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Benign peripheral nerve sheath tumor of the extremities: a retrospective analysis and review of the literature

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Abstract

Peripheral nerve sheath tumors (PNSTs) are a group of primary neurogenic tumors. Most of these tumors are benign. The malignant transformation could occur, especially in large tumors and those associated with neurofibromatosis type 1 (NF 1). These tumors can cause pain, nerve damage and loss of function in the affected extremities. Treatment usually includes surgery to remove the tumor or observation. Benign peripheral nerve sheath tumors (BPNST) include schwannoma, neurofibroma, and perineurium. This study aims to evaluate the demographic data, admission complaints, diagnosis, and surgical treatment steps of the patients who were operated on due to peripheral nerve sheath tumors and to compare the data with the literature. In this study, a retrospective examination was made of patients who presented with complaints of pain and swelling and were treated surgically in the Orthopedics and Traumatology Clinic of the 3rd Step University Hospital and diagnosed with BPNST between January 2010 and April 2022. The study included 107 patients diagnosed with benign peripheral nerve sheath tumors. 56 of 107 patients were excluded because the tumor was around the spine, head and neck. A total of 51 patients, 31 schwannomas, 12 neurofibroma, three traumatic neuromas, three plexiform schwannoma and two plexiform neurofibroma, were evaluated, and the data were analyzed. The most common subtype of BPNST was determined to be schwannoma and followed by neurofibroma. Benign nerve tumors originate from the nerve sheath. The most common are schwannoma, followed by neurofibromas. Typically surgical excision is recommended for BPNTS causing pain, swelling or other symptoms. Following surgical treatment, temporary postoperative symptoms could occur, like pain, paraesthesia, and sensory or motor function of the affected nerve. A biopsy should be planned when malignancy is suspected, and an experienced team should diagnose and treat these patients.

Keywords: schwannoma, neurofibroma, peripheral nerve sheath tumor, benign

1. Introduction

Peripheral nerve sheath tumors; from benign tumors such as schwannoma, neurofibroma, and neuroma; It covers a broad spectrum of diagnosis, ranging from malignant peripheral nerve sheath tumors, many of which are resistant to conventional therapies (1,2). Ten to twelve percent of all benign soft tissue tumors are benign peripheral nerve sheath tumors (BPNST). Compared to malignant peripheral nerve sheath tumors, they are physiologically non-aggressive tumors with a favorable prognosis (3,4). Typically, benign and cancerous peripheral nerve sheath tumors appear infrequently (5, 6). This study aims to examine the demographic data, admission complaints, diagnosis and surgical treatment stages of the patients who were operated on with the BPNST diagnosis and compare the data obtained during the post-surgical follow-ups with the literature.

2. Patients and Methods

Between January 2010 and April 2022, a retrospective analysis of 51 patients diagnosed with BPNST treated surgically in the Orthopedics and Traumatology Clinic of the 3rd step University hospital was performed. The hospital ethics committee approved the study with the decision dated 26.07.2022 and numbered B.30.2.ODM.0.20.08/352-457. Patient protocol information, clinical data, radiological images, pathology results, and follow-up data were obtained from the hospital archive and computer system. Information about the patient's initial complaint, follow-up period, pathological diagnosis, and the size of the excised material were evaluated. One hundred seven patients with pathological diagnoses of BPNST were identified.

56 of 107 patients were excluded because the tumor was around the spine, head, and neck. In the study, A total of 51 patients, 31 schwannomas, 12 neurofibroma, three traumatic neuromas, three plexiform schwannoma, and two plexiform neurofibroma, were evaluated, and the data were analyzed. All patients underwent magnetic resonance imaging (MRI) for pre-operative imaging. It was determined that the patients who would undergo a biopsy before the operation were determined according to the MRI results. Peripheral enhancement and heterogeneous appearance detected in the mass due to MRI aroused the suspicion of malignancy, and a biopsy was planned

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according to these findings. In the surgical treatment of BPNSTs, After the incision, a gentle dissection was performed until the surface of the tumor was exposed. After reaching the tumor, it was understood from the surgical notes that the mass was removed in a block with the capsule by the rules of tumor surgery. The patients were called for control in the first year after the operation, on the 14th postoperative day, at the third and sixth months, and yearly intervals at the end of the one-year follow-up.

