CLINICAL STUDY

VESTIBULAR SCHWANNOMA SURGERY WITH TRANSLABYRINTHINE APPROACH: RESULTS AND COMPLICATIONS

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SUMMARY

Objective: Vestibular schwannomas (VS) are benign tumors originating from Schwann cells in the vestibulocochlear nerve. Although they are benign tumors, they can cause serious problems. The aim of our study was to present the clinical features and complications of VS cases that were operated with translabyrinthine approach.

Materials and Methods: We retrospectively evaluated 11 VS patients who operated with translabyrinthine approach. Demographic data, symptoms, preoperative audiometric tests, tumor sizes, postoperative complications, hospital stay time were examined. Preoperative and postoperative facial nerve (FN) functions were evaluated with the House Brackmann (HB) grading system. The House grading system was used for tumor staging: Grade 1 ≤ 10 mm, grade 2 ≤ 20mm, grade 3 ≤ 30mm, grade 4 ≤ 40 mm and grade 5> 40 mm.

Results: 5 male and 6 female patients included the study. Mean age of the patients were 50.4 years (range, 18-66 years). The tumor was located on the left side in 7 patients. Grade 1 tumor was determined in 2 patients, Grade 2 in 5 patients and Grade 3 in 4 patients. The most common symptoms were tinnitus and hearing loss. In 1 patient cerebrospinal fluid fistula appeared. In one case, the integrity of the facial nerve had been disrupted during the operation. In 2 patients with these complications, the tumor was grade 3

Conclusion: VS surgery with translabyrinthine approach is a method with low complication rates and mortality. The most common early and late postoperative complication is facial paralysis.

Keywords: Vestibular schwannoma, acoustic neuroma, translabyrinthine, complications, House Brackmann

TRANSLABİRENTİN YAKLAŞIMLA VESTİBÜLER SCHWANNOMA CERRAHİSİ: SONUÇLAR VE KOMPLİKASYONLAR

ÖZET

Amaç: Vestibüler schwannomlar (VS), vestibülokoklear sinirdeki Schwann hücrelerinden köken alan benign tümörlerdir. İyi huylu tümörler olmalarına rağmen ciddi sorunlara neden olabilirler. Çalışmamızda translabirentin yolla opere edilen VS olgularının klinik özelliklerini ve cerrahi sonrası görülebilen komplikasyonları sunmayı amaçladık.

Gereç ve Yöntemler: Translabirentin yaklaşımıyla opere edilen 11 VS hastasının dosyası retrospektif olarak değerlendirildi. Hastaların demografik özellikleri, semptomları, ameliyat öncesi işitme eşikleri, tümör boyutları, ameliyat sonrası komplikasyonlar, hastanede kalış süreleri incelendi. Ameliyat öncesi ve sonrası fasiyal sinir (FN) fonksiyonları House Brackmann derecelendirme sistemi ile değerlendirildi. Tümör evrelemesi için House sınıflaması kullanıldı: Grade 1 ≤ 10 mm, Grade 2 ≤ 20mm, Grade 3 ≤ 30mm, Grade 4 ≤ 40 mm ve Grade 5> 40 mm.

Bulgular: Çalışmaya 5 erkek ve 6 kadın hasta dahil edildi. Hastaların yaş ortalaması 50.4 yıldı (18-66 yaş). Yedi hastada tümör sol tarafta yerleşmişti. 2 hastada grade 1, 5 hastada grade 2 ve 4 hastada grade 3 tümör saptandı. En sık görülen semptomlar kulak çınlaması ve işitme kaybı idi. Bir hastada ameliyat sonrası beyin omurilik sıvısı fistülü ortaya çıktı. 1 hastada ise, ameliyat sırasında fasiyal sinirin bütünlüğü bozuldu. Bu komplikasyonların görüldüğü 2 hastada da tümör grade 3'tü.

Sonuç: Translabirentin yaklaşımıyla VS cerrahisi, düşük komplikasyon oranları olan bir yöntemdir. Ameliyat sonrası erken ve geç dönemde en sık görülen komplikasyon fasiyal paralizidir. Fakat bu yaklaşımla fasiyal sinirin daha distalden tanınması diğer yöntemlere göre fasiyal paralizi riskini azaltmaktadır.

