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CLINICOPATHOLOGICAL SPECTRUM OF SOFT-TISSUE NEOPLASMS WITH SELECTIVE IMMUNOHISTOCHEMICAL EVALUATION: A RETROSPECTIVE DESCRIPTIVE STUDY OF 154 CASES

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ABSTRACT

Soft-tissue neoplasms comprise a heterogeneous group of mesenchymal tumors characterized by considerable diversity in histogenesis, morphology, biological behavior, and clinical presentation. Histopathological examination remains central to their diagnosis, supplemented by immunohistochemistry (IHC) and molecular investigations in selected diagnostically challenging tumors. This retrospective descriptive observational study aimed to characterize the clinicopathological spectrum of soft-tissue neoplasms diagnosed in the Department of Pathology, Kalaignar Centenary Super Speciality Hospital, attached to Government Kilpauk Medical College, Chennai, India, from January 2024 to January 2026. A total of 154 histopathologically diagnosed soft-tissue neoplasms were included. Demographic characteristics, anatomical site, gross and microscopic findings, final histopathological diagnosis, Fédération Nationale des Centres de Lutte Contre le Cancer (FNCLCC) grade where documented, and available IHC findings were analyzed. The mean age was 47.49 ± 17.34 years, with a median age of 48.5 years (interquartile range, 34.0–60.75 years) and a range of 7–82 years. There were 83 males (53.9%) and 71 females (46.1%), with a male-to-female ratio of 1.17:1. Lipoma was the predominant diagnosis, accounting for 82 cases (53.2%), followed by schwannoma in 10 (6.5%), neurofibroma in 8 (5.2%), and fibroma in 6 (3.9%). The series also included a heterogeneous spectrum of intermediate and malignant soft-tissue neoplasms. FNCLCC grade was documented in 21 cases, with seven cases each classified as grades 1, 2, and 3. IHC findings were available in 21 cases and were used selectively as ancillary diagnostic evidence. The findings demonstrate the broad histopathological diversity of soft-tissue neoplasms encountered in tertiary-care pathology practice, with benign adipocytic tumors constituting the predominant component. Accurate diagnosis requires integration of clinical information and histomorphology with appropriately selected ancillary investigations. Molecular and genetic findings were not available in the present dataset and were therefore not inferred.

KEYWORDS: Soft-tissue neoplasms; Histopathology; Immunohistochemistry; Soft-tissue sarcoma; FNCLCC grade; Clinicopathological spectrum

INTRODUCTION

Soft-tissue neoplasms constitute a heterogeneous group of tumors arising predominantly from mesenchymal tissues and encompass lesions showing adipocytic, fibroblastic/myofibroblastic, smooth-muscle, skeletal-muscle, vascular, peripheral nerve sheath, and other forms of differentiation. Their biological behavior ranges from benign neoplasms to intermediate tumors characterized by local aggressiveness or occasional metastatic potential and malignant soft-tissue sarcomas. Contemporary classification reflects this considerable morphological and biological heterogeneity and continues to evolve with advances in molecular pathology [1,2].

The classification and diagnosis of soft-tissue tumors remain challenging areas of surgical pathology. Considerable morphological overlap can occur between biologically distinct entities, while tumors belonging to a single diagnostic category may exhibit variable histological appearances. The fifth edition of the World Health Organization (WHO) classification incorporated newly recognized entities, reclassified several tumor groups, and placed greater emphasis on molecular and genetic characteristics relevant to diagnostic classification [1-3].

Histopathological examination nevertheless remains fundamental to the diagnostic process. Evaluation of tumor architecture, cytomorphology, stromal characteristics, vascular pattern, necrosis, and mitotic activity provides the initial framework for establishing a differential diagnosis. These morphological findings, together with clinical and anatomical information, guide the selection of ancillary investigations [1,2].

Immunohistochemistry plays an important role in the diagnostic evaluation of soft-tissue tumors. Conventional markers may assist in determining the probable line of differentiation, while newer immunohistochemical markers may act as

surrogates for specific underlying molecular alterations. However, individual immunohistochemical markers may not be completely specific for a single entity, emphasizing the importance of interpreting IHC as part of a panel and in the context of morphology [4-7].

