Journal of Clinical Neuroscience xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical commentary

The difficulty of predicting clinical outcome after intended submaximal resection of large vestibular Schwannomas

Rebecca MacKenzie [a], Peter Sporns [b], Tarek Zoubi [b], Mario Koopmann [c], Christian Ewelt [a], Walter Stummer [a], Benjamin Brokinkel [a,1], Eric Suero Molina [a,*,1]

[a] Department of Neurosurgery, University Hospital Münster, Münster, Germany
[b] Institute of Clinical Radiology, University Hospital Münster, Münster, Germany
[c] Department of Otorhinolaryngology, Head and Neck Surgery, University Hospital Münster, Münster, Germany

ARTICLE INFO

Article history:
Received 9 September 2017
Accepted 8 January 2018
Available online xxxx

Keywords:
Vestibular schwannoma
Microsurgery
Stereotactic radiosurgery
Gamma knife
Subtotal resection

ABSTRACT

Introduction: Intended subtotal resection of large vestibular schwannomas (T4a and b according to the Hannover classification system) has been shown to be safe and, in combination with stereotactic radiosurgery, might enable sufficient tumor control. However, risk factors for postoperative neurological deterioration in these surgically challenging lesions are largely unknown.
Methods: Pre- and postoperative symptoms, clinical and radiological data of patients who underwent intended subtotal resection for vestibular schwannoma in our department between 2010 and 2014 were reviewed. Risk factors for postoperative neurological deterioration were analyzed in uni- and multivariate analyses.
Results: 63 patients harboring T4a (N = 33, 52%) or T4b (N = 30, 48%) tumors were included. At time of discharge, facial nerve and hearing function had deteriorated from a serviceable to a non-serviceable level (H&B grades I + II vs. >II) in 24% (N = 15/63) and 21% (N = 6/29), respectively. Deterioration of vertigo was more common after near (N = 3/9, 33% vs. 2/38, 5%) than after subtotal resection (<.25 ccm vs. ≥ .25 ccm tumor remnant on the initial postoperative MRI; p = .042). No further correlation with patient age, sex, neurofibromatosis, resection extent and tumor volume, or -cyst volume was found. Patients were reevaluated after a median of 3 months after surgery. At that time, facial nerve function and hearing had both decreased from a preoperative serviceable to a non-serviceable level in 5%. In univariate analyses, risk of deterioration of facial nerve function increased with preoperative tumor volume (p = .037).
Conclusion: Intended submaximal resection provides satisfactory neurological outcome for patients with large VS. Risk factors for postoperative neurological deterioration remain unclear.

1. Introduction

The treatment of vestibular schwannoma (VS) still remains controversial and strategy significantly depends on the tumor size. Although stereotactic radiosurgery (SRS) has been shown to enable sufficient local tumor control with low therapy side effects for small and medium-sized tumors [1–3], both efficiency and safety of SRS seems to decrease with rising tumor size. Hence, treatment of large VS reaching the brain stem (T4a and T4b according to the Hannover classification system [4]) is challenging [5]. Concerning microsurgery (MS), postoperative facial nerve outcomes were shown to decrease with increasing tumor size and extent of tumor resection [6–8]. On the other hand, extent of resection was found to strongly correlate with risk of tumor recurrence and several studies showed growth of residual tumor tissue after surgery [8–13]. As SRS has been shown to be well feasible when treating recurrent VS [14,15], several series reported combined intended submaximal microsurgical resection with subsequent SRS as efficient, particularly for the treatment of large VS [5,16]. However, prediction of clinical outcome and factors associated with neurological deterioration after submaximal resection are largely unknown [17]. In this study, we retrospectively evaluated clinical outcome after MS in a large series of intended submaximally resected T4a and T4b VS and aimed to identify risk factors associated with postoperative neurological deterioration.

* Corresponding author at: Department of Neurosurgery, University Hospital Münster, Albert-Schweitzer-Campus 1, Building A1, 48149 Münster, Germany.
E-mail address: eric.suero@ukmuenster.de (Suero Molina E).
[1] Authors equally contributed.