Anahtar Sözcükler: Vestibüler schwannom, akustik nöroma, translabirentin, komplikasyon, House Brackmann

INTRODUCTION

Vestibular schwannomas (VS) are benign tumors originating from Schwann cells in the vestibulocochlear nerve. Although they are benign tumors, they can cause serious problems by putting pressure on the surrounding structures. They can be located in the internal auditory canal (IAC) and/or at the the cerebellopontine angle (CPA). These are the most common tumors in CPA (75%), with equal frequency in female and male gender, but are more common in white races (84%). The incidence has been reported to be 1.1 per 100,000 and the average age of emergence is 53.1 years[1,2].

Patients may present with unilateral or asymmetric symptoms such as tinnitus, progressive or sudden hearing loss, vertigo, and headache. Large tumors can cause facial weakness and brain stem compression[3].

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Magnetic resonance image (MRI) analysis with gadolinium helps in diagnosis, and since the widespread use of contrast-enhanced MRI, smaller tumors started to be diagnosed incidentally[4]. Radiotherapy, microsurgery or combined approaches can be used in the treatment of vestibular schwannomas. Some selected patients can be followed closely with MRI. In recent years, observation has been used more, especially in tumors <1 cm. Surgical resection (mostly subtotal) is used more in tumors> 2 cm[5].

Vestibular schwannomas are operated on with 3 main surgical approaches: retrosigmoid, translabyrinthine or middle fossa approaches. Which method is to be chosen varies according to the size of the tumor, its localization, preoperative hearing thresholds, the surgeon's and institution's experience[6]. The aim of the current study was to present the clinical features of 11 VS cases that were operated on with translabyrinthine approach and our approach to postoperative complications.

MATERIAL and METHODS

This retrospective study was conducted in Uludağ University Department of Otorhinolaryngology by examining the medical files of patients who were operated on due to a CPA tumor between 2010 and 2016. Data collection was done by one person. Medical records were withdrawn from the electronic medical recording system. Approval for the study was granted by the Uludağ Local Ethics Committee (Decision no: 2020-6/27). Since it was a retrospective study, informed consent was not obtained from the patients. Demographic data, symptoms, preoperative audiometric tests, internal acoustic meatus MRI examinations, tumor sizes, postoperative complications, hospital stay and follow-up times were examined. Preoperative and postoperative facial nerve (FN) functions were evaluated with the House Brackmann (HB) grading system. Intraoperative electrophysiological monitoring of the FN was applied in all cases with a facial electromyographic device (NIM response 2.0 Nerve Integrity Monitoring System, Medtronics Xomed Surgical Products Inc., Jacksonville, FL, USA). The size of the tumors was determined from measurements on T1 slices of contrast-enhanced MRI. The longest tumor dimension was accepted as the tumor size. The House grading system was used for tumour staging: Grade 1≤10 mm, grade 2≤ 20mm, grade 3≤30mm, grade 4≤40 mm and grade 5> 40 mm[7].

All patients were operated with extended translabyrinthine approach. A large anteriorly based skin and a periosteal flap were elevated separately. Mastoidectomy was performed to expose middle fossa dura, sigmoid sinus and posterior fossa dura. External auditory meatus was kept intact. Mastoid segment of the FN was identified. Labyrinthectomy was followed by exposure of internal auditory canal which was prepared 180 to 270º of its lateral circumference. IAC and posterior fossa dura was opened in T fashion. Superior semicircular branch of superior vestibular nerve was identified and cut. Following this nerve proximally, staying on the vertical crest, FN was identified. Tumors were reduced and totally resected by intracapsular debulking and piecemeal removal technique with the help of bipolar cauterization. Extreme caution was used to protect FN, brainstem and vascular structures. After tumor removal, hemostasis was obtained meticulously. Incus was removed and aditus ad antrum was obliterated with a periosteum plug to seal off the tympanic cavity. Mastoid cell tracts were obliterated by bone wax (BONE WAX; Ethicon/Johnson&Johnson, Miami, Florida, USA). Dural defect was obliterated either by placing abdominal fat tissue prepared as long strips into dural opening tightly in cork and bottleneck fashion (8 patients); or covering the dural opening with temporal fascia and sealing with fibrin glue (TISSEEL Lyo; Baxter AG, Viyana, Avusturya) (3 patients). Mastoid cavity was also obliterated with fat without leaving any empty space. Incisions were closed in overlapping three layers (periosteum, subcutaneous and skin).

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences version 22.0 software (SPSS Inc., Chicago, IL, USA). Descriptive data were expressed in arithmetic mean and standard deviation (SD),

and median (min-max) values. Numerically obtained data were expressed in percentile (%).

