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Original Research Article

Panorama of Soft Tissue Tumours at a Tertiary Care Centre in Bihar: A Retrospective Observational Study

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Abstract

Objective and Aim: Soft tissue tumors (STTs) represent a heterogeneous group of neoplasms with diverse histogenesis, biological behavior, and clinical outcomes. The present study aims to evaluate the spectrum, frequency, demographic distribution, anatomical location, and histopathological patterns of soft tissue tumors diagnosed at a tertiary care center in Bihar, India, with special emphasis on benign–malignant correlation and clinicopathological characteristics.

Materials and Methods: This retrospective observational study was conducted in the Department of Pathology at a tertiary care teaching hospital in Bihar over a period of five years (January 2019–December 2023). All histopathologically confirmed cases of soft tissue tumors were included. Tumors were classified according to the WHO Classification of Soft Tissue and Bone Tumors (2020). Statistical analysis was performed using SPSS version 26.0. Descriptive statistics, chi-square test, and logistic regression analysis were applied.

Results: A total of 312 cases of soft tissue tumors were analyzed. Benign tumors constituted 76.9%, intermediate tumors 7.4%, and malignant tumors 15.7%. The most common benign tumor was lipoma (38.1%), while undifferentiated pleomorphic sarcoma (21.4%) was the most frequent malignant tumor. Malignant tumors were significantly associated with age >40 years ($p < 0.001$) and deep-seated location ($p = 0.002$).

Conclusion: Soft tissue tumors in Bihar show a predominance of benign lesions with lipoma being the most common entity. However, a significant proportion of malignant tumors underscores the importance of early diagnosis, adequate sampling, and histopathological evaluation for optimal patient management.

Keywords: Soft Tissue Tumours; Histopathology; Tertiary Care Centre; Sarcoma; Clinicopathological Study; Malignancy Predictors.

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Introduction

Soft tissue tumors (STTs) comprise a broad and complex group of neoplasms arising from mesenchymal tissues such as adipose tissue, muscle, fibrous tissue, blood vessels, and peripheral nerves. These tumors range from benign lesions with indolent behavior to highly aggressive sarcomas with significant morbidity and mortality. Despite their relative rarity, soft tissue sarcomas represent a major diagnostic and therapeutic challenge due to their histological diversity and overlapping morphological features [1].

Globally, soft tissue sarcomas account for approximately 1% of adult malignancies and nearly 7–15% of pediatric cancers, with an estimated annual incidence of 4–5 cases per 100,000 population [2]. In India, the burden of soft tissue tumors is believed to be underestimated due to lack of centralized cancer registries, delayed presentation, and limited access to specialized diagnostic facilities, particularly in rural and resource-limited states such as Bihar [3].

The diagnosis of soft tissue tumors relies heavily on histopathological examination supplemented by immunohistochemistry (IHC) and molecular techniques. The WHO Classification of Soft Tissue and Bone Tumors (2020) has significantly refined tumor categorization based on morphology, immunophenotype, and genetic alterations, improving diagnostic accuracy and prognostic stratification [4]. Epidemiological studies from different regions of India reveal marked geographic variations in the distribution and types of soft tissue tumors. While lipomas and benign fibrous tumors predominate in most series, the pattern of

malignant tumors shows considerable heterogeneity [5,6]. Studies from northern and eastern India remain sparse, and data from Bihar are particularly limited.

Bihar, one of the most populous states in India, faces significant healthcare challenges including late presentation of malignancies, lack of awareness, and inadequate referral systems. Understanding the local spectrum of soft tissue tumors is crucial for improving diagnostic algorithms, guiding resource allocation, and optimizing patient outcomes [7].

The present study was undertaken to analyze the panorama of soft tissue tumors at a tertiary care center in Bihar, focusing on demographic patterns, anatomical distribution, histological subtypes, and benign-malignant correlations. This study aims to bridge the existing knowledge gap and contribute region-specific data to the national and global literature.

