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Cytohistopathological and Immunohistochemical correlation of soft tissue tumors: A retrospective study at a tertiary care rural hospital in central India

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Original Article

Abstract

BACKGROUND: Soft tissue tumors (STT) are rare, heterogeneous neoplasm, derived from the mesoderm. The wide range of STT and absence of recognizable architectural patterns on cytology makes the diagnosis of STT through fine needle aspiration cytology (FNAC) difficult.

METHODS: This laboratory-based, non–interventional, observational, retrospective study was conducted on 526 diagnosed cases of STT between 2015 and 2019, for cytological and histopathological correlation. In all the cases, complete clinical details, radiological and clinical data, and cytopathological and histopathological diagnosis were recorded from the Hospital Information System and pathology records. The cytological smears were examined and were categorized as benign, suspicious for malignancy, and malignant. Corresponding histopathology slides were examined for diagnostic concordance considering histopathology as the "gold standard." Cytohistopathological correlation was assessed in all cases and the diagnostic accuracy of FNAC was expressed as a percentage. Statistical analysis was carried out using SPSS software. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated using the respective formulae. P values < 0.05 were considered to be significant.

RESULTS: Overall accurate categorizations of benign STT and malignant STT were 61.96% and 17.05%, respectively. The overall diagnostic accuracy of FNAC was 93.5%. Its sensitivity, specificity, PPV, and NPV were 83.68%, 97.39%, 91.47%, and 94.20%, respectively. Correlations with a p value < 0.001 were considered significant.

CONCLUSION: FNAC is an important preliminary diagnostic tool in STT and is helpful in the diagnosis of local recurrence and metastatic tumors in the soft tissue. FNAC has a high degree of correlation with core biopsy, thereby avoiding significant clinical complication associated with it.

KEYWORDS: Soft Tissue Tumor; Cytology; Correlation; Histopathology

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Introduction

Soft tissue tumors (STT) are a heterogeneous group of neoplasm, which include tumors of adipose tissue, fibrous connective tissue, skeletal muscle, blood vessels, and peripheral nerves.[1,2]

The prevalence of soft tissue sarcomas (STSs) is much higher in children (7-10%) and they account for more than 20% of solid cancers.[3,4] In the United States, 13,040 new

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cases of STSs and 5,150 deaths due to STSs have been reported, representing 0.75% of overall cancer incidence and 0.84% of overall cancer mortality.[4] The Surveillance, Epidemiology, and End Results (SEER) Program shows that the age adjusted incidence of STS is 3.1/100,000 irrespective of gender. In India, these rates vary among children in different parts; it is 3.6% in Delhi to 14.8% in Barshi among males and 3.7% in Bangalore to 9.5% in Bhopal among females.[5]

Most of the STT have benign and malignant counterparts; some are of intermediate grade with aggressive local invasion.[3] The exact aetiology of STS remains undetermined; however, numerous risk factors are linked to its development, including age, exposure to radiation, previous malignancy, and genetic background.[5,6] Nearly 70 histological types of sarcomas have been recognized by the World Health Organization (WHO).[6] This histological heterogeneity, low prevalence rate, and the lack of proper correlation between clinical–radiological features and pathological findings make their diagnosis a challenging task in surgical pathology.

Recently, fine needle aspiration cytology (FNAC) has proved to be an important screening method for numerous pathologic lesions. It is a rapid outpatient procedure, comparatively painless, safe, and easy to perform, and cost effective.[7] FNAC can also provide a predictive diagnosis of a benign or malignant STT. Moreover, in inoperable malignant or recurrent cancers, cytological diagnosis has proven helpful for the administration of a palliative treatment.[6]

However, the absence of recognizable tissue architectural patterns in cytological preparation and overlapping cytomorphological features make the diagnosis of STSs more difficult based on cytology.[5,6]

Padmanabhan et al.[1] achieved 93.81% accuracy in cytohistopathological correlation of the benign tumors and 100% accuracy in differentiating benign and malignant lesions. Soni et al.[6] reported a sensitivity, specificity, positive predictive value, negative predictive value, and efficiency of 70%, 100%, 97.90%, 100%, and 98%, respectively.

Different studies in laboratories where FNAC, histopathology, and immunohistochemistry (IHC) are available found higher sensitivity and specificity of diagnosis and histological categorization of STT. However, in order for the evaluation to reach a definite diagnosis, the combined effort and collaboration of surgeons, radiologists, and pathologists was required. Therefore, the present study was conducted to determine the cytohistological correlation of STT tissue with histopathology and IHC (wherever required).

Methods

This laboratory-based, non–interventional, observational, retrospective study was carried out at the Department of Pathology at the Mahatma Gandhi Institute of Medical Sciences, a rural tertiary care hospital in Sevagram, Central India. Sample size was calculated for the expected proportion of STT subjects as around 120-150 cases of STT diagnosed each year. During a 5-year period (2015-2019), 573 cases of STT were diagnosed through FNAC; from among them, 526 cases were successfully followed up and excision biopsies were obtained. Due to inability to obtain a biopsy, 47 cases were excluded from the study.