RESULTS

Evaluation was made of 11 patients, comprising 5 males and 6 females with a mean age of 50.4 years (range, 18-66 years). The tumor was located on the left side in 7 patients. Grade 1 tumor was determined in 2 patients, Grade 2 in 5 patients and Grade 3 in 4 patients (Table 1) The most common symptoms were tinnitus and hearing loss. One patient was diagnosed with facial paralysis. The preoperative bone-conduction hearing thresholds were mean 59 dB.

No complications were determined in 7 patients in the early postoperative period. Cerebrospinal fluid (CSF) fistula was determined in 1 patient on postoperative day 1 and was reoperated to repair the fistula. Dural defect had been repaired with temporal fascia and fibrin glue technique in the first operation. However, CSF leakage from the suture lines was observed. In the second operation dural defect was obliterated using fat strips with cork and bottleneck technique.

The facial nerve was left anatomically intact in 10 out of 11 patients. Despite anatomic integrity, in four patients, facial nerve functions were deteriorated in the early postoperative period which recovered to grade 1 or 2 in up to 6 months except the patient who underwent revision surgery due to CSF fistula. This patient ended up with grade 3 facial function. In one case, the integrity of the facial nerve had been disrupted by surgical manipulation during the operation. That patient underwent hypoglossal-facial nerve anastomosis as primary anastomosis was not feasible. At the 1-year follow-up examination, that patient had HB grade 4 facial nerve function. In 2 patients with these complications, the tumor was grade 3. (Table 2)

The average length of hospital stay after surgery was found to be 8 days. (Table 1)

Table 1. Characteristics of the patients

Age average (min-max) (years)	50.45 (18-66)	
Gender	Male: 5 (45.4%)	Female: 6 (54.6%)
Tumor size (mm) average (min-max)	17.81 mm (8-35 mm)	
Tumor side	Right: 4	Left: 7
Hospital stay average (days)	8 (5-15)	

%: Percent

Table 2. Clinicopathological features of the patients

Patient	Age (years)	Symptoms	Bone conduction pure tone average (0.5,1, 2, 4 kHz) (dB)	Tumor size mm (MRG)	Complications	House classification of tumor size (Grade)
1	47	Tinnitus	55	12	No	2
2	66	Tinnitus	30	25	HB Grade 4 facial nerve disorder, CN 7-12 nerve anastomosis	3
3	18	Sudden hearing loss	70	19	No	2
4	40	Hearing loss, aural fullness	62	13	HB Grade 2	2
5	59	Tinnitus, hearing loss	65	8	No	1
6	48	Tinnitus, hearing loss	52	25	CSF leak, HB grade 3	3
7	53	Hearing loss	50	23	No	3
8	58	Hearing loss	60	12	No	2
9	60	Tinnitus, hearing loss, facial nerve paralysis	65	15	No	2
10	45	Tinnitus, hearing loss	70	10	No	1
11	62	Hearing loss	50	24	No	3

HB: House Brackmann, CSF: Cerebrospinal fluid leak

DISCUSSION

Vestibular schwannomas are the most common tumors in the cerebellopontine angle and constitute 75% of the lesions in this region. Translabyrinthine, retrosigmoid and middle fossa approaches can be used in the surgical treatment of these tumors8. The translabyrinthine approach was first described by Panse in 1904, and was then popularised in the 1960s following reports by House of 47 cases[9]. Sanna [10,11], defined the extended translabyrinthine approach, which we employed in our surgeries to be able to obtain the largest exposure. Recently, with the development of intraoperative nerve monitoring techniques, and a clearer understanding of the anatomy of the cochlear and facial nerve, the tumor can be resected with a 0.4% mortality rate and low risk of facial paralysis. With the translabyrinthine approach, vestibular

schwannoma, meningioma, cholesteatoma, neuroma, epidermoid, glomus tumors, choroid plexus papillomas and chordomas localized in the internal acoustic meatus and CPA can be resected [6]. In our study, all of the patients were operated on for vestibular schwannoma.

The translabyrinthine approach allows excellent and direct access to the IAC and cerebellopontine. It is indicated in patients with a large tumor with non-serviceable, preoperative hearing thresholds or a very low chance of preservation of hearing. It is difficult to maintain hearing regardless of the surgical method used in tumors >2.5 cm and in which the apex of fundus is involved. Therefore, it is recommended for patients with a tumor >2.5 cm and poor hearing. Tumor size is not a limiting factor in the translabyrinthine approach. Since there is less cerebellar retraction, intracranial complication risks are lower. With this method, the facial nerve can be identified more distally and earlier in the operation. Thus, the nerve protection rate is higher as the facial nerve is approached laterally. A disadvantage of this approach is operation length and need of meticulous dissection of neuro-otologic structures which requires an experienced neuro-otologic surgeon. Tumor removal can also be performed by neuro-otologic surgeon.

