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Schwannoma: a spectrum from benign to malignant

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Abstract

Peripheral nerve sheath tumors are a group of neoplasms that arise from Schwann cells. This study evaluates the histopathological and immunohistochemical (IHC) characteristics of these entities, spanning a spectrum from benign to malignant lesions. We focused on tumor variants, particularities, and differential diagnoses. A total of 25 cases were analyzed, with conventional schwannomas being the most common benign tumor subtype. Classic schwannomas exhibited typical Antoni A and Antoni B patterns, with Verocay bodies as defining features. Additionally, less common variants, such as cystic and myxoid schwannomas, were identified, highlighting the morphological variations of these entities. Malignant peripheral nerve sheath tumors (MPNSTs), representing the malignant counterpart, were characterized by spindle cell and epithelioid morphologies, high mitotic activity, and aggressive clinical behavior. Differentiating MPNSTs from other soft tissue tumors, such as neurofibromas and melanomas, was challenging due to overlapping histological features. IHC markers, particularly S100 and sex determining region Y (SRY)-box transcription factor 10 (SOX10), played an important role in the diagnostic process, though their interpretation required precision to avoid diagnostic pitfalls. This study highlights the importance of integrating histopathology and immunohistochemistry for accurate diagnosis and differentiation of peripheral nerve sheath tumors. The recognition of rare variants and analysis of tumor subtypes contribute to a better understanding of these entities, which is crucial for appropriate clinical management.

Keywords: schwannoma, malignant peripheral nerve sheath tumor, morphology, immunohistochemistry.

Introduction

Peripheral nerve sheath tumors represent a spectrum of neoplasms that arise from Schwann cells and can be either benign or malignant.

Schwannomas are benign tumors of neural origin, composed of Schwann cells, which affect the peripheral nervous system. These tumors can occur sporadically or in association with genetic conditions such as neurofibromatosis type 2 (NF2) and schwannomatosis. Sporadic cases are typically observed in the extremities, trunk, or head and neck regions, appearing as solitary lesions without apparent risk factors, although past irradiation may play a role. Cases associated with NF2 or schwannomatosis present as multiple tumors of varying sizes, often affecting the same anatomical areas. Some cases involve cranial nerves (most commonly VIII, V, and X), with vestibular schwannomas being a hallmark of neurofibromatosis [1–3].

The clinical appearance of these tumors varies, with shapes ranging from round to oval or irregular, and colors typically white or yellow. Chronic pain is associated with a small number of cases, and nearly half of the tumors are located in the head and neck region, particularly in sporadic cases. Despite being one of the most common nerve sheath tumors, schwannomas exhibit various subtypes that pose significant challenges in differential diagnosis, including cystic, ancient, and myxoid variants. Surgical excision is

the primary treatment, with risks and considerations specific to the tumor's location, as schwannomas can rarely affect visceral organs, including the intracranial region [4–6].

Schwannomas exhibit diverse histological subtypes, including plexiform, cellular, microcystic, ancient, and epithelioid schwannomas. Cystic and microcystic schwannomas are the rarest subtypes, typically located in visceral organs and lacking some characteristic features of classic schwannomas. These tumors predominantly show Antoni A areas and abundant collagenous stroma but lack Verocay bodies. Another rare subtype, ancient schwannoma, is distinguished by atypia and hypercellularity [7–9]. Detailed documentation of these tumors helps improve diagnostic accuracy, aids in differential diagnosis, and enhances understanding of their features.

Malignant peripheral nerve sheath tumors (MPNSTs) are rare, aggressive malignant neoplasms of neuroectodermal origin that arise from the peripheral nerve sheath. In some cases, they develop from neurofibroma or in association with neurofibromatosis type 1 (NF1). Also referred to as malignant schwannomas, these tumors typically occur in the fourth decade of life, affecting the limbs, trunk, or occasionally the head and neck regions. They account for approximately 10% of soft tissue sarcomas, while cutaneous involvement is exceptionally rare, with only a few cases reported in the literature [1, 2, 10].

The classic histological features of MPNST include

spindle cell proliferation with significant pleomorphism and atypia. These tumors exhibit a solid growth pattern, often arranged in fascicles or a storiform configuration, with tumor cells distributed around blood vessels. Cytological features vary, with spindle cells being predominant; however, round or oval cells and, in rare cases, purely epithelioid morphologies may be observed (the latter defining a distinct subtype known as epithelioid MPNST) [1, 2, 11].

Although no specific markers exist, immunohistochemistry consistently shows positivity for S100 and sex determining region Y (SRY)-box transcription factor 10 (SOX10), expressed in varying intensities in a subset of cells. Other markers, such as keratins (for the epithelioid subtype), p53, p27, and p16, may be helpful, but none have proven entirely reliable [1, 2, 11, 12].

The treatment of MPNSTs is not standardized. Surgical excision with negative margins remains the cornerstone of management, significantly influencing overall survival. For metastatic cases, chemotherapy and radiotherapy are options, though outcomes are often suboptimal. Targeted therapies are under investigation, but clinical trials have yet to demonstrate long-term prognostic improvements [11].

Aim

The main objective of this study was to highlight the particularities of schwannomas based on the experience of Department of Pathology, Mureș County Clinical Hospital, Târgu Mureș, Romania.

Materials and Methods

We conducted a retrospective observational study spanning five years, from 2019 to 2024.

