of inducing a watertight seal preventing the egress of gush. Once CSF gush was stopped by Healon®injection which provide a clear surgical field, insertion of active electrode was done. Finally cochleostomy was tightly sealed with small pieces of temporalis fascia surrounding the electrode in the cochleostomy. No signs of CSF leak were seen during postoperative follow up, which ranged from 6 to 27 months .

CONCLUSIONS:

The results of the review suggest that intraoperative injection of Healon®could be a simple, early and effective method to stop CSF gush during cochlear implant surgery.

Acknowledgements

We thank Dr Gao Zhen MD, PhD for his help in gathering data used in this study.

REFERENCES:

1. Micco AG (2003) Post-cochlear implant gusher and CSF leak. Operative Techniques in otolaryngology- Head and neck Surgery 14(4):297-299.
2. Wootten CT, Backous DD, Haynes DS (2006) Management of cerebrospinal fluid leakage from cochleostomy during cochlear implant surgery. The Laryngoscope 116:2055-2059.
3. Mylanus EA, Rotteveel LJ, Leeuw RL (2004) Congenital malformation of the inner ear and pediatric cochlear implantation. Otol Neurotol 25:308-317.

4. Woolley Al, Jenison V, Stroer BS, et al (1998) Cochlear implantation in children with inner ear malformations. Ann Otol Rhinol Laryngol 107:492-500.
5. Aschendorff A, Marangos N, Laszig R (1997) Large vestibular aqueduct syndrome and its implication for cochlear implant surgery. Am J Otol (suppl)18:S57.
6. Kim CS, Ju Kwon B, Chang SO, et al (2004) CSF gusher in cochlear implantation. Cochlear Implants Int 5:67-69.
7. Lehnhardt E (1993) Intracochlear placement of cochlear implant electrodes in soft surgery technique . HNO 41:356-359.
8. Donnelly MJ, Cohen LT, Clark GM (1995) Initial investigation of the efficacy and biosafety of sodium hyaluronate (Healon) as an aid to electrode array insertion. Ann Otol Rhinol Laryngol Suppl 166:45-48.
9. De Iaco PA, Stefanetti M, Pressato D, Piana S, Doná M, Pavesio A, Bovicelli L (1998) A novel hyaluronan-based gel in laparoscopic adhesion prevention: preclinical evaluation in an animal model. Fertil Steril Feb 69(2):318-23
10. Cacciatori M, Azzolini M, Sborgia M, Coppola M, De Molfetta V (2004) Sodium hyaluronate 2.3% prevents contact between indocyanine green and retinal pigment epithelium during vitrectomy for highly myopic macular hole retinal detachment. Retina Feb 24(1):160-
11. Jackler RK, Hwang PH (1993) Enlargement of the cochlear aqueduct: fact or fiction? Otolaryngol Head Neck Surg 109:14-25.
12. Graham JM, Phelps PD, Michaels L (2000) Congenital Malformation of the ear and cochlear implantation in children: review and temporal bone report of common cavity. J Laryngol Otol Supp 25:1-14.
13. Marks HW (2004) Simple Method to Control a Cerebrospinal Fluid Gusher during cochlear implants Surgery. Otol Neurotol 25:483-484
14. Kiefer J, Gstoettner W, Baumgartner W, Pok SM, Tillein J, Ye Q, von Ilberg C (2004) Conservation of low-frequency hearing in cochlear implantation. Acta Otolaryngol Apr124(3):272-80