3. Results

The study included 26 men (50.98%) and 25 (49.02%) women. Fifty-one patients were diagnosed with 31 schwannomas (60.78%), 12 neurofibromas (23.53%), three traumatic neuromas (5.88%), three plexiform schwannomas (5.88%) and two plexiform neurofibromas (3.93%) were evaluated (Table 1). The mean follow-up period was 8.09 months (1 month-72 months). All patients underwent pre-operative magnetic resonance imaging (MRI). According to clinical findings and MRI results, 19 patients (37.25%) underwent a biopsy with suspicion of malignancy. All patients were treated with total or subtotal excision surgery.

Table 1. Distribution of patients with benign peripheral nerve sheath tumor (BPNST)

Benign Peripheral Nerve Sheath Tumor (BPNST)	n=51	%
Schwannoma	31	60.78
Neurofibroma	12	23.53
Plexiform schwannoma	3	5.88
Plexiform neurofibroma	2	3.93
Traumatic neuroma	3	5.88

-Schwannoma: There were 31 patients diagnosed with schwannoma, with a mean age of 47.77 years, 18 men (58.1%) and 13 women (41.9%). The mean follow-up period was 7.35 months (1 month-36 months). The presenting complaint was a palpable mass in 11 patients (35.48%) and pain in 26 patients (83.87%). Six patients (19.35%) complained of pain and a palpable mass. The mean tumor size was 3.88 cm (1-15.5 cm). No recurrence was observed in any patient (Fig.1.).

-Plexiform Schwannoma: Our patients with a diagnosis of plexiform type schwannoma were three women with a mean age of 43, and the follow-up period of these patients was 4.33 months. All three patients applied with the complaint of swelling, and one complained of pain. The mean tumor size was 5.4 cm (2.2-9 cm). Total excision was performed in 3 patients. No recurrence was observed in 3 patients after treatment.

-Neurofibroma: There were 12 neurofibroma patients, five men (41.67%) and seven women (58.33%), with a mean age of 36.5 years and a mean follow-up period of 13.83 months (1 month-72 months). There was a palpable mass in 6 patients (50%) and pain in 10 (83.33%). 3 (25%) of 12 patients were associated with NF type-1. The mean tumor size was 3.72 cm (0.8-10.5). Recurrence was seen in 1 patient (8.33%).

-Plexiform neurofibroma: One of the two patients in this group was a 40-year-old woman, and the other was a 56-year-old man; the mean follow-up period was 7.5 months. The presenting symptom was pain in the male patient and a palpable mass in the female patient. The mean tumor size was 6.6 cm (2.2-11 cm). Total excision was performed in one of the cases, and their complaints wholly regressed. The other patient underwent subtotal excision due to the localization and size of the tumor, and recurrence was observed in the follow-up of that patient.

-Traumatic Neuroma: There were three patients with a mean age of 43, one woman and two men, diagnosed with traumatic neuroma, and the follow-up period of the patients was 5.67 months. It was observed that all of the patients presented with complaints of severe pain in the long-term follow-up after a previous transfemoral amputation. It originated from the right femoral nerve of 2 patients and the left femoral nerve of 1 patient. After the excision, no recurrence was observed, and the complaints wholly regressed (Table 2).