Advances in molecular pathology have further transformed the classification of soft-tissue neoplasms. Recurrent gene fusions are recognized in a substantial subset of these tumors and may serve as important diagnostic markers. Molecular techniques, including fluorescence in situ hybridization, polymerase chain reaction, and next-generation sequencing-based approaches, may provide diagnostic confirmation for selected tumors characterized by recurrent genomic alterations [3,7-10]. However, access to comprehensive molecular testing varies, and morphology supplemented by targeted IHC continues to constitute an important diagnostic approach in routine practice.

Histological grading is an additional component in the assessment of appropriate malignant soft-tissue tumors. Among the grading systems used for adult-type soft-tissue sarcomas, the FNCLCC system has demonstrated prognostic relevance and is widely employed in clinical practice [11-13]. Nevertheless, histological grading is not uniformly applicable to all soft-tissue neoplasms and should be used according to the specific tumor entity.

Characterization of the spectrum of soft-tissue neoplasms encountered in routine histopathology practice can provide information regarding their demographic distribution, relative frequencies, morphological diversity, and utilization of ancillary diagnostic investigations. Previous descriptive studies have similarly demonstrated a broad histopathological spectrum and highlighted the complementary role of IHC in selected cases [14].

The present study was undertaken to describe the clinicopathological spectrum of soft-tissue neoplasms diagnosed at a tertiary-care super-speciality hospital in Chennai from January 2024 to January 2026, with emphasis on histopathological diagnosis, FNCLCC grade where documented, and selective immunohistochemical characterization.

MATERIAL AND METHODS

This retrospective descriptive observational study was conducted in the Department of Pathology, Kalaignar Centenary Super Speciality Hospital, attached to Government Kilpauk Medical College, Chennai, Tamil Nadu, India. The study included histopathologically diagnosed soft-tissue neoplasms evaluated during the period from January 2024 to January 2026.

All histopathologically diagnosed benign, intermediate, and malignant soft-tissue neoplasms with adequate pathological material and sufficient available demographic and pathological information were eligible for inclusion. Cases in which IHC had been performed as an ancillary diagnostic investigation were also included. Non-neoplastic soft-tissue lesions, specimens with inadequate or poorly preserved tissue precluding a definitive histopathological diagnosis, duplicate records corresponding to the same biopsy specimen, and cases with insufficient records for meaningful clinicopathological evaluation were excluded.

A total of 154 cases fulfilling the eligibility criteria were included in the final analysis. Cases were retrospectively identified from the histopathology records of the Department of Pathology. Relevant information was retrieved from available departmental records and compiled into a structured dataset. Variables analyzed included age, sex, anatomical site, gross pathological findings, microscopic features, final histopathological diagnosis, FNCLCC grade where documented, and available IHC findings.

Each case was identified internally using its biopsy number. The dataset was evaluated for duplicate biopsy identifiers and completely duplicated records before analysis. No duplicate biopsy numbers or completely duplicated case records were identified among the 154 included cases. Variations in sex coding, including “male,” “female,” “M,” and “F,” were standardized into male and female categories for statistical analysis. Minor spelling, capitalization, and formatting variations in diagnostic terminology were harmonized for aggregate analysis without altering the original source diagnosis. Histologically distinct tumor subtypes were retained separately where appropriate.

Histopathological diagnoses documented in the departmental records constituted the diagnostic data used for the study. Available gross and microscopic findings were evaluated from the recorded data. Tumors were diagnosed primarily according to their histomorphological features, with IHC used selectively as an ancillary investigation in diagnostically relevant cases.

FNCLCC grade was analyzed only in cases for which a grade was documented in the source data. Tumors for which FNCLCC grading was not applicable and cases for which grading had not been documented were not retrospectively assigned a grade. The FNCLCC system is an established three-tier histological grading approach used for appropriate soft-tissue sarcomas [11-13].

IHC findings were available for 21 cases. The markers represented in the dataset included smooth muscle actin (SMA), CD34, vimentin, S100, CD99, pan-cytokeratin, desmin, HMB45, CD68, CD15, ALK, and Ki-67. IHC was used selectively according to the morphological differential diagnosis and was not performed as a uniform panel across the entire study population. Consequently, individual marker positivity rates were not calculated using all 154 cases as the denominator. Such a morphology-directed, panel-based approach is consistent with the established principles of diagnostic IHC in soft-tissue pathology [4-7].

No genetic or molecular test results were available in the study dataset. Therefore, no genetic alterations, molecular findings, or molecular diagnoses were retrospectively inferred from histological diagnoses or immunophenotypic findings.