The study included patients diagnosed with schwannomas and MPNSTs in the Department of Pathology, Mureș County Clinical Hospital. Samples analyzed during the study were obtained from patients treated in the Departments of Surgery and Plastic Surgery of the same Hospital. Patients with other soft tissue or cutaneous tumors were excluded from the study.

Tissue samples were prepared for histopathological examination following standard protocols. Samples were fixed in formalin, embedded in paraffin blocks, sectioned, and stained with Hematoxylin–Eosin (HE). Immunohistochemical (IHC) analysis was performed on 4 μm-thick sections using an automated immunostainer (Benchmark GX, Ventana Medical Systems, Inc., Tucson, AZ, USA) according to the manufacturer's protocols.

Results

We analyzed 25 cases, including 19 schwannomas and six MPNSTs. Among these, 15 patients were female, and 10 were male. The schwannoma cases included eight males and 11 females, while the MPNST cases included four females and two males.

The overall mean age was 56 years. For schwannomas, the mean age was 51 years (range: 28–83 years), while for MPNSTs, the mean age was 75 years (range: 69–87 years).

The most common location for schwannomas was the lower limb, specifically the calf ($n=4$), followed by the neck ($n=2$) and retroperitoneum ($n=2$). Rare locations included the sole and breast.

Clinical symptoms varied, with some patients experiencing pain ($n=8$) or swelling ($n=4$), while others reported no symptoms ($n=7$). Pain was predominantly associated with tumors located on the extremities, reported by four male and four female patients (Table 1).

Table 1 – Clinical and grossing data

Location	Gender	Symptoms	Shape and color	Other gross details
Elbow	M	Pain	Round; white and brown	Fasciculate, firm
Lower limb (calf)	F	Pain	Round; yellow	Homogenous, firm
Lower limb (calf)	M	Swelling	Round; white	Homogenous, soft
Torso	M	–	Oval; yellow	Firm, fragmented
Lower limb (calf)	F	–	Round; white	Homogenous, firm
Hand (dorsum)	F	Pain	Oval; white	Homogenous, soft
Sole	M	Pain	Round; yellow	Homogenous, firm
Knee	F	Pain	Round; yellow	Homogenous, firm
Neck	F	Swelling	Round; brown	Cystic, soft
Thorax	M	–	Round; white	Homogenous, firm
Breast	F	Swelling	Round; white	Homogenous, firm
Neck	F	Swelling	Round; white and yellow	Homogenous, elastic
Pylorus	F	–	Round; white	Homogenous, firm
Lower limb (calf)	M	Pain	Round; white	Homogenous, firm
Retroperitoneum	F	–	Round; white and yellow	Homogenous, firm
Axillary region	F	Pain	Oval; white	Cystic and solid, firm
Retroperitoneum	M	–	Round	Homogenous, elastic
Gluteal region	M	Pain	Round; white	Homogenous, firm
Abdominal region	F	–	Round; white and yellow	Homogenous, elastic

F: Female; M: Male.

Most schwannomas were homogenous on cross-section; eight presented a capsule and the consistency was described as firm in most cases ($n=12$).

Out of the 19 schwannomas diagnosed, 14 were conventional, three were cellular variants, one myxoid type and one cystic type.

The conventional-type tumors were predominantly characterized by a biphasic proliferation of neoplastic cells, delineating two distinct architectural regions: a hypercellular and a hypocellular component. The hypercellular component, referred to as Antoni A, was composed of elongated spindle cells exhibiting indistinct cytoplasmic borders and nuclei with variable degrees of atypia ($n=18$). Within these areas, the nuclei frequently demonstrated palisading adjacent to a hypocellular, fibrillary matrix. Two parallel rows of palisading nuclei constituted Verocay bodies, a well-recognized morphological hallmark of schwannomas ($n=6$). The hypocellular component consisted predominantly of a myxoid

stroma containing fewer neoplastic cells and corresponded to the Antoni B pattern ($n=15$) (Figure 1, A and B).

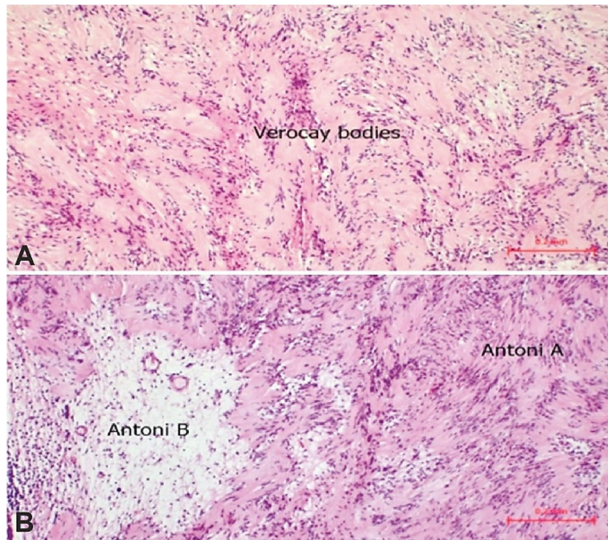


Figure 1 – Conventional schwannoma, lower limb (HE staining): (A) Image is showing tumor cells with palisading nuclei and formation of Verocay bodies; (B) Tumor proliferation consisting of two different areas, one characterized by hypercellularity (Antoni A area) and the other by hypocellularity and myxoid changes (Antoni B area). The cells are elongated, with uniform, single nuclei. (Department of Pathology Collection). Scale bar: (A and B) 200 μ m. HE: Hematoxylin–Eosin.