https://doi.org/10.1016/j.jocn.2018.01.033
0967-5868/

2. Methods

2.1. Surgical procedure

All surgeries were performed using a retrosigmoid approach with the patient placed in a park-bench position. Incomplete resection was classified in case of any tumor remnant was left behind according to the surgeons' intraoperative evaluation [16]. After anesthesia-induction, patients received dexamethasone, mannitol and a single-shot antibiotic prophylaxis. All surgeries were performed by a team of two neurosurgeons. A skin incision of about 10 cm was placed 3–4 cm posterior to the mastoid process and a retrosigmoid craniotomy of approximately 4 by 4 cm size was performed exposing parts of the sigmoid and transverse sinuses. After installation of a budde halo brain self-retaining retractor system (Integra GmbH, Ratingen, Germany), the dura was incised and CSF drained by opening the cerebellomedullary cistern, thus ensuring minimal brain retraction. Anatomical and electrophysiological identification of the cochlear nerve was strived in all surgeries but impeded due to severe adhesions and the tumor size in some cases. The tumor was then dissected and bimanually debulked by using a suction and an ultrasonic surgical aspirator (CUSA Excel, Integra GmbH, Ratingen, Germany), avoiding overstretching of nerve. Intrameatal tumor portions were reached by opening the internal auditory canal with diamond drills [4,18,19]. Intraoperative neuromonitoring including electromyography of the cranial nerves V, VII, IX-XII, acoustic and somatosensory evoked potentials as well as monopolar facial nerve stimulation (Inomed Medizintechnik GmbH, Emmendingen, Germany) during all surgeries. Sequences of repetitive and high-frequency potentials were considered sensitive and specific indicators of postoperative facial nerve palsy [20,21] and required an immediate change in or termination of microsurgical preparation of tumor remnants adjacent to affected nerves. A complete resection was a priori not attempted. Due to abnormal nerve activity during preparation, the tumor capsule or a minimized residue usually adhering to the facial or acoustic nerve was left to ensure serviceable postoperative nerve function (submaximal resection).

2.2. Data collection

Data from operative and medical reports was reviewed from patients who underwent intended submaximal resection for histopathologically confirmed vestibular schwannoma graded as T4a and T4b according to the Hannover classification system [4] between 2010 and 2014 in our department (University Hospital Münster, Department of Neurosurgery). Clinical data at the time of presentation, at discharge and at outpatient examination 3 months after surgery was obtained from medical and operative reports according to physical examinations by a neurosurgeon and registered in a standardized manner (Table 1). Facial nerve and hearing function were classified according to the House and Brackmann (H&B) and Gardner Robertson scales and classified as serviceable (grades 1 + 2) and non-serviceable (grades >2) according to previous descriptions [5,22–24]. Vertigo was semiquantitatively registered as absent, transient or permanent, while signs of trigeminal nerve impairment were quantified as absent, hypesthesia, paresthesia and neuralgia. Signs of brain stem (e.g. positive Babinski sign) or cerebellar compression (e.g. ataxia, dysarthria, dysmetria) as well as other neurologic symptoms attributed to

Table 1
Frequency of neurological symptoms at the time of presentation, initially postoperative and at the time of outpatient examination together with radiological data. Follow-up was performed at the time of discharge and after a median of 3 month of surgery; follow-up data was available in 63 (100%) and 59 (94%) patients respectively.

Clinical data	Preoperative N (n%)	At time of discharge N (n%)	Follow-up N (n%)
Facial nerve function	63 (100%)	63 (100%)	59 (94%)
Serviceable	60 (95%)	45 (71%)	45 (76%)
I	54 (86%)	36 (57%)	39 (62%)
II	6 (10%)	9 (14%)	6 (10%)
III	1 (2%)	8 (13%)	6 (10%)
IV	2 (3%)	9 (14%)	7 (11%)
V	0	1 (2%)	1 (2%)
Non-serviceable	3 (5%)	18 (29%)	14 (24%)
Hearing	31 (49%)	31 (49%)	43 (68%)
Serviceable	18 (58%)	9 (29%)	6 (14%)
Non-serviceable	13 (41%)	22 (71%)	37 (86%)
Vertigo	63 (100%)	63 (100%)	59 (94%)
Absent	34 (54%)	46 (73%)	43 (73%)
Transient	18 (29%)	12 (19%)	15 (24%)
Permanent	10 (16%)	5 (8%)	1 (2%)
Disabling	1 (2%)	0	0
Trigeminal nerve symptoms	63 (100%)	63 (100%)	59 (94%)
Absent	40 (63%)	54 (86%)	52 (88%)
Hypesthesia	17 (27%)	6 (9%)	6 (10%)
Paresthesia	4 (6%)	3 (5%)	0
Neuralgia	2 (3%)	0	1 (2%)
Other symptoms	63 (100%)	63 (100%)	59 (94%)
Tinnitus	15 (24%)	3 (5%)	7 (11%)
Hemifacial spasm	1 (2%)	0	0
Cerebellar signs	29 (46%)	14 (22%)	17 (29%)
Brain stem signs	4 (6%)	4 (6%)	2 (3%)
III, IV, VI palsy	5 (8%)	4 (6%)	3 (5%)
N. IX palsy	0	3 (5%)	1 (2%)
Subtile hemiparesis	0	2 (3%)	0
Radiological data	50 (79%)	N/A	47 (75%)
Median tumor volume (ccm, range)	7.68 (0.74–41.44)	N/A	0.86 (0.00–17.56)
Median cyst volume (ccm, range)	0.00 (0.00–16.84)	N/A	0.00 (0.00–0.52)

Please cite this article in press as: MacKenzie R et al. The difficulty of predicting clinical outcome after intended submaximal resection of large vestibular Schwannomas. J Clin Neurosci (2018), https://doi.org/10.1016/j.jocn.2018.01.033