Statistical analysis was primarily descriptive, consistent with the retrospective descriptive design of the study. Continuous variables were summarized using mean and standard deviation and median with interquartile range, with minimum and maximum values reported where informative. Categorical variables were expressed as frequencies and percentages. The denominator for individual analyses was determined by the number of cases for which the corresponding variable was

available and applicable. Given the heterogeneous diagnostic spectrum and the small number of cases in several individual tumor categories, inferential statistical testing was not undertaken solely for the generation of P-values.
The study was approved by the Institutional Ethics Committee of Government Kilpauk Medical College, Chennai, Tamil Nadu, India. As this was a retrospective analysis of existing histopathology records, no additional diagnostic or therapeutic intervention was performed for research purposes. Patient confidentiality was maintained throughout the study, and personally identifiable patient information was excluded from the analytical dataset used for publication.

RESULTS

A total of 154 histopathologically diagnosed soft-tissue neoplasms were included in the study. The mean age of the patients was 47.49 ± 17.34 years, while the median age was 48.5 years, with an interquartile range of 34.0-60.75 years. Patient age ranged from 7 to 82 years.
There was a slight male predominance. Of the 154 patients, 83 (53.9%) were male and 71 (46.1%) were female, corresponding to a male-to-female ratio of approximately 1.17:1 (Table 1).

Table 1. Demographic characteristics of patients with soft-tissue neoplasms

Characteristic	Result
Total number of cases	154
Mean age ± SD, years	47.49 ± 17.34
Median age (IQR), years	48.5 (34.0-60.75)
Age range, years	7-82
Male, n (%)	83 (53.9)
Female, n (%)	71 (46.1)
Male:female ratio	1.17:1

SD = standard deviation; IQR = interquartile range.

The study demonstrated a broad histopathological spectrum of soft-tissue neoplasms. Benign adipocytic tumors, predominantly lipoma, constituted the largest diagnostic category, accounting for 82 of 154 cases (53.2%) and constituting more than half of the entire study population. Schwannoma was identified in 10 cases (6.5%), followed by neurofibroma in 8 (5.2%) and fibroma in 6 (3.9%). Hemangioendothelioma was recorded in 4 cases (2.6%).
Undifferentiated pleomorphic sarcoma, benign capillary hemangioma, hemangioma, and atypical lipomatous tumor were each represented by 3 cases (1.9%). Myxofibrosarcoma and grade 1 leiomyosarcoma were each represented by 2 cases (1.3%).
The remaining cases comprised a heterogeneous spectrum of less frequently represented neoplasms. These included well-differentiated liposarcoma, superficial angiomyxoma, glomangiomyxoma, dermatofibrosarcoma protuberans, angiosarcoma, low-grade fibrosarcoma, angioleiomyoma, intermuscular lipoma, glomangiomyoma, plexiform neurofibroma, myopericytoma, leiomyoma, glomus tumor, cavernous hemangioma, benign fibrous histiocytoma, synovial sarcoma, malignant peripheral nerve sheath tumor, desmoid fibromatosis, leiomyosarcoma, Ewing sarcoma, myxoma, ganglioneuroma, histiocytic neoplasm, and low-grade myofibroblastic sarcoma, among other individually represented diagnoses.

Table 2. Major histopathological diagnoses in the study population

Histopathological diagnosis	n	%
Lipoma	82	53.2
Schwannoma	10	6.5
Neurofibroma	8	5.2
Fibroma	6	3.9
Hemangioendothelioma	4	2.6
Undifferentiated pleomorphic sarcoma	3	1.9
Benign capillary hemangioma	3	1.9
Hemangioma	3	1.9
Atypical lipomatous tumor	3	1.9
Myxofibrosarcoma	2	1.3
Leiomyosarcoma, grade 1	2	1.3
Other individually represented diagnoses	28	18.2
Total	154	100.0

FNCLCC grade was documented in 21 cases, representing 13.6% of the overall study population. Among the 21 tumors with documented grades, 7 (33.3%) were grade 1, 7 (33.3%) were grade 2, and 7 (33.3%) were grade 3 (Table 3).
The remaining tumors were not collectively considered to have missing FNCLCC grades because the study population contained a large proportion of benign neoplasms and other entities for which FNCLCC grading was not applicable.