Such cases were predominantly diagnosed in the limbs but were also encountered in the retroperitoneum and gastrointestinal tract (Figure 2, A and B; Figure 3, A and B).

Cystic schwannoma presented as a cystic lesion surrounded by spindle-shaped tumor cells with pale cytoplasm and elongated nuclei. Significant hemorrhage, hemosiderin deposits, and changes surrounding the cystic area were observed. Focally, along with the described cells, hypocellular areas and Verocay bodies were noted. At the periphery of the proliferation, a partially present thin fibrous capsule was identified (Figure 4, A and B).

Other types of schwannomas diagnosed included cellular schwannoma, which was composed entirely of Antoni A areas (Figure 5, A and B). Myxoid schwannoma presented an abundant myxoid stroma, which constituted the majority of the tumor tissue (Figure 6, A and B).

Phenomena such as necrosis and hemorrhage were observed in two cases. Hyalinization was identified in one case, while inflammatory infiltrates (predominantly polymorphic) were seen in five cases. IHC reactions for nuclear markers S100 and SOX10 were performed. Both markers were used in 12 cases, showing intense and diffuse positivity in the tumor cells. S100 was used alone in the remaining seven cases and presented the same pattern of positivity. Additionally, the Ki67 proliferation index was analyzed, with a maximum value of 7%, a minimum of less than 1%, and a mean value of 2.57% across all cases.

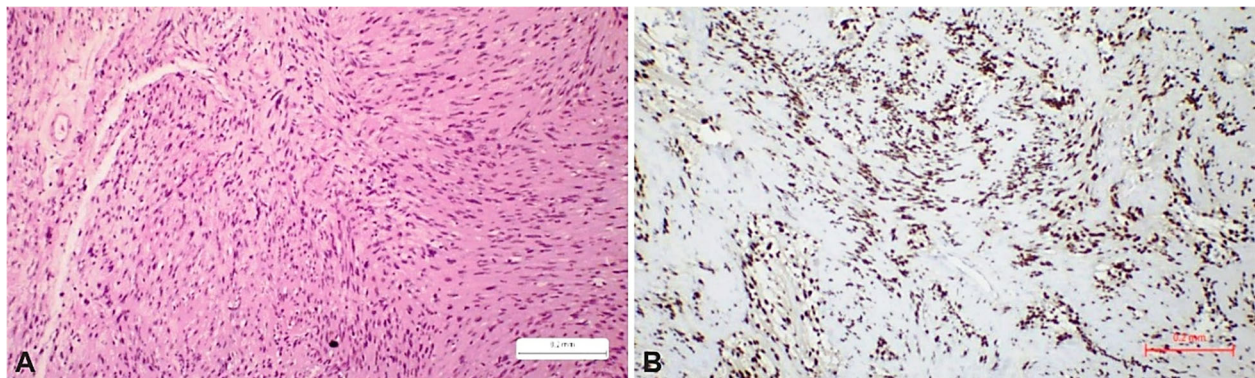


Figure 2 – Retroperitoneal schwannoma exhibiting a tumor proliferation consisting of spindle cells, with hypercellular and hypocellular areas: (A) The nuclei are uniform and elongated (HE staining); (B) Immunohistochemistry reaction with SOX10 showing positivity in the tumor cells. Scale bar: (A and B) 200 μ m. HE: Hematoxylin–Eosin; SOX10: Sex determining region Y (SRY)-box transcription factor 10.

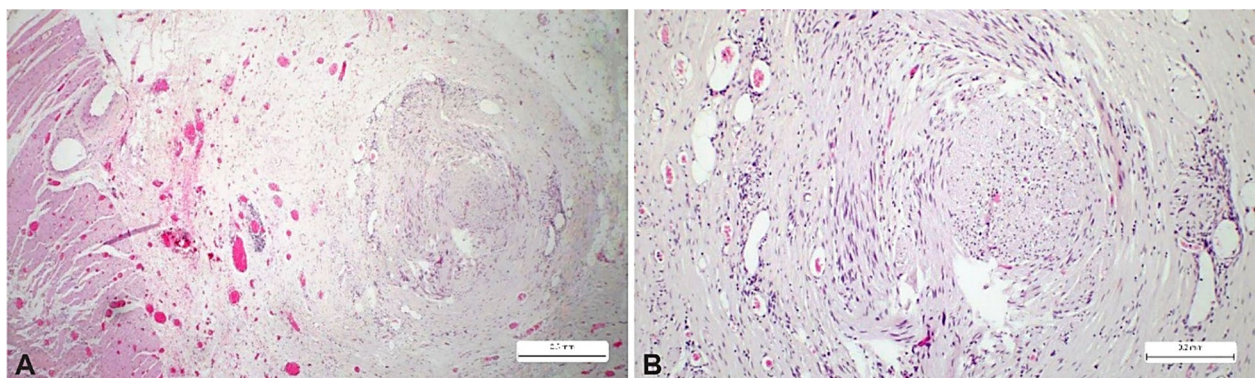


Figure 3 – Tumor proliferation consisting of elongated cells located in the subserosa layer of the gastric wall (HE staining): (A) The tumor is relatively well-defined and consists of spindle cells with elongated nuclei, with dense and hypocellular areas slightly visible; (B) Capsule is absent. (Department of Pathology Collection). Scale bar: (A) 500 μ m; (B) 200 μ m.