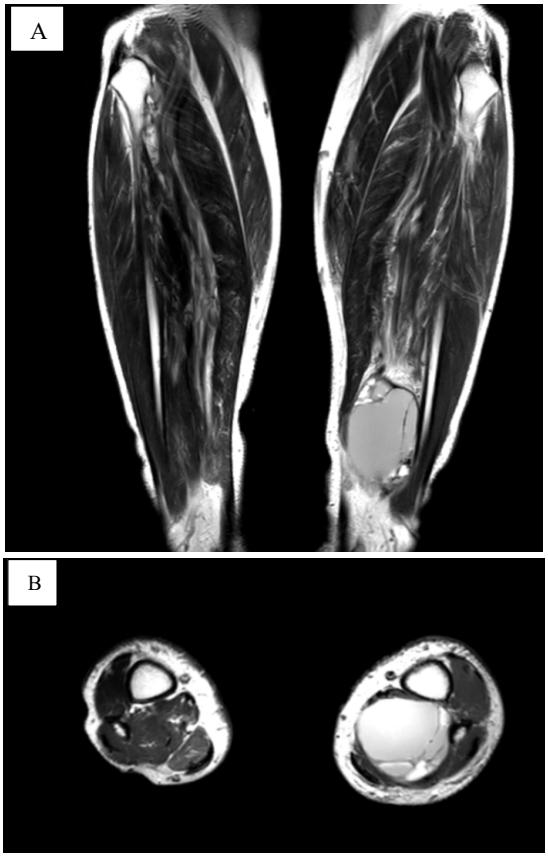

Fig. 1. In the MRI of the left leg of a 72-year-old male patient, who had a cystic formation of 76x52x45 mm in size, which was located in the distal 1/3 posterior inner part of the left leg, in the intermuscular distance, with septum inside, hyperintense on T2 sequences, but showing peripheral enhancement, the patient underwent excision, and the pathology result was consistent with schwannoma(A: coronal image, B: axial image).

Table 2. Data on mean age, mean size, and mean follow-up time of BPNSTs

Benign Peripheral Nerve Sheath Tumor (BPNST)	n=51	Age (mean years)	Size (mean cm)	Follow-up Time (mean months)
Schwannoma	31	47.77	3.88	7.35
Neurofibroma	12	36.50	3.72	13.83
Plexiform schwannoma	3	43	5.4	4.33
Plexiform neurofibroma	2	48	6.6	7.5
Traumatic neuroma	3	43	1.17	5.67

4. Discussion

Schwannoma is an eccentrically enlarged, encapsulated tumor that develops histologically from the nerve sheath. It runs along the surface of the nerve fibers and separates from the nerve fibers. It is the most common subtype of peripheral nerve tumors. It can be seen on the head, neck and extremities (7). It is more common in the second and fourth decades, and the reason for admission is usually neuropathic pain due to compression and loss of nerve function. Most are in the form of a single lesion. Multiple cases are associated with Neurofibromatosis Type 2. Our study calculated the mean age of patients diagnosed with schwannoma as 47.77 years. The most common complaints were palpable mass in 11 patients (35.8%) and pain in 26 patients (83.87%). The literature has reported that schwannomas do not show a clear gender bias (8). In our study, 18 (58.1%) of 31 patients were male, 13 (41.9%) were female, and it was more common in males.

The diagnosis of schwannoma is made by clinical examination, imaging and biopsy. The primary treatment objective is to remove the tumor while keeping the nerve bundles intact. Most peripheral schwannomas can be removed without causing neurologic impairments afterward (9). A rare kind of Schwann cell tumor called plexiform schwannoma has an intraneural development pattern that is frequently multi-nodular (10). In our study, only three patients (5.88%) were operated for plexiform schwannoma; no recurrence was detected in their follow-up.

The incidence of neurofibromas among all benign soft tissue tumors is less than 5% (11). Neurofibroma is a less limited, non-capsular tumor that develops within the endoneural tissue. It is associated with neurofibromatosis (NF) type-1, an autosomal dominant disease (12). It usually occurs in the second and third decades. The most common form is local intraneural neurofibromas. Generally, all neurofibromas present with pain, but the incidence of pain in schwannomas varies between 0% and 100% (13). Our study of patients diagnosed with neurofibroma determined that 10 (83.33%) of them presented with complaints of pain, and 6 (50%) presented with a palpable mass. The mean age of 12 patients in this group was 36.5, 7 (58.33%) were female, and 5 (41.67%) were male. It was observed that 3 of the patients (25%) were associated with Neurofibromatosis Type-1. Recurrence was seen in 1 patient (8.33%).