Table 3. Distribution of documented FNCLCC grades

FNCLCC grade	n	% of graded cases
Grade 1	7	33.3

Grade 2	7	33.3
Grade 3	7	33.3
Total	21	100.0

IHC findings were documented in 21 of the 154 cases (13.6%). The markers represented in the dataset included SMA, CD34, vimentin, S100, CD99, pan-cytokeratin, desmin, HMB45, CD68, CD15, ALK, and Ki-67.(Figure 1, 2)
The IHC profiles were used selectively as part of the diagnostic work-up of individual tumors rather than as a standardized panel across the entire cohort. Therefore, overall positivity rates for individual markers were not calculated. Among cases in which Ki-67 proliferation indices were documented, the recorded values ranged from less than 2% to 30%.
No molecular or genetic testing results were available for analysis.

DISCUSSION

The present retrospective descriptive study evaluated the clinicopathological spectrum of 154 soft-tissue neoplasms diagnosed at a tertiary-care super-speciality hospital in Chennai between January 2024 and January 2026. The findings demonstrate considerable histopathological heterogeneity, ranging from common benign adipocytic and peripheral nerve sheath tumors to uncommon intermediate and malignant mesenchymal neoplasms. Such diversity is characteristic of soft-tissue tumor pathology and underlies the increasingly integrated morphological and molecular framework adopted in contemporary classification [1-3].
The most prominent finding in the present series was the predominance of lipoma, which accounted for 53.2% of the study population. The predominance of benign lesions, including adipocytic tumors, has also been observed in descriptive histopathological series of soft-tissue tumors [14]. However, comparisons of relative frequencies between institutional studies should be interpreted cautiously because referral patterns, inclusion criteria, anatomical case mix, and institutional practice can substantially influence the observed distribution.
Peripheral nerve sheath tumors constituted another important component of the diagnostic spectrum. Schwannoma was the second most frequent diagnosis, accounting for 6.5% of cases, while neurofibroma accounted for 5.2%. Plexiform neurofibroma was retained as a distinct diagnostic entity in the dataset rather than being combined indiscriminately with conventional neurofibroma. Contemporary classification emphasizes precise histological categorization because entities within the same broad line of differentiation may differ in clinical associations and biological behavior [1,2].
The study also demonstrated a diverse spectrum of vascular and perivascular neoplasms. Diagnoses represented in the dataset included hemangioma and its documented variants, hemangioendothelioma, angiosarcoma, angioleiomyoma, glomus tumor, glomangiomyoma, glomangiomyxoma, and myopericytoma. The morphological diversity of soft-tissue tumors and potential overlap among diagnostic categories reinforce the importance of integrating morphological assessment with appropriately selected ancillary studies [1,4].
A heterogeneous group of malignant soft-tissue tumors was identified, including undifferentiated pleomorphic sarcoma, myxofibrosarcoma, leiomyosarcoma, angiosarcoma, synovial sarcoma, malignant peripheral nerve sheath tumor, Ewing sarcoma, low-grade fibrosarcoma, and low-grade myofibroblastic sarcoma. Several of these entities were represented by only one or a few cases. This diagnostic heterogeneity, combined with small subgroup sizes, limits statistically meaningful comparisons between individual malignant tumor types in the present cohort.
Contemporary soft-tissue tumor classification increasingly integrates histological appearance with immunophenotypic and molecular genetic findings. The fifth edition of the WHO classification incorporated substantial advances in the molecular characterization of soft-tissue neoplasms, including newly recognized entities and refined diagnostic categories [1-3]. Gene fusions are particularly relevant in a subset of soft-tissue tumors and can serve as useful molecular diagnostic markers [8,9].
Despite these advances, histomorphology remains fundamental to diagnosis. Careful assessment of architecture, cellular morphology, stromal characteristics, vascular patterns, cytological atypia, mitotic activity, and necrosis establishes the morphological framework within which ancillary investigations are interpreted [1,2].
IHC findings were documented in 21 cases in the present study and included markers directed toward multiple potential lines of differentiation. The selective use of IHC reflects a morphology-driven diagnostic approach in which individual markers or panels are chosen according to the differential diagnosis. This approach is supported by the recognized limitations of individual immunohistochemical markers, many of which demonstrate expression across more than one tumor category [4-6].
Recent developments have expanded the role of IHC beyond conventional lineage assessment. Several newer antibodies can function as surrogate markers for recurrent gene fusions, amplifications, or other molecular alterations, although their diagnostic performance and interpretation must be understood in the context of the specific tumor entity [6,7]. Molecular confirmation remains appropriate when required for definitive classification or when immunohistochemical findings are equivocal.
The present study did not contain molecular or genetic testing results. Consequently, no molecular abnormality was retrospectively assigned to an individual tumor on the basis of histological diagnosis or IHC profile. This is an important distinction because the presence of a characteristic molecular alteration reported in the literature for a tumor type does not establish that the same alteration is present in an individual patient without direct testing. Advances in RNA-based fusion detection and other next-generation sequencing approaches offer increasingly comprehensive options for molecular characterization of selected sarcomas [9,10].
FNCLCC grade was documented in 21 tumors, with equal numbers classified as grades 1, 2, and 3. This distribution should be interpreted descriptively. Histological grade is an established prognostic variable in appropriate adult-type soft-