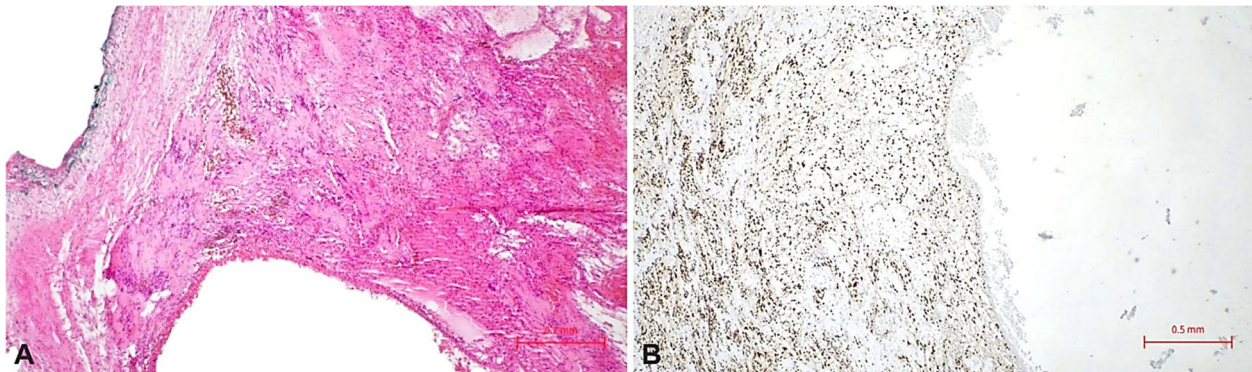


Figure 4 – Cystic schwannoma on the neck region of a female patient: (A) We observed a cystic tumor proliferation with abundant areas of hemorrhage and hemosiderin deposits (HE staining); (B) Immunohistochemistry reaction with SOX10 showing positivity in tumor cells. (Department of Pathology Collection). Scale bar: (A) 200 μ m; (B) 500 μ m.

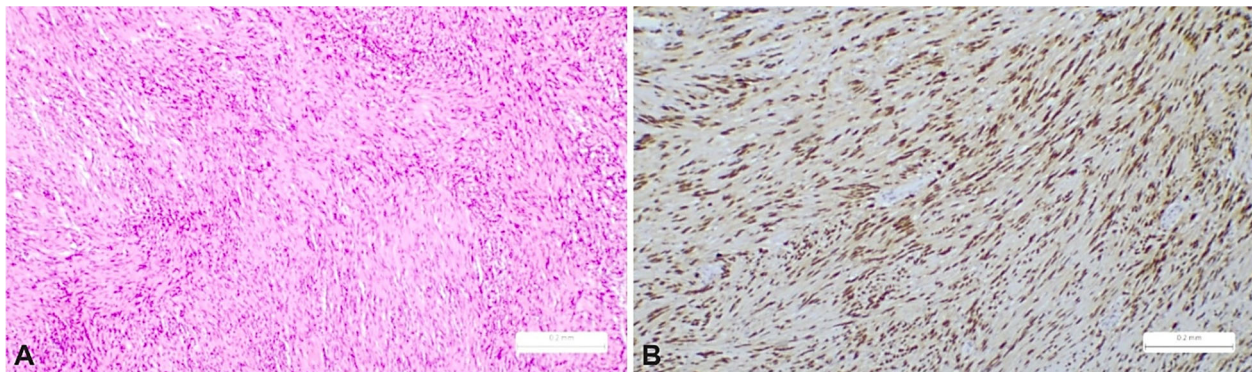


Figure 5 – Cellular schwannoma: (A) Tumor proliferation consisting of elongated cells distributed in fascicles (HE staining); (B) Tumor proliferation showed intense positivity for SOX10 marker. (Department of Pathology Collection). Scale bar: (A and B) 200 μ m.

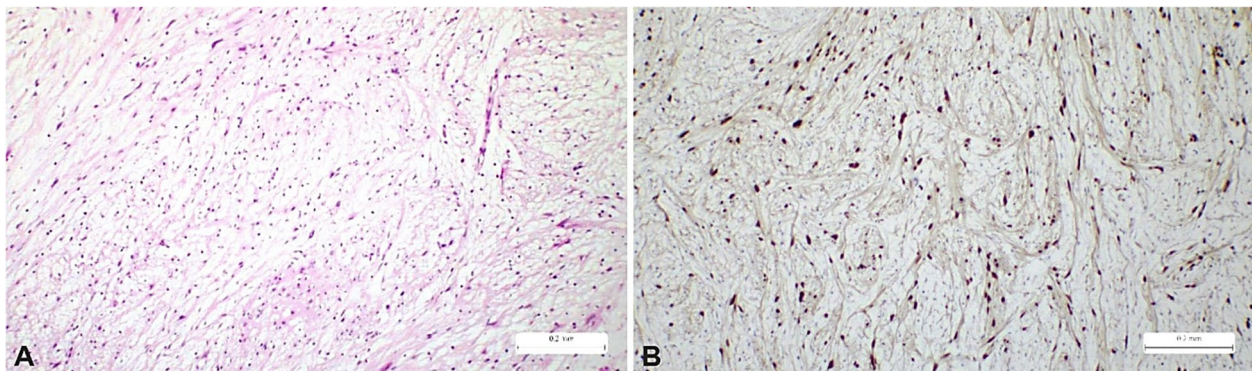


Figure 6 – Myxoid schwannoma: (A) Tumor proliferation consisting of elongated, spindle cells, distributed in an abundant myxoid stroma (HE staining); (B) Tumor cells presented positivity to SOX10 marker. (Department of Pathology Collection). Scale bar: (A and B) 200 μ m.