Material & Methods

This retrospective observational study was conducted in the Department of Pathology of a tertiary care teaching hospital in Bihar, India, over a period of five years from January 2019 to December 2023. The study included all patients who were diagnosed with soft tissue tumors based on histopathological examination during the study period. Cases were identified from the departmental histopathology records and pathology archives. All excision specimens, incisional biopsies, and trucut biopsies diagnosed as soft tissue tumors were included in the study. Bone tumors, tumor-like lesions such as ganglion cysts and inflammatory pseudotumors, and cases with inadequate or autolyzed tissue were excluded from the analysis.

Clinical data including age, sex, anatomical site of tumor, tumor size, depth of lesion, and type of surgical procedure were retrieved from pathology requisition forms and hospital medical records wherever available. All specimens had been fixed in 10% neutral buffered formalin for an adequate duration, followed by routine tissue processing and paraffin embedding. Sections of 4–5 μm thickness were cut and stained with hematoxylin and eosin. Special histochemical stains such as Masson's trichrome and periodic acid–Schiff were employed in selected cases wherever required. Immunohistochemistry was performed in diagnostically challenging cases using a limited but relevant panel of antibodies including vimentin, desmin, smooth muscle actin, S-100 protein, CD34, myogenin, and cytokeratin, based on morphological suspicion and differential diagnosis.

Histopathological evaluation was performed independently by two experienced pathologists, and tumors were classified according to the World Health Organization Classification of Tumours of Soft Tissue and Bone (5th edition, 2020). Tumors were categorized into benign, intermediate (locally aggressive or rarely metastasizing), and malignant groups. Discrepant cases were reviewed jointly to arrive at a consensus diagnosis. Tumor size was categorized as ≤5 cm or >5 cm, and tumor depth was classified as superficial or deep in relation to the investing fascia.

All collected data were entered into a Microsoft Excel spreadsheet and subsequently analyzed using Statistical Package for the Social Sciences (SPSS) software version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize demographic and clinicopathological variables, which were expressed as frequencies, percentages, means, and standard deviations. Associations between categorical variables were assessed using the chi-square test or Fisher's exact test as appropriate. Binary logistic regression analysis was performed to identify independent predictors of malignancy, and odds ratios with 95% confidence intervals were calculated. A p-value of less than 0.05 was considered statistically significant.

Results

Table 1 summarizes the distribution of soft tissue tumors according to their biological behavior in the study population and correlates these categories with key demographic and anatomical variables. Of the total 312 soft tissue tumorsanalyzed, benign tumors constituted the majority, accounting for 240 cases (76.9%). This finding highlights that most soft tissue lesions encountered in routine surgical pathology practice are non-aggressive in nature. Intermediate tumors, which include locally aggressive and rarely metastasizing neoplasms, comprised 23 cases (7.4%), while malignant soft tissue tumors accounted for 49 cases (15.7%).

A clear age-related trend is evident from the table. The mean age at presentation increased progressively from benign to malignant tumors, with benign tumors presenting at a mean age of 34.6 ± 14.2 years, intermediate tumors at 41.8 ± 12.6 years, and malignant tumors at 52.3 ± 13.9 years. This indicates that malignant soft tissue tumors are significantly more common in older individuals, a finding that is consistent with established epidemiological patterns. Sex distribution revealed an overall male predominance across all tumor categories, with an increasing male-to-female ratio observed in malignant tumors (1.5:1) compared to benign tumors (1.2:1). Although males were more frequently affected, the sex difference alone was not sufficient to predict malignancy, emphasizing that biological behavior is influenced by multiple factors. Anatomical depth

showed a strong association with tumor behavior. The majority of benign tumors were located superficially (75.8%), whereas malignant tumors demonstrated a marked predilection for deep-seated locations, with 71.4% of malignant tumors arising deep to the fascia. Intermediate tumors showed an almost equal distribution between superficial and deep locations. Statistical analysis revealed that deep location was significantly associated with malignancy, underscoring its importance as a clinical warning sign.

Table 1: Distribution of Soft Tissue Tumors According to Biological Behavior (n = 312)

Biological Behavior of Tumor	Number of Cases (n)	Percentage (%)	Mean Age ± SD (years)	Male: Female Ratio	Superficial Location n (%)	Deep Location n (%)
Benign	240	76.9	34.6 ± 14.2	1.2: 1	182 (75.8)	58 (24.2)
Intermediate (locally aggressive/ rarely metastasizing)	23	7.4	41.8 ± 12.6	1.1: 1	11 (47.8)	12 (52.2)
Malignant	49	15.7	52.3 ± 13.9	1.5: 1	14 (28.6)	12 (52.2)
Total	312	100	39.8 ± 16.7	1.3: 1	207 (66.3)	105 (33.7)

Table 2 illustrates the histopathological spectrum of soft tissue tumors in the present study according to the WHO 2020 classification. Adipocytic tumors formed the largest category, with lipoma being the most common individual tumor type, reflecting the predominance of benign lesions.