tissue sarcomas, and comparative studies have supported the prognostic performance of the FNCLCC grading system [11-13]. However, FNCLCC grading is not applicable to all soft-tissue neoplasms. Accordingly, the absence of a grade in the majority of cases in the present study should not be interpreted simply as missing data, particularly because benign neoplasms constituted a substantial proportion of the cohort.

An important characteristic of the present dataset is the markedly uneven distribution of diagnostic entities. Although the overall study population comprised 154 cases, lipoma alone represented more than half of the cohort, whereas several intermediate and malignant tumors were represented by only one or two cases. Inferential statistical comparisons between these small and heterogeneous diagnostic groups would have limited statistical power and could generate unstable estimates. For this reason, the present analysis was intentionally descriptive.

The study has limitations. Its retrospective design restricted analysis to information documented in existing pathological records. The available dataset did not contain comprehensive clinical presentation, radiological findings, treatment details, recurrence information, survival outcomes, or longitudinal follow-up. IHC was selectively performed and available only for a subset of cases, preventing systematic comparison of immunophenotypic profiles across diagnostic categories. Molecular and genetic testing results were unavailable, precluding molecular characterization and genotype-phenotype correlation. Several intermediate and malignant tumor entities were represented by small numbers, limiting meaningful inferential statistical analyses. Finally, as this was a single-center study, the observed distribution represents the institutional case mix and should not be interpreted as population-level incidence or prevalence.

Despite these limitations, the study provides a descriptive overview of the broad clinicopathological spectrum of soft-tissue neoplasms encountered in a tertiary-care pathology setting. The findings emphasize the continuing importance of systematic histomorphological evaluation supplemented by judicious use of IHC. Future studies incorporating standardized clinical and radiological information, comprehensive immunophenotypic characterization, targeted molecular testing, and longitudinal outcome data may enable more detailed evaluation of diagnostically challenging and biologically significant soft-tissue neoplasms.

CONCLUSION

Soft-tissue neoplasms encountered in the present retrospective series demonstrated substantial histopathological diversity. Benign adipocytic neoplasms, particularly lipoma, constituted the predominant diagnostic group, while peripheral nerve sheath, fibroblastic, vascular, perivascular, smooth-muscle, intermediate, and malignant neoplasms comprised the remaining spectrum.

Histomorphological examination remains central to the diagnosis and classification of soft-tissue tumors, while appropriately selected IHC provides valuable ancillary information in diagnostically challenging cases. FNCLCC grading provides useful information in applicable malignant soft-tissue sarcomas but should not be indiscriminately applied across the entire spectrum of soft-tissue neoplasia [11-13].

The absence of molecular and genetic testing in the present cohort precludes molecular conclusions. Integration of morphology, immunophenotyping, and targeted molecular diagnostics, where indicated and available, may further improve diagnostic precision in contemporary soft-tissue tumor pathology [3,7,9,10].

Conflicts Of Interest

No conflicts of interest.

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Figures

Figure 1. Histopathological and immunohistochemical features of histiocytic neoplasm of the chest wall.