The locations of MPNSTs included three cutaneous cases, one in the soft tissue of the lower limb, one in the sigmoid colon, and one in the thorax (soft tissue). Three patients were asymptomatic; one presented with bleeding (cutaneous, lower limb), another with pain (soft tissue, lower limb), and one with both bleeding and constipation (intestinal location).

Macroscopically, the tumors were predominantly white on cut sections and exhibited a firm consistency. The cutaneous and soft tissue lesions were nodular, while the intestinal lesion demonstrated an infiltrative, circumferential pattern that caused stenosis. Histologically, using HE staining, the tumors displayed a solid growth pattern with cells arranged in fascicles, and some cases showed storiform areas (Figure 7, A–C; Figure 8, A and B).

In four cases, the cytological profile included spindle and epithelioid cells in varying proportions. In the remaining two cases (both soft tissue), the cells were exclusively epithelioid. All cases showed marked pleomorphism, with tumor cells exhibiting eosinophilic cytoplasm and enlarged, bizarre nuclei, some with prominent nucleoli. The mitotic index was high, with a mean of 45/mm², ranging from 30/mm² to 60/mm² (Figure 9, A and B).

Necrosis ($n=2$), hemorrhage ($n=3$), and inflammation ($n=4$) were present in varying degrees across all six cases. Positive surgical margins were observed in two cases: one cutaneous and one involving the soft tissue of the limb. IHC reactions consistently showed positivity for S100 and SOX10 markers. The Ki67 proliferation index had a mean value of 80%, with a range of 60% to 90% (Figure 7D; Figure 8, C and D).

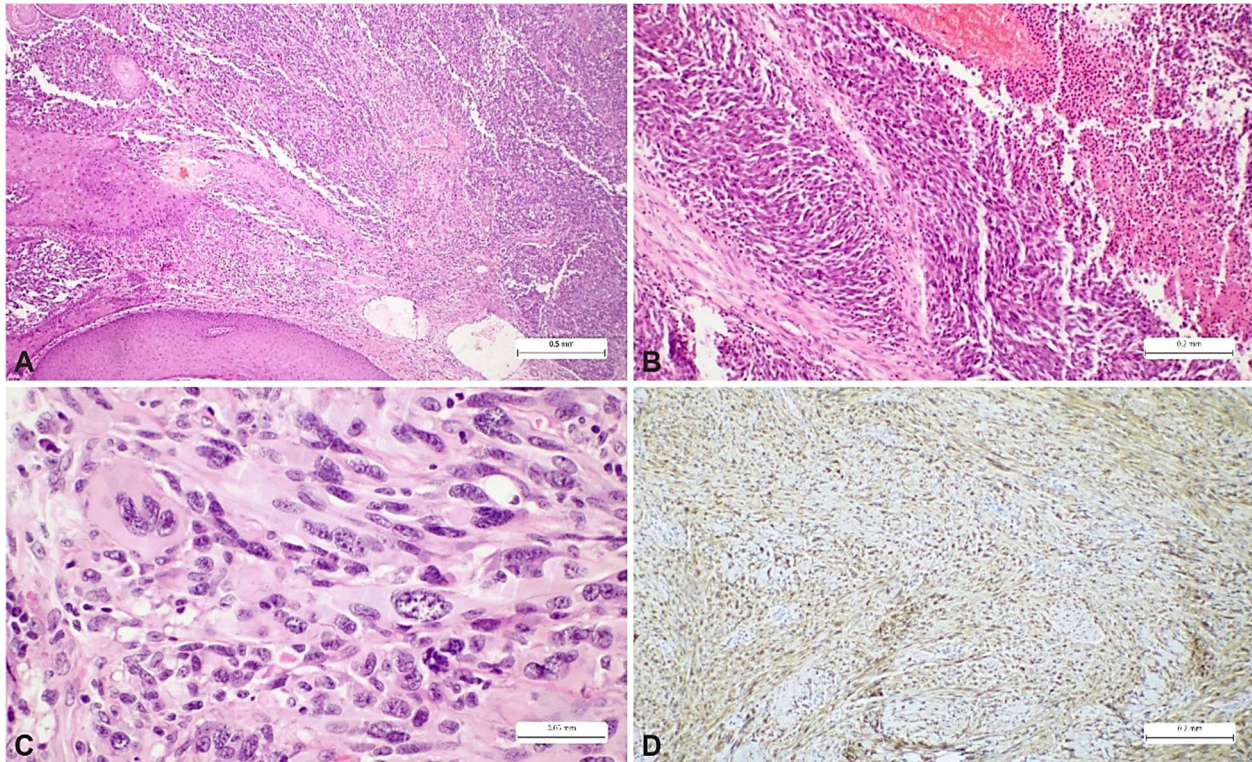


Figure 7 – Cutaneous MPNST: (A) Solid tumor proliferation growing beneath the epidermis, without involvement of the epithelial surface (HE staining); (B) Tumor cells arrangement in fascicles, along with revealing some of the characteristics we encountered in these tumors, such as hemorrhage, inflammation and necrosis (HE staining); (C) High pleomorphism of the tumor – we can observe tumor cells with various shapes and sizes, some of them are slightly elongated while others are round, epithelioid or even multinucleated (HE staining); (D) Immunohistochemistry reaction for S100, identified as positive in many cells. (Department of Pathology Collection). Scale bar: (A) 500 μm ; (B and D) 200 μm ; (C) 50 μm . HE: Hematoxylin–Eosin; MPNST: Malignant peripheral nerve sheath tumors.