Fibroblastic and myofibroblastictumors constituted the next major group, followed by peripheral nerve sheath and vascular tumors. Among malignant soft tissue tumors, undifferentiated pleomorphic sarcoma and synovial sarcoma were the most frequently encountered sarcomas, while malignant peripheral nerve sheath tumor, leiomyosarcoma, and rhabdomyosarcoma were relatively less common.

Overall, the table highlights the wide histological diversity of soft tissue tumors and underscores the importance of accurate histopathological classification for appropriate diagnosis and clinical management.

Table 2: Histopathological Spectrum of Soft Tissue Tumors According to WHO Classification (2020) (n = 312)

Histological Category	Specific Tumor Type	Number of Cases (n)	Percentage (%)
Adipocytic tumors	Lipoma	119	38.1
	Lipomatosis	8	2.6
	Atypical lipomatous tumor	9	2.9
	Liposarcoma	11	3.5
Fibroblastic / Myofibroblastictumors	Fibroma	21	6.7
	Nodular fasciitis	14	4.5
	Fibromatosis (desmoid-type)	7	2.2
	Fibrosarcoma	6	1.9
Peripheral nerve sheath tumors	Schwannoma	17	5.4
	Neurofibroma	22	7.1
	Malignant peripheral nerve sheath tumor	5	1.6
Malignant peripheral nerve sheath tumor	Hemangioma	26	8.3
	Angiosarcoma	4	1.3
Smooth muscle tumors	Leiomyoma	9	2.9
	Leiomyosarcoma	6	1.9
Skeletal muscle tumors	Rhabdomyoma	3	1.0
	Rhabdomyosarcoma	7	2.2
Tumors of uncertain differentiation	Undifferentiated pleomorphic sarcoma	12	3.8
	Synovial sarcoma	10	3.2
	Epithelioid sarcoma	3	1.0
Others	Giant cell tumor of soft tissue	4	1.3
	Myxoma	6	1.9
	Dermatofibrosarcoma protuberans	5	1.6

Table 3 presents the results of multivariate logistic regression analysis performed to identify clinicopathological factors independently associated with malignancy in soft tissue tumors.

Increasing age, tumor size greater than 5 cm, and deep-seated tumor location were found to be statistically significant predictors of malignancy. Patients older than 40 years had a markedly higher likelihood of harboring malignant tumors compared to younger patients. Similarly, tumors larger than 5 cm and those located deep to the fascia showed significantly increased odds of malignancy. Sex and anatomical site, although showing higher odds ratios for malignancy, did not reach statistical significance in the multivariate model. These findings emphasize that age, tumor size, and depth are key parameters that should raise clinical suspicion for malignancy and guide further diagnostic evaluation and management of soft tissue tumors.

Table 3: Multivariate Logistic Regression Analysis of Clinicopathological Factors Associated with Malignancy in Soft Tissue Tumors (n = 312)

Variable	Category	Malignant Cases n/N (%)	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Age group (years)	≤40	14/179 (7.8)	1 (Reference)		
	>40	35/133 (26.3)	3.12	1.82–5.35	<0.001
Sex	Female	17/128 (13.3)	1 (Reference)		
	Male	32/184 (17.4)	1.38	0.74–2.56	0.31
Tumor size	≤5 cm	12/142 (8.5)	1 (Reference)		
	>5 cm	37/170 (21.8)	2.71	1.51–4.87	0.001
Tumor depth	Superficial	14/207 (6.8)	1 (Reference)		
	Deep	35/105 (33.3)	2.48	1.39–4.42	0.002
Anatomical site	Trunk & head-neck	9/96 (9.4)	1 (Reference)		
	Extremities	40/216 (18.5)	1.91	0.89–4.07	0.09

