Comparative Study of Endolymphatic Sac Decompression and Vestibular Neurectomy in Intractable Meniere's Disease

Yiqing Liu · Jie Han · Xuanchen Zhou · Deheng Luan ·
Fengyang Xie · Kun Gao

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Abstract To comparative study the clinical effect of endolymphatic sac decompression (ELSD) and vestibular neurectomy (VN) in intractable Meniere's disease (MD). The study included 30 MD intractable patients, 21 of which underwent ELSD and nine of which were treated by VN via retrosigmoid approach. Follow-up period ranged from 3 to 6 years. In 21 patients by ELSD, excellent vertigo control and good control were noted in 11 patients (52.4 %) and 4 patients (19.0 %), partial control in 4 and no control in 2 patients. All the 9 patients by VN, vertigo was excellent control. ELSD can improve hearing and tinnitus, but VN not. VN can achieve much better effect in improving vertigo in intractable MD patients. But relative to ELSD, it has much more disadvantages.

Keywords Meniere's disease · Surgery · Endolymphatic sac decompression · Vestibular neurectomy

Abbreviations

MD Meniere's disease
ELSD Endolymphatic sac decompression
VN Vestibular neurectomy

Introduction

Meniere's disease (MD) is a disease process characterized by vertigo, fluctuating sensorineural hearing loss, tinnitus, and aural fullness. Endolymphatic hydrops may contribute to this

disease, but the detail etiology and pathophysiology of MD are not very clear up to now. Although over half of the patients with MD could be controlled by the use of various medications, only the patients considered medical failures need to undergo surgical intervention. Intractable MD is the advanced stage of MD. Patients with intractable MD could not go to work and school and take part in other social activities, due to frequent attacks of vertigo and severe hearing loss. Some surgeries have been employed to treat MD, such as endolymphatic sac decompression (ELSD), vestibular neurectomy(VN), and labyrinthectomy. ELSD, first described by Portmann in 1926 [1], is common used all over the world, but its efficacy remains controversial today. VN which was first performed by Dandy in 1930s is an operation to cut the balance nerve while preserving the hearing nerve. We retrospected 30 patients with intractable MD in our department, which underwent ELSD or VN via retrosigmoid approach, and compared the outcome with regard to vertigo control, hearing loss and tinnitus improvement after 3–6 years' follow-up.

Materials and Methods

Ethic Statement

Our retrospective study was approved by Shandong Provincial Hospital Ethic Institutional Committee. Each individual involved in the study signed an informed consent form authorizing the Institute to utilize their information for research purposes.

Clinical Materials

This study included 30 intractable patients at the Department of Otorhinolaryngology Head and Neck Surgery,

Y. Liu · J. Han (✉) · X. Zhou · D. Luan · F. Xie · K. Gao
Department of Otorhinolaryngology Head and Neck Surgery,
Shandong Provincial Hospital Affiliated to Shandong University,
Jinan 250021, China
e-mail: hanjie64@sohu.com

Shandong Provincial Hospital affiliated Shandong University, Jinan, China between 2002 and 2005. All the patients enrolled in the study had been diagnosed as intractable MD according to the 1995 American Academy of Otolaryngology–Head and Neck Surgery (AAO–HNS) criteria. A total of 30 patients were presenting severe episodic vertigo, fluctuant hearing loss, tinnitus, and aural fullness, which had been resistant to previous medical treatments and had severely troubled their ability to work and quality of life. In our study, the patients underwent a series of examination, such as testing vestibular function by a caloric test.

Using electronystagmography (ENG), pure tone audiometry, glycerol test. In addition, CT and MRI of cerebellopontine angle and temporal bone were employed to exclude other diseases for patients. Both ELSD and VN were carried out by the same otologist at our institution. The surgical operation was chosen according to patient and physician preference as well as the severity of the patient's MD. Vertigo relief was judged as “excellent control”, “good control”, “partial control” and “no control”. “Excellent control” is that a patient reported complete vertigo relief after operation. “Good control” relief is that a patient experienced vertigo attack less than 3 times every year since the surgery. Patients who experienced vertigo attack more than 3 times each year, were judged as “partial control”. Patients who reported little or no vertigo relief, were designated the “no control”. The follow-up period ranged from 3–6 years, with 3.8 years' mean duration.

Endolymphatic Sac Decompression

Twenty-one patients underwent ELSD as their first procedure. This group comprised 11 male and 10 female, with a mean age of 36.5 years old (20–49) and a mean medical history 5.9 years [3–10]. The preoperative pure tone average (PTA, average of hearing sensitivity at 500 Hz, 1, and 2 kHz) were about 35 dB hearing level. 14 cases suffered from tinnitus. Fifteen cases were positive in glycerol test, and 6 cases were negative. A comparison of demographic and clinical data in both groups of patients are showed in Table 1.