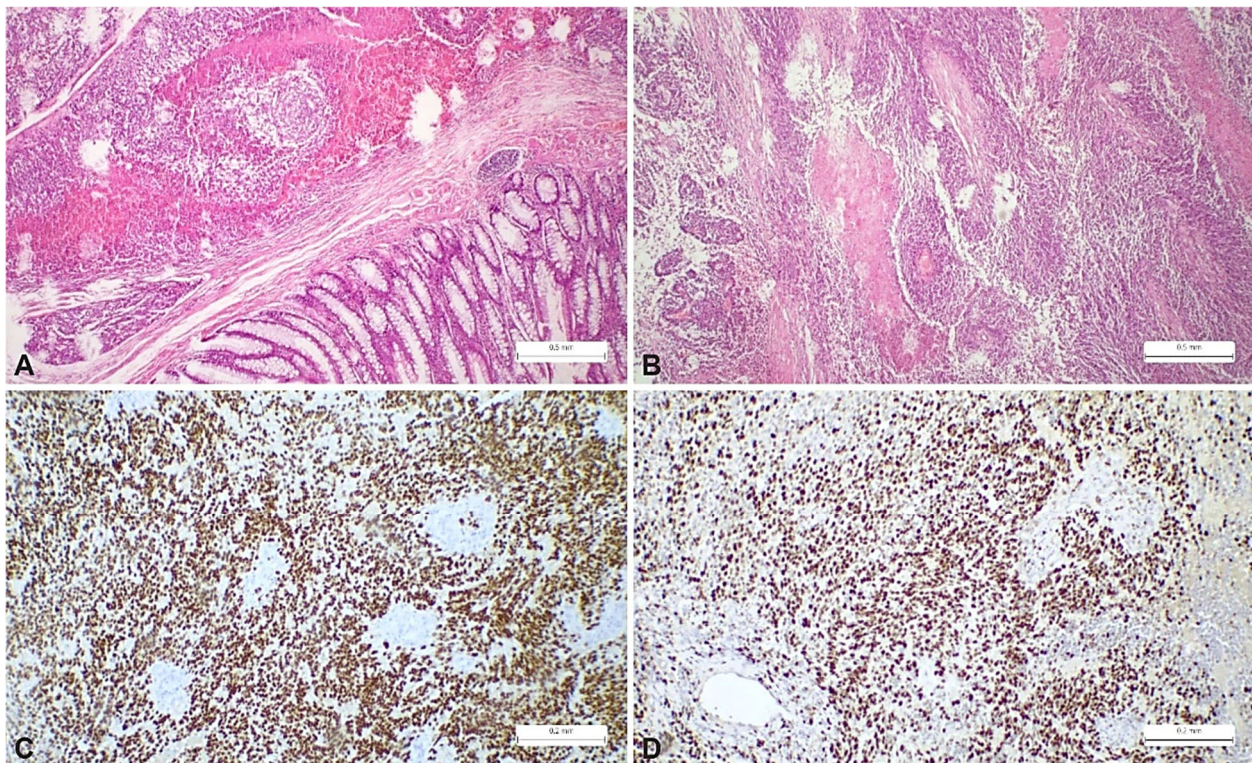


Figure 8 – Intestinal MPNST involving sigmoid colon: (A) Tumor proliferation consisting of fascicles with storiform areas, surrounded by abundant hemorrhage (HE staining); (B) More details regarding the architecture, highlighting the disposition of spindle tumor cells around the blood vessels (HE staining); (C) Positive immunohistochemistry reaction for SOX10 marker; (D) High Ki67 proliferation index for this case, which presented an overall percentage of 70%. (Department of Pathology Collection). Scale bar: (A and B) 500 μm ; (C and D) 200 μm .