Diagnosis in neurofibroma such as schwannomas; clinical examination, imaging method and biopsy. Heterogeneity, peripheral contrast enhancement, and perilesional edema on T1 and T2-weighted images on MRI help differentiate malignant peripheral nerve sheath tumors from neurofibromas (14). In addition, lesions showing eccentric extension parallel to the planar axis of the nerve on MRI suggest schwannoma, while centrally located lesions suggest neurofibromas (12). In our study, all patients underwent pre-operative magnetic resonance imaging. This way, information about the tumor's location, size and characteristics was obtained. In treating neurofibromas, excision of the nerve from which it originates together with the mass is required, as there is nerve involvement. Due to the nerve dysfunction caused by surgery in significant nerve involvement, the pain can be followed without surgery until tolerated.

Plexiform neurofibromas are a rare type of neurofibroma arising from the proliferation of all neural elements, presenting with intrafascicular and extrafascicular growth and involving the entire nerve without capsule formation (8). The risk of malignant transformation makes this tumor important. In our study, two female and one male patients were operated for the diagnosis of plexiform neurofibroma.

A traumatic neuroma usually develops as a result of trauma to a nerve during a surgical procedure. All three patients in our study, two men and one woman, had a history of transfemoral amputation. After the severe pain persisted in the long-term follow-up, it was determined that the postoperative complaints of these patients, who were diagnosed with MRI and operated on, improved dramatically.

The pre-operative biopsy is indicated for treatment planning if malignancy is suspected in all peripheral nerve sheath tumors (13). In our study, 19 (37.25%) patients underwent a biopsy due to malignant suspicion. Surgical planning was performed according to the biopsy results. Surgical excision of BPNSTs can be performed as subtotal excision or total excision, which may or may not leave the capsule behind (4). All BPNSTs have been shown to have a higher recurrence rate following subtotal excision (15). In the literature, recurrence rates are reported to be lowest in schwannomas, lowest in neurofibromas, and highest in plexiform types of BPNSTs. (16). Recurrence was observed in only one neurofibroma patient and one plexiform type neurofibroma out of 51 patients included in our study. Both patients were surgically treated with the subtotal excision method.

Finally, among the parameters limiting this study are the retrospective nature, the exclusion of malignant peripheral nerve sheath tumors, and the exclusion of all patients with BPNST due to non-compliance with the follow-up schedule. Biopsy should be planned carefully, considering the balance between suspected malignancy and possible nerve damage. Since tumors are at risk of malignant transformation in patients with neurofibromatosis, follow-up examinations of these patients should be done in more detail. It is recommended that the preoperative and postoperative sensory and motor nerve examinations of the patients should be recorded, and the patients should be evaluated for the risk of neurological deficits.

Benign peripheral nerve sheath tumors (BPNST) are a dynamic and evolving field of tumor surgery with an increasingly multidisciplinary approach. Benign peripheral nerve sheath tumors are not uncommon tumors. Yet, they are controllable malignancies with a tolerable morbidity risk. However, surgery remains the only viable treatment. Biopsy should be planned considering the balance between suspected malignancy and possible nerve damage, and it is recommended that these tumors be treated and managed in a reference center.

Conflict of interest

The authors have no conflicts of interest to declare.

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Ethical statement

Ethics committee approval was obtained by Ondokuz Mayis University Clinical Research Evaluation Committee with the decision number B.30.2.ODM.0.20.08/352-457 dated 26.07.2022. Because the study was designed retrospectively, no written informed consent form was obtained from patients. The study protocol complies with international agreements.

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None to declare.

Authors' contributions

Concept: T.C., Design: H.S.C., N.D., Data Collection or Processing: Ş.A.Ş., Analysis or Interpretation: Ş.A.Ş., Literature Search: T.C., Writing: T.C., N.D.

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