Our ELSD surgery was carried out under general anesthesia or local anesthesia. Firstly made a 4 cm postauricular incision and simple mastoidectomy, then skeletonize the posterior fossa until posterior semicircular canal were identified by slightly grinding a blue area. Enlarged the tympanic sinus to expose the incudal fossa and horizontal semicircular canal clearly. The thickened portion of the dura that usually began just inferior to a line extending from the lateral semicircular canal bisecting the posterior semicircular canal was endolymphatic sac. Incise the lateral wall of the endolymphatic sac under the microscope

Table 1 Demographic and clinical information in the 21 patients of ELSD and 9 patients of VN

Feature	ELSD	VN
Total number of patients	21	9
Age (years)		
Median	36.5	39.2
Range	20–49	22–53
Sex-F:M	11:10	5:4
Duration of symptoms (years)		
Median	5.9	6.5
Range	3–10	3–15
PTA (dB)	35	55
Glycerol test		
Positive	15	9
Negative	6	0
Tinnitus	14	5
Follow-up period (years)		
Median	3.9	3.5
Range	3–6	3–6

PTA pure tone average

and keep it partly opening by using a silver clip clamping the incisal edges, which persistently makes the lymph fluid drainage into mastoid cavity.

Vestibular Neurectomy

Eight patients underwent VN as their first procedure. This group comprised 5 male and 4 female, with a mean age of 39.2 years old (22–53) and a mean medical history 6.5 years (3–15). The preoperative PTA was 55 dB hearing level. Due to loss of hearing after the procedure, VN was only offered to patients with a mean PTA greater than 55 dB HL. Five cases suffered from tinnitus. All the cases were positive in glycerol test and had lost their vestibular function.

VN via retrosigmoid craniotomy cerebellopontine angle exploration is performed under general anesthesia. After exposing the cerebellopontine angle, the VII and VIII cranial nerve are found under the microscope. Auditory nerve separated into two bundles by a faint boundary is thicker and bigger than the facial nerve. The location of the cochlear nerve, which is initially difficult to recognize, can be progressively identified using a color difference of the cochlear and vestibular partitions. Vestibular nerve next to the VII cranial nerve is grayish white, and the cochlear nerve is pure white. After identifying the relationships of the facial nerve, vestibular nerve and cochlear nerve, the vestibular nerve is severed by the micro-shears. Meticulous care is taken to avoid damaging the nerve and specially the inferior cerebellar artery.

Results

Endolymphatic Sac Decompression

The median follow-up time after ELSD was 3.9 years (range 3–6 years). Postoperatively, 12 patients' auditory threshold elevated more than 20 dB, 7 cases did not changed, and 2 cases descended average 15 dB. 14 cases with tinnitus had all improved after surgery. A comparison of hearing improvement data in both groups of patients is displayed in Table 2. According to 1995 AAO-HNS Committee on hearing and equilibrium criteria [2], in 21 cases of ELSD after surgery, excellent vertigo control and good control were noted in 11 patients (52.4 %) and 4 patients (19.0 %), partial control in 4 and no control in 2 patients, respectively. Table 3 reports the comparative vertigo relief outcome of ELSD and VN. Of 15 patients with positive in glycerol test preoperatively, excellent vertigo control and good control were noted in 11 and 3 patients, partial control in 1 patient, respectively. Of 6 patients with negative in glycerol test preoperatively, excellent vertigo control and partial control were noted in 1 and 3 patients, no control in 1 patient, respectively (Table 4).

Vestibular Neurectomy

The median follow-up time after VN was 3.5 years (range 3–6 years). After surgery 6 cases had no changed, 3 cases auditory threshold had descended 30 dB. 5 patients with tinnitus had not improved postoperatively. All the cases of VN vertigo were excellent control (Table 3).

Discussion

As it is known to us, many patients with MD achieved vertigo control by the aid of medication. Surgical treatment

is only required in a minority of cases that fail medical treatment. ELSD is one of representative of the typical nondestructive operation for MD, which was firstly reported by Portmann in 1926 [1]. Though it has been improved by many researchers, its efficacy remains controversial so far. At present, it is generally accepted that ELSD accomplished a 42–88 % complete vertigo control in clinical [3]. Because of simplicity of operation and according with physiological requirements, now ELSD is still the first choice of surgical treatment for early MD patients [4, 5]. Stephen J. Wetmore retrospective 83 patients with MD for 24 months after ELSD, 77 % of patients achieved improvement in vertigo [6]. From our results mentioned above, ELSD reached 52.1 % complete vertigo control and 90.5 % (19/21) reasonable effective rate, which is higher than Stephen J. Wetmore's results. In fact, vertigo control and hearing control both can be improved by ELSD. Mune-hisa Fukushima and colleagues ever reported 48.1 % of 52 patients obtained improvement in hearing function and 78.8 % achieved complete vertigo control after ELSD [3]. Comparing to our outcome, hearing function improved in approximate 57.1 % of 21 patients. Additionally, ELSD can remit tinnitus symptom. Fourteen patients found disappearance of their tinnitus in our study after ELSD is a good interpretation for it.