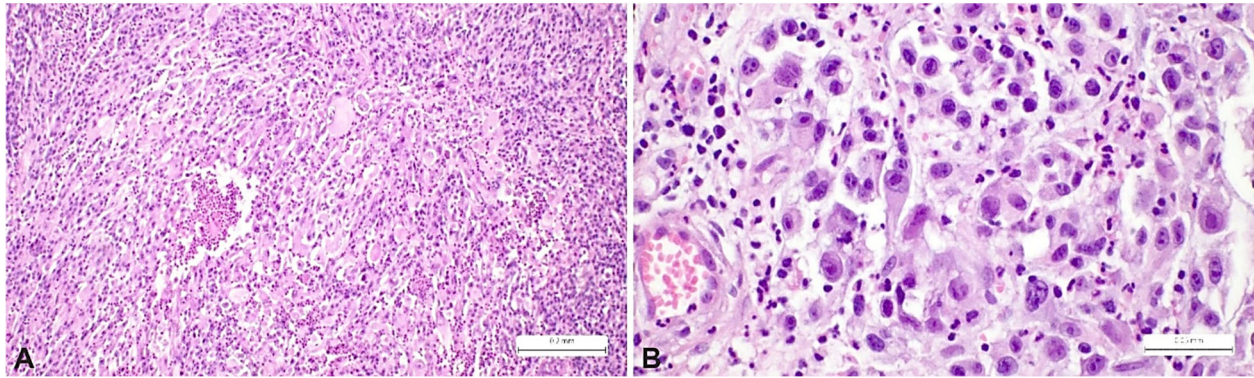


Figure 9 – Epithelioid MPNST: (A) Tumor proliferation consisting of solid areas of malignant epithelioid cells with high pleomorphism and cytological atypia (HE staining); (B) Tumor cells present variability in size, epithelioid aspect, eosinophilic cytoplasm and enlarged, irregular nuclei with prominent nucleoli; mixed inflammatory infiltrate is observed between the tumor cells. (Department of Pathology Collection). Scale bar: (A) 200 μm ; (B) 50 μm .

☞ Discussions

Schwannomas are benign tumors that can occur in various parts of the body. They exhibit multiple histological variants and features, sometimes making diagnosis challenging. While schwannomas are primarily found in soft tissues and skin, involvement of the viscera and retroperitoneum is rare. In our study, most cases involved different regions of the limbs, while some tumors were identified in the retroperitoneum, abdominal region, or gastrointestinal tract. Rare locations described in the literature include intraocular, intraosseous, perineal, or subungual regions. Another uncommon site is the foot (sole or ankle), where schwannomas are more often associated with pain compared to those in other locations. Among the spectrum of rare locations, the breast is also noteworthy. Both sole and breast schwannomas were identified in our study [13–18].

These benign tumors grow slowly and are generally asymptomatic, although some patients may rarely report pain. Contrary to this typical presentation, pain was observed in almost half of our patients ($n=8$), followed by swelling, while seven patients were asymptomatic. Pain is more commonly associated with schwannomatosis. All our cases were sporadic schwannomas, with no evidence of NF2 or multiple tumors [19, 20].

We observed a slight predominance of female patients, with 11 women and eight men included in our study. Although schwannomas are not known to have a gender predilection overall, certain subtypes and locations may be more common in specific genders. For instance, spinal schwannomas are more frequently seen in men, whereas vestibular schwannomas exhibit either an equal gender distribution or a slight female predominance [21, 22].

The gross appearance of schwannomas typically includes encapsulated, firm tumors that are light in color, ranging from white to slightly yellow. In most cases diagnosed in this study, the tumors were firm and white yellow but lacked a distinct capsule. However, one case presented as a cystic lesion. On cross-section, the tumors were predominantly homogeneous, with a fasciculate pattern observed in one instance [1].

Conventional schwannomas are composed mainly of well-differentiated Schwann cells and display two distinct areas, Antoni A and Antoni B, often accompanied by Verocay bodies (palisading areas in hypercellular regions). Of the

19 cases in our study, 14 were conventional schwannomas exhibiting hypercellular and hypocellular areas, with six also showing palisading nuclei (Verocay bodies).

The most critical differential diagnosis in such cases is neurofibroma, another type of benign peripheral nerve tumor. Neurofibromas are typically sporadic lesions, rarely associated with NF1, and primarily involve the skin and small nerve locations. These tumors are composed of various cell types (Schwann cells, fibroblasts, mast cells, and axons) embedded in a collagenous or myxoid stroma. Both schwannomas and neurofibromas are positive for IHC markers S100 and SOX10, as both contain Schwann cells. However, differentiation is possible by identifying specific morphological features. Neurofibromas usually exhibit homogeneous cellularity without significant variation between hypercellular and hypocellular areas. Axon entrapment is a key diagnostic feature of neurofibromas. Additionally, Verocay bodies and capsules are absent in neurofibromas.

Distinguishing cellular schwannomas without Verocay bodies from cellular neurofibromas can be challenging. Hypercellularity and fascicles are consistent features of schwannomas, whereas neurofibromas sometimes exhibit a more haphazard pattern. The nuclei in schwannomas are typically elongated and uniform, while those in neurofibromas are wavy and irregular. Cluster of differentiation 34 (CD34) IHC staining, which highlights the stromal component of neurofibromas as a lattice-like network, can aid diagnosis, as this pattern is absent in schwannomas. Another critical differential diagnosis is MPNST, particularly in cases where tumors exhibit high mitotic activity and significant atypia. Cellular schwannomas can be distinguished by their lack of high pleomorphism, diffuse positivity for S100 and SOX10, and positive p16 expression [1, 23–28].

Other types identified in our study included myxoid schwannomas and cystic schwannomas. Myxoid schwannomas are characterized by a predominantly loose, myxoid stroma surrounding tumor cells. These tumors can mimic other myxoid lesions, such as low-grade myxoid sarcomas or myxomas, making immunohistochemistry essential for diagnosis. Additional IHC markers such as calponin and type IV collagen can be helpful [1, 29].

