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Case study

Risk factors for neurological complications after operative treatment for schwannomas ☆

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ABSTRACT

Schwannoma is a common benign soft tissue tumor. Although schwannomas can be theoretically enucleated without nerve damage, neurological complications occasionally develop following enucleation. The aim of this study was to elucidate the incidence of and risk factors for postoperative neurological complications following schwannoma enucleation. Ninety-eight schwannomas from 95 patients that were treated by surgical excision between January 2003 and December 2014 were included in this retrospective case series study. Patients were 49 men and 46 women with a median age of 60.5 years (range, 22–87 years). The incidence of postoperative neurological complications was evaluated in all the patients, and characteristics, such as age, tumor size, sex, preoperative symptoms, MRI findings, tumor location, and the nerve of origin, were compared between the cases with or without complications at the last follow-up. In our study population, postoperative neurological complications were observed in 18.4% of the cases. In univariate analysis, preoperative sensory disturbance, tumor location, and the nerve of origin were associated with the incidence of postoperative neurological complications ($p < 0.001$, $p = 0.034$, and $p = 0.003$, respectively). In multivariate analysis, tumors showing preoperative sensory disturbance and tumors located in the proximal aspect of the limbs were identified as independent risk factors for postoperative neurological complications ($p < 0.001$ and $p = 0.014$, respectively). A certain percentage of schwannoma cases undergoing enucleation would show postoperative neurological complications. Therefore, patients with schwannoma, in particular, those with risk factors for postoperative neurological complications, should be informed regarding the possibility of postoperative complications. In cases of schwannoma enucleation, the procedure should be meticulously performed to minimize the damage to the affected nerve of origin.

1. Introduction

Schwannomas are common benign soft-tissue tumors and account for 5% of all soft-tissue tumors. Schwannomas could occur at all ages but are particularly observed in the fifth and sixth decades of life. They may arise in any part of the body, and have been reported to show a predilection for the brachial plexus and the upper extremities. Malignant transformation is rare. The major histological characteristics of schwannomas include the presence of two components, named Antoni A and Antoni B areas, and uniformly intense immunostaining for the S-100 protein. Unlike neurofibromas, which belong to the same category as benign neurogenic tumors and often grow in diffuse or plexiform patterns, schwannomas arise in nerve sheaths and are surrounded by a true capsule consisting of the epineurium [1]. Encapsulation is also a major characteristic of schwannomas and theoretically allows for their enucleation without nerve damage [2]. However, neurological complications, such as numbness, pain, or palsy, occasionally develop following schwannoma enucleation. The rate of neurological complications following schwannoma enucleation varies according to the previous reports. Although various risk factors for neurological complications have been reported, no consensus exists. In this study, 98 schwannoma cases from 95 patients, who were treated by surgical excision at our institute, and were retrospectively reviewed, and their preoperative clinical characteristics and postoperative neurological complications were evaluated. The aim of this study was to elucidate the incidence of and risk factors for postoperative neurological complications.

2. Patients and methods

In total, 98 schwannoma cases from 95 patients who were treated by surgical excision at our institute between January 2003 and

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December 2014 were reviewed. Only cases of pathologically diagnosed schwannomas in the extremities and the trunk were included, and those that arose in the spinal nerve roots or the cranial nerves were excluded. The medical records of the patients were analyzed to extract data regarding age, sex, tumor location, the nerve of origin and the presence of the following preoperative symptoms: radiating pain, pain or tenderness, sensory disturbance, or palsy. Maximal tumor diameters were measured by a preoperative MRI or CT scan. The target sign, split-fat sign (Fig. 1) [3], and gadolinium enhancement were also evaluated on MRI when the necessary imaging was available. Clinical outcomes were evaluated at the last follow-up. Some patients without postoperative neurological complication completed their follow-up at 1 month of re-examination. The median period of follow-up for the other patients was 12.0 months (range, 2–80 months).

Postoperative symptoms were defined as follows: the disappearance of or reduction in preoperative symptoms was considered as "no complication," and persistence or deterioration of preoperative symptoms or the appearance of new-onset neurological symptoms was considered as "complication." The assessment of neurological symptoms was based on patient complaints. Age, tumor size, sex, preoperative symptoms, MRI findings, tumor location, and the nerve of origin were compared between the cases with and without complications at the last follow-up. There was no patient who had a preoperative needle or incisional biopsy preoperatively. Surgical excision primarily consisted of enucleation followed by meticulous dissection and peeling of the epineurial capsule (Fig. 2). Procedures were performed without using a surgical loupe or electrophysiological monitoring.