The indication of ELSD surgery is very important for intractable MD. In our opinion, PTA below 35 dB is a criteria to select ELSD as surgical intervention. In principle, ELSD is forbidden to use in patients with negative result in glycerol test. However, because the detail mechanism of MD is not officially known, a negative result is not enough to prove if there is hydrolabyrinth. Therefore, early stage patients should firstly undergo ELSD even though they are negative in glycerol test. Table 4 described excellent vertigo control and partial control were noted in 2 and 3 patients, no control in 1 patient, respectively in 6 patients with negative in glycerol test preoperatively. According to this finding, it is basically similar to the view above.

VN has long been the gold standard for management of sever vertigo in patients with intractable MD because of reducing episodic vertigo in a high percentage of patients [7]. Fish et al. claimed that VN should be a preferred surgery and stopped the use of ELSD [8]. However, VN have a relatively high surgical morbidity and can not effectively improve the tinnitus and hearing loss by cochlea

Table 2 Hearing improvement outcome of ELSD versus VN

	Improved	Unchanged	Worse
ELSD	12(57.1 %)	7(33.3 %)	2(9.5 %)
VN	0	6(66.7 %)	3(33.3 %)

Table 3 Comparative vertigo relief outcome of ELSD versus VN

Vertigo relief outcome	ELSD (21 patients)	VN (9 patients)
Excellent control	11(52.4 %)	9(100 %)
Good control	4(19.0 %)	0
Partial control	2(9.5 %)	0
No control	2(9.5 %)	0

Table 4 Comparative vertigo control in glycerol test positive and negative cases

	Excellent	Good	Partial	No
Positive	11	3	1	0
Negative	2	0	3	1

lesions. In our study, 100 % of patients with intractable MD had excellent vertigo control, but no one had tinnitus and hearing loss improved. Rosenberg described a 47 patients study undergoing VN. Vertigo was controlled in 90–95 % of patients. Hearing improved in 1/3rd, unchanged in 1/3rd, and worsened in 1/3rd [9]. Its result was basically the same as us: most patients were free from vertigo, but achieved poor efficacy in the hearing improvement.

VN could be divided into Translabyrinthine Vestibular Neurectomy, Retrolabyrinthine Vestibular Neurectomy, Retrosigmoid Vestibular Neurectomy and Middle Cranial Fossa Vestibular Neurectomy [10]. The VN via labyrinth is one of the typical representatives of the destructive surgical procedures, which is not only cutting off the postganglionic neurofibers, but also cutting off preganglionic neurofibers. It is the most reliable method of eliminating the function of vestibular endings organ in theory. The biggest drawback is that can not keeping residual hearing, so it is just only applying to the patient of no hearing. Besides, according to long term following up the patients with MD, 67 % patients' symptoms were bilateral, therefore we should perform labyrinth destruction as little as possible [11].

In cerebellopontine angle, vestibular nerve is seizing the upper part of the VIII cerebral nerve, cochlear nerve at the lower half part. Although there is always a fissure easily identified between vestibular nerve to cochlear nerve, this is not very precise, because it is absent at about 25 % of patients. Sometimes we would like to intentionally cut the anterior two-thirds of the VIII cerebral nerve, in order to ensure having clearly cut the vestibular nerve off. That is the cochlear nerve is even cut more, few bundles of vestibular nerve fibre can be miss. In order to overcome this problem, Silverstein et al. reported one method of the VN via internal acoustic meatus of retrosigmoid sinus approach [12]. They described to firstly open the posterior wall of internal acoustic meatus with the electrical drill and to exposure every branches of the vestibular nerve, then cut the vestibular off exactly. But there is a biggest problem in this approach that most patients feel serious headache postoperatively. That may be a result of the irritative aseptic meningitis caused by bone debris at the cerebrospinal fluid derivate from intraoperative electric drilling internal acoustic meatus. In addition, the difficult operative skill of ELSD makes it not to be used widespreadly in clinic.

Although the VN is an effective method to treat severe peripheral vertigo, not improving the auditory acuity and tinnitus is a great disadvantage from our analysis above. And it even can cause anacusia if damaging the cochlear nerve or the internal auditory artery. So in view of its much more risks, VN only applies to the patients with severe vertigo of frequent attacks, with little or without auditory

acuity, loss of vestibular function, or failure from ELSD. 9 cases of using the VN in our research reached excellent relief in vertigo relief.

In a word, the endolymphatic sac surgery meets the physiological request of the patients with MD [13], and should be as a preferred surgery for the early patients of requiring surgical treatment. For the patients in intermediate or advanced stage, who had lost their work ability because of the severe vertigo, should adopt the VN. After VN, there was one side instability for losing their vestibular function, which could be generally compensated by uninjured side vestibule in 1–3 months after surgery. Therefore we consider that the elder patients of 65 years old or above with intractable MD are not proper to use VN surgery, because their compensation capability are attenuated.

Conclusion

ELSD and VN has different advantages and disadvantages for treating intractable MD patients. For the patients with MD that want to recover their normal life, we recommend VN as the surgical procedure. And ELSD is considered a well-done approach for the patients that hope to keep their auditory acuity.

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