Figure 1 shows a representative photomicrograph of lipoma, the most common benign soft tissue tumor in the present study. The section demonstrates mature adipocytes arranged in well-circumscribed lobules, separated by delicate fibrous septa. The adipocytes are uniform in size and shape, with clear cytoplasm due to dissolved lipid and peripherally placed flattened nuclei. No cellular atypia, lipoblasts, mitotic activity, or necrosis is identified. These features are characteristic of a benign adipocytic neoplasm and help in differentiating lipoma from atypical lipomatous tumor and liposarcoma.(Hematoxylin and eosin stain, ×100 magnification)

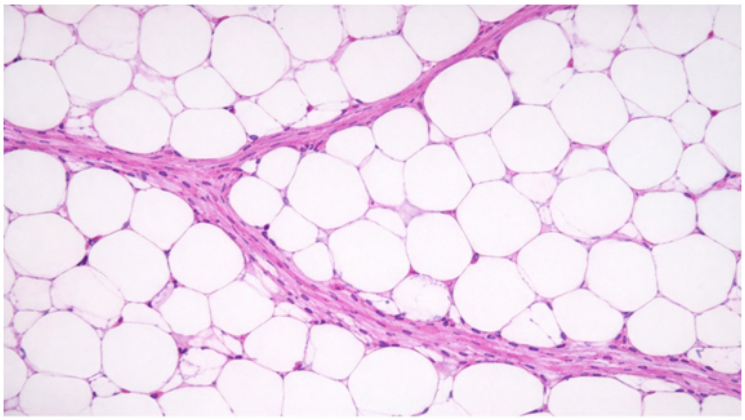

Figure 1: Photomicrograph of a lipoma showing mature adipocytes arranged in well-circumscribed lobules separated by thin fibrous septa. Adipocytes have clear cytoplasm with peripherally placed flattened nuclei. (H&E, ×100)

Figure 2 depicts a representative histopathological section of synovial sarcoma showing a monophasic spindle cell pattern. The tumor is composed of densely packed, uniform spindle-shaped cells arranged in intersecting fascicles within a collagenous stroma. The cells exhibit elongated nuclei with mild to moderate pleomorphism and increased mitotic activity. Focal areas of hemorrhage may be seen. These microscopic features are characteristic of synovial sarcoma and help distinguish it from other spindle cell soft tissue neoplasms. (Hematoxylin and eosin stain, ×200 magnification)

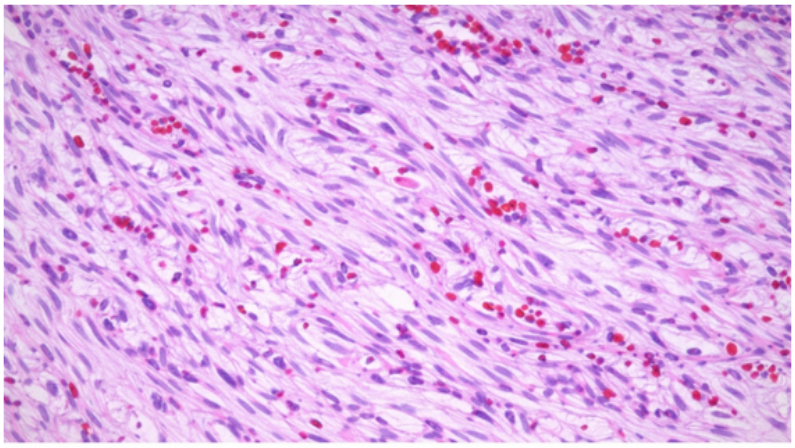

Figure 2: Photomicrograph of nodular fasciitis demonstrating plump spindle-shaped fibroblasts in a vascular pattern set in a myxoid stroma with prominent extravasated erythrocytes and collagen (H&E, ×200)

Figure 3 shows the histopathological features of undifferentiated pleomorphic sarcoma. The tumor is composed of highly pleomorphic spindle and polygonal cells arranged in a disorganized pattern. Marked nuclear atypia, hyperchromasia, and frequent atypical mitotic figures are evident. Areas of tumor necrosis and hemorrhage are also present, indicating aggressive biological behavior. These features are diagnostic of a high-grade malignant soft tissue sarcoma.(Hematoxylin and eosin stain, ×200 magnification)