Statistical analyses were performed by using Student's t-test for quantitative variables and Fisher's exact test for categorical variables. Variables identified as significant in the univariate analysis were evaluated by multivariate analysis. Multivariate analysis was performed using JMP®11 (SAS Institute Inc., Vary, NC, USA). The level of statistical significance was set at p of <0.05.

The institutional review board of our institution approved the present retrospective case series study, and it has been performed in accordance with the ethical standards of the Declaration of Helsinki.

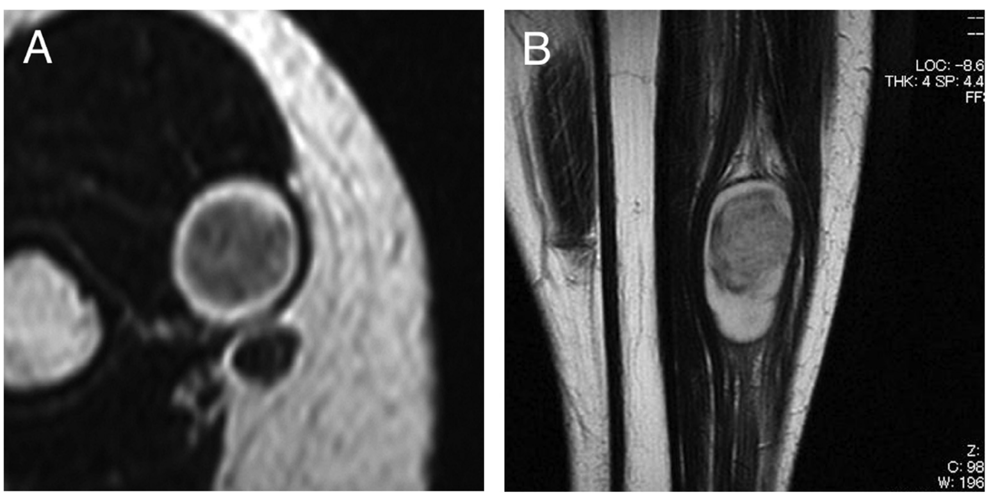

Fig. 1. Target sign and split fat sign. A. Schwannoma arising in the thigh showing the target sign (T2-weighted MRI, sagittal view). Target sign consists of a central low-to-intermediate signal intensity with a peripheral ring of high signal intensity. B. Schwannoma arising in the leg showing the split-fat sign (T2-weighted MRI, sagittal view). The split-fat sign is characterized by a rim of fat around the tumor. The presence of a target sign on MRI indicates a neurogenic neoplasm, whereas a split-fat sign indicates a tumor in the intermuscular space [3].

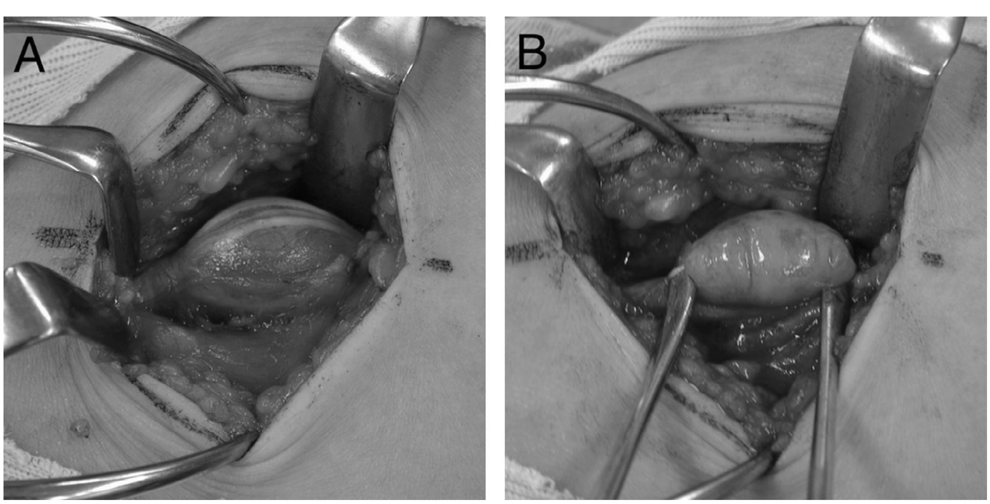

Fig. 2. Representative case showing a schwannoma enucleation. A. The tumor is exposed along with the nerve of origin. Some nerve fascicles can be observed to be running on the surface of the tumor. The dissection should be carefully performed on the epineurial area devoid of fascicles. B. The epineurial capsule is meticulously peeled to enucleate the schwannoma. A fascicle is often continuous with the tumor parenchyma and it may unavoidably need to be sacrificed.

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