In 2019, Visagan et al.[12] investigated the factors affecting the length of hospital stay in 117 VS patients operated on with translabyrithine or retrosigmoid approach. The length of hospital stay, the need for intensive care, and the length of stay in intensive care were shown to be longer in patients operated on by the retrosigmoid approach. Complications such as cranial nerve deficits, bulbar symptoms, cerebrospinal fluid leak, seizure, wound infection and facial paralysis were found to be statistically significantly lower in the translabyrinthine method. In 2018, Obaid et al.[13] compared the translabyrinthine and retrosigmoid approaches, and the incidence of facial paralysis was reported to be lower in the translabyrinthine approach. A higher rate of ataxia, tinnitus and cranial nerve injuries was reported in the retrosigmoid group. Therefore, the translabyrinthine approach is the preferred method especially in patients with poor preoperative hearing results due to low facial nerve and CSF fistula complications. In the current study, 3 (27%) patients had early postoperative facial paralysis. Mortality rate is lower than 0.5% in the vestibular schwannoma sugery in recent years[14]. There was no mortality in our study.

In a study examining 13 VS patients, 10 underwent surgery and 3 were followed up conservatively. The translabyrinthine approach was used in 5 of the 10 patients, and different surgical approaches were used in the other patients. In one of these 5 cases, postoperative facial paralysis developed but it improved after 1 year of follow-up. No additional complications were seen in the other patients. The translabyrinthine approach was stated to be the most appropriate method for facial nerve preservation and complete resection of the tumor[15].

Some complications that may occur after VS operation with the translabyrinthine approach are cerebrospinal fluid leak, intracranial hemorrhage, facial nerve disorders, meningitis and death. Another advantage of translabyrinthine approach is the ease of re-exposing the surgical field in case of a complication. Fibrin glue and/or abdominal adipose tissue can be used to close the defect after surgery in order to prevent CSF leakage. As the tumor size increases, the risk of intracranial bleeding and facial nerve disorder increases [16]. In our study, 2 patients with complications (cases with CSF fistula and 7-12 facial nerve anastomosis due to facial nerve severance) also had House grade 3 VS. Increased tumor size increased the risk of postoperative complications.

Sanna et al.[10] found the most common complication to be abdominal subcutaneous hematoma with 3.2% (fat removal area) when they examined the patients operated on due to VS. CSF leak, subdural and cerebellar hematoma were other recorded complications. The average length of hospital stay was 6.4 days. There was seen to be a significant relationship between the length of hospital stay, tumor size, surgical approach and presence of complications. In the current study, the hospital stay was 8 days, and

patients with complications were those who remained in the hospital for a longer period of time.

If functional improvement is not expected in facial nerve palsy after VS surgery, dynamic procedures can be used. These include cable graft use, 7-12 cranial nerve anastomosis, muscle transposition, reconstruction with tendon or free muscle flaps[8]. Since facial nerve integrity was impaired in 1 patient in this study, hypoglossal-facial nerve anastomosis was applied in the early period. In the postoperative 1st year, facial paralysis of this patient was observed as HB grade 4. Intravenous or oral steroid treatment is beneficial in early postoperative paralyses. Tumor size and facial nerve recovery time have been reported to be the determinant prognostic factors in VS patients operated on with the translabyrinthine approach[17].

The limitation of this study was the low number of patients. However, the number of patients undergoing surgery is decreasing due to the low incidence of the tumor, close follow-up procedure and the recent advances in radiosurgical and radiotherapy treatment[18].

CONCLUSION

Vestibular schwannoma excision with translabyrinthine approach has low complication rates. Tumor size, localization and grade can affect the postoperative results. In patients who have low hearing thresholds this approach can be performed safely.

MAIN POINTS

• Translabyrinthine vestibular schwannoma surgery has low complication rates.

• The facial nerve can be identified early and at the distal part of the nerve, providing better chance of protection in the translabyrinthine approach.

• Staging the disease, determining hearing thresholds and tumor localization in the preoperative period are the most important factors affecting the surgical success.

Informed Consent: Written informed consent was not obtained from patients because of the retrospective design of the study

Conflict of Interest: The authors declare that they have no conflict of interest.

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