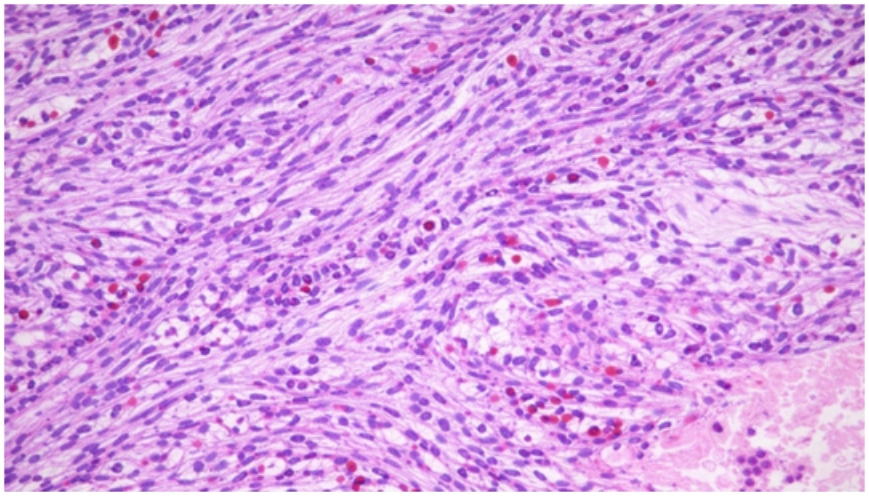

Figure 3: Photomicrograph of a malignant peripheral nerve sheath tumor showing hypercellular fascicles of epithelioid-shaped cells with enlarged pleomorphic hyperchromatic nuclei, frequent mitotic figures (some abnormal), areas of necrosis and nuclear palisading (H&E, ×200)

Discussion

Soft tissue tumors constitute a diagnostically challenging group due to their rarity, histological overlap, and varied biological behavior. The present study provides a comprehensive overview of the spectrum of soft tissue tumors encountered at a tertiary care center in Bihar. In this study, benign tumors constituted the majority (76.9%), consistent with studies by Kransdorf et al. and Nirmala et al., who reported benign lesions in 70–80% of cases [8,9]. Lipoma emerged as the most common benign tumor, reflecting its ubiquitous nature and similarity with global and Indian literature [10].

The incidence of malignant soft tissue tumors (15.7%) in our study is comparable to reports from other Indian tertiary centers, which range between 12–20% [11,12]. Undifferentiated pleomorphic sarcoma was the most common malignant tumor, a finding in line with the post-WHO reclassification trend where many previously labeled malignant fibrous histiocytomas have been reclassified [13].

Age distribution revealed a peak incidence in the 3rd and 4th decades for benign tumors, while malignant tumors were significantly more common in patients above 40 years of age. This age-related trend has been well documented and highlights the need for increased clinical suspicion in older patients presenting with soft tissue masses [14].

Male predominance observed in our study aligns with several published series, possibly reflecting

occupational exposure and healthcare-seeking behavior differences [15]. Anatomical distribution showed extremities as the most common site, particularly for malignant tumors, consistent with classical descriptions of soft tissue sarcomas [16].

Logistic regression analysis identified age >40 years, deep-seated location, and tumor size >5 cm as independent predictors of malignancy. These parameters are well-established red flags in sarcoma evaluation and reinforce existing diagnostic algorithms [17]. The lack of routine molecular diagnostics and limited IHC panels in resource-constrained settings like Bihar remains a challenge. However, meticulous histopathological evaluation combined with clinicoradiological correlation can significantly improve diagnostic accuracy [18]. This study is limited by its retrospective nature and lack of long-term follow-up data. Nevertheless, it provides valuable region-specific data and underscores the importance of strengthening pathology services in underserved areas.

Conclusion

The present study demonstrates that soft tissue tumors at a tertiary care center in Bihar are predominantly benign, with lipoma being the most common lesion. However, a significant proportion of malignant tumors, particularly in older patients and deep-seated masses, highlights the need for early diagnosis and comprehensive histopathological evaluation. Awareness, timely referral, and adherence to standardized classification systems are essential for improving patient outcomes.

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