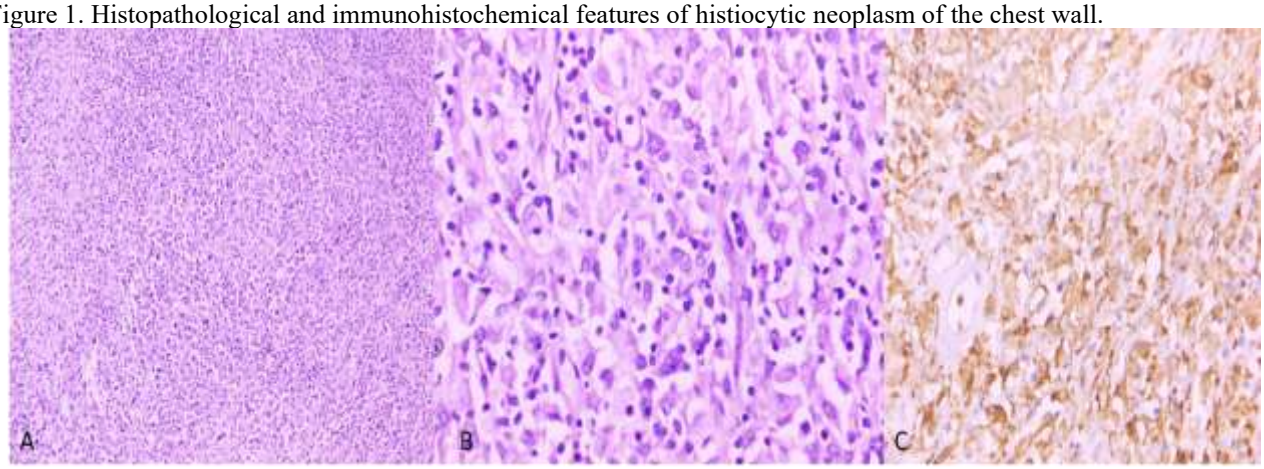

Figure 1. Representative photomicrographs of a histiocytic neoplasm arising in the chest wall.

(A) Hematoxylin and eosin (H&E, low power) showing a cellular neoplasm composed of diffuse sheets of large histiocyte-like cells associated with a prominent mixed inflammatory infiltrate. (B) H&E (high power) demonstrating large polygonal cells with abundant pale to eosinophilic cytoplasm, vesicular nuclei with conspicuous nucleoli, admixed inflammatory cells, and mild nuclear pleomorphism. (C) Immunohistochemistry showing diffuse granular cytoplasmic positivity of the neoplastic cells for CD68, supporting histiocytic differentiation.

Abbreviations: H&E, hematoxylin and eosin; CD68, cluster of differentiation 68.

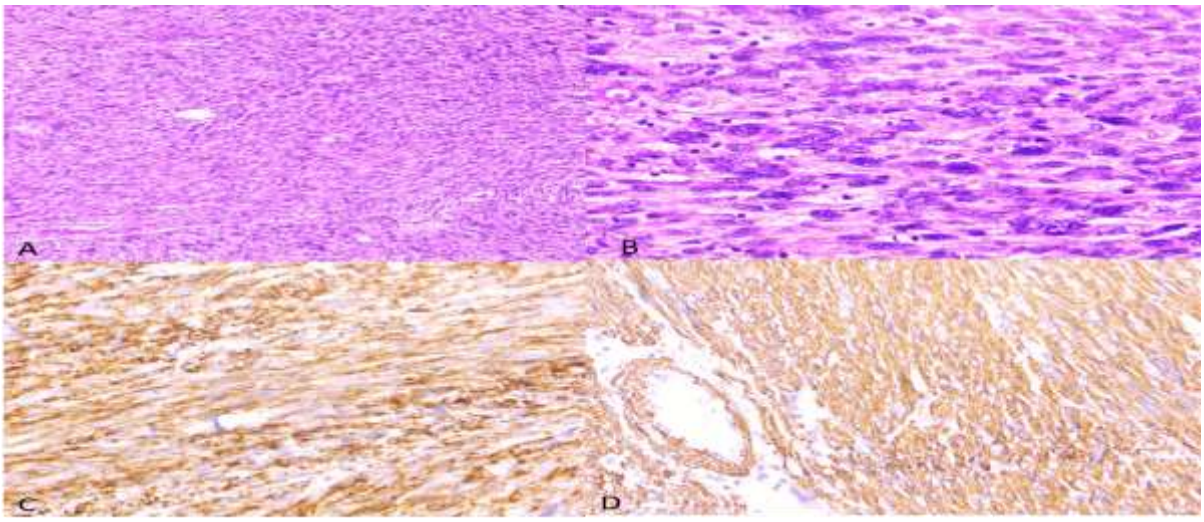

Figure 2. Histopathological and immunohistochemical features of leiomyosarcoma.