Cystic schwannomas are rare lesions, most commonly found in viscera. They appear as cystic lesions and can mimic a wide range of entities. Partial cystic degeneration may occur in conventional schwannomas, often in spinal nerve

roots, while complete cystic degeneration is exceptionally rare. In one of our cases, a young female presented with a cystic schwannoma in the anterior neck region. Histological examination revealed a cyst lined by areas of hemorrhage and hemosiderin pigment, surrounded by elongated cells resembling Antoni A areas. Hypocellular Antoni B areas were also noted, and the diagnosis was confirmed by IHC positivity for S100 and SOX10 [30–33].

MPNSTs are aggressive tumors with poor prognosis, particularly when associated with NF1. Prognostic factors negatively impacting outcomes include positive resection margins, invasion, and head and neck localization. In our study, MPNSTs involved the skin, soft tissue, intercostal muscles, and visceral locations (e.g., sigmoid colon). Cutaneous involvement is exceptionally rare, with only a few cases reported in the literature. Two such cases in our study occurred in the lower limb, and one involved the scalp. We also encountered two cases with positive surgical resection margins – one cutaneous and one in soft tissue. This data is vital, as surgical treatment is a crucial factor for improving patient outcomes, and obtaining clear margins is essential for survival [34].

MPNSTs can occur across all age groups but are more common in elderly patients, particularly sporadic cases. For NF1-associated tumors, they often appear in young adults. The patients in our study were significantly older than those with schwannomas, with a mean age of 75. The oldest patient, aged 87, had a tumor in the lower limb's soft tissue. Although rare, MPNSTs have been reported in young patients, including pediatric populations, often associated with NF1 and deoxyribonucleic acid (DNA) methylation [35].

The most common histological appearance of MPNSTs includes a solid proliferation of spindle cells arranged in fascicles, sometimes with a storiform pattern. Mixed cytology is also seen, with tumors containing spindle, epithelioid, round, bizarre, or multinucleated cells. Epithelioid MPNST, a distinct histological variant, is exceedingly rare. Regardless of location, the tumors in our study showed a similar pattern, with spindle cells arranged in fascicles, sometimes mixed with epithelioid cells. High pleomorphism, hyperchromatic nuclei, and a high mitotic count (30–60/mm²) were consistent findings [1, 2, 36].

The differential diagnosis of MPNST often includes other soft tissue sarcomas, depending on localization. Melanoma, particularly spindle or epithelioid cell variants, is a significant differential diagnosis, especially in cutaneous cases. Melanomas arise from melanocytes and appear as solid, nodular tumors with pleomorphic, atypical cells, enlarged nuclei, and eosinophilic nucleoli. Diagnostic challenges arise from the similar IHC profiles of MPNST and melanoma, as both express S100 and SOX10. Additional melanocytic markers, such as human melanoma black 45 (HMB45) and Melan A, can assist in diagnosis, alongside newer markers like keratin or nestin. Molecular and genetic analysis is recommended for cases resembling epithelioid melanoma [2, 37].

Other important differential diagnoses include fibrosarcoma, fibrosarcomatous variant of dermatofibrosarcoma protuberans (DFSP), and myoepithelial carcinoma. Myoepithelial carcinoma is a malignant tumor that primarily arises in the salivary glands but can also occur in soft tissue

and bone. It consists of a multinodular proliferation with alternating hypercellular and hypocellular areas. The tumor cells can exhibit diverse morphologies, including spindle, epithelioid, and clear cell types, and are often associated with necrosis [38, 39].

Fibrosarcoma and DFSP with fibrosarcomatous differentiation present tumor cells arranged in fascicles, storiform patterns, or a herringbone configuration. In these cases, the IHC profile is crucial for diagnosis. DFSP is typically positive for the CD34 marker, but its expression is lost in fibrosarcomatous areas. However, DFSP remains negative for markers such as S100 and SOX10, which help in distinguishing it from other tumors [1, 2, 40].

A particularly rare case diagnosed during this study involved sigmoid MPNST. Intestinal involvement is extremely uncommon, with only a few cases reported in the literature, such as those affecting the transverse colon or small bowel. In these situations, differential diagnosis with gastrointestinal stromal tumors (GISTs) is vital, and IHC profiling provides critical insights. The prognosis for such cases is typically poor, as metastases often develop before the tumor is diagnosed [41, 42].

Conclusions

Schwannomas are benign nerve sheath tumors that most commonly occur in the limbs and display a range of histological subtypes. Conventional schwannomas were the most frequently encountered subtype in this study, characterized by hallmark features such as Antoni A and Antoni B areas and Verocay bodies. Less common variants, including cystic and myxoid schwannomas, were also identified, emphasizing the morphological diversity of this tumor entity. In contrast, MPNSTs are rare, aggressive malignancies with poor prognoses. Their histopathological features are highly variable, encompassing spindle cells, epithelioid cells, and even monstrous, multinucleated cells. IHC markers such as S100 and SOX10 play a pivotal role in differentiation; however, careful interpretation is required, particularly when distinguishing MPNSTs from other tumors with overlapping features, such as melanoma or certain sarcomas. This study provides valuable insights into the clinical, histological, and IHC profiles of peripheral nerve tumors. By documenting subtype variations, rare variants, and unusual locations, the findings enhance diagnostic accuracy and shed light on potential diagnostic challenges. These contributions are essential for improving patient outcomes and advancing the understanding of these complex entities.

Conflict of interests

The authors declare that they have no conflict of interests.

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