The study inclusion criteria included STT diagnosed by FNAC and follow-up through histopathology diagnosis and immunohistochemistry. Cases in which histopathology diagnosis was not available were excluded from the study.

In all 526 cases, complete clinical details, pertaining to age, sex, site, radiological findings, and clinical diagnosis, were recorded from the hospital information system and pathology records. Both Papanicolaou and May–Grunwald-Giemsa (MGG) stained

smears of these cases were reviewed by 2 of the authors (MA and PG) and their cytological features were recorded.

The cytological smears were examined for cytological details and architectural pattern, and were categorized as benign, suspicious for malignancy, and malignant tumors along with specific subtyping of all STT. Corresponding hematoxylin and eosin (H&E) stained sections of biopsy specimens of all the above cases were examined. Special stains and IHC slides were also reviewed wherever required for confirmation of diagnosis. Immunohistochemical markers of S100 proteins, desmin, vimentin, CD34, CD99, smooth muscle actin, epithelial membrane antigen (EMA), and leukocyte common antigen (LCA) were used in our study for the confirmation of diagnosis.

Cytohistopathological correlation was assessed in all cases and the diagnostic accuracy of FNAC was expressed as a percentage in relation to the histopathological diagnosis. Considering that FNA, as a screening test, has a relatively high sensitivity for the diagnosis of malignancy, we included all lesions suspicious for malignancy in the category of malignant lesions for statistical analysis. The sensitivity and specificity were the gold standard method. Statistical analysis was carried out using SPSS software (version 19; SPSS Inc., Chicago, IL, USA). Percentage and frequency were used for descriptive analysis. Various cytological categories were compared using chi-square test. P value < 0.05 was considered to be significant. Sensitivity, specificity, and overall accuracy with positive and negative predictive values from cytology and histopathology were determined using the following formulas:

Sensitivity = (TP/ (TP + FN)) × 100

Specificity = (TN/ (TN + FP)) × 100

Overall accuracy = ((TP + TN)/ (TP + TN + FP + FN)) × 100

Positive predictive value = (TP/ (TP + FP)) × 100

Negative predictive value = (TN/ (TN + FN)) × 100

TP = true positive, TN = true negative; FN = false negative, FP = false positive

Results

Of the total 526 cases, 397 (75.47%), 108 (22.39%), 21 (3.99%) were diagnosed as benign STT, malignant STT, and suspicious for malignancy on cytology, respectively. The majority of benign STT cases [106 (26.7%)] were found in the fourth decade of life while 28 (25.92%) malignant STT cases were diagnosed in the sixth decade of life. Moreover, 59.3% (312/526) of cases with STT including both benign and malignant were men and 40.6% (214/526) were women, with an overall men to women ratio of 1.4:1.

The commonest site of involvement for both benign [27.9% (111/397)] and malignant [51.8% (56/108)] STT was lower extremities, followed by the trunk, and head and neck regions. On FNAC, the commonest benign STT was lipoma [44.8% (178/397)] followed by peripheral nerve sheath tumor (PNST) [11.3 % (45/397)] and fibroblastic tumor [4.03% (16/397)]. The benign STT which could not be categorized into a specific group were labeled as benign mesenchymal tumor (BMT), which constitutes 33.5% (134/397) of cases. The most common category of malignant STT diagnosed through cytology was liposarcoma [9.25% (10/108)], while 83.33% (90/108) of malignant STT that could not be categorized accurately were labeled as malignant mesenchymal tumors (MMTs). The spectrum of STT on cytology is presented in table 1.

The cytology smears of lipoma cases showed clusters of mature adipocytes, fat filled histiocytes, and thin capillaries (Figure 1e). The results showed that 95.48% (169/177) of lipoma cases were diagnosed accurately on FNAC. The cytology smears of liposarcoma showed univacuolated or multivacuolated lipoblasts with scalloped nuclear margin with nuclear atypia (Figure 2b).

Table 1. Spectrum of soft tissue tumors on fine needle aspiration cytology

Category	Benign STT n (%)	Malignant STT n (%)	Total
Adipocytic tumors	177 (94.68)	10 (5.32)	187
Fibroblastic tumors	16 (88.88)	2 (11.11)	18
Fibrohistiocytic tumors	12 (73.33)	4 (26.66)	16
Smooth muscle tumors	1 (50)	1 (50)	2
Vascular tumors	12 (100)	0 (0)	12
Peripheral nerve sheath and related tumors	45 (97.82)	1 (2.16)	46
Nonspecific cases (Benign mesenchymal tumor)	134 (59.82)	90 (40.17)	224
Suspicious	0 (0)	21 (100)	21
Total cases	397 (75.47)	129 (24.52)	526

Moreover, 10 (58.8%) cases of liposarcoma were diagnosed accurately on cytology and findings were confirmed on histology with few variants.

Desmoid fibromatosis yielded scant cellularity with clusters of loosely cohesive oval to spindle-shaped cells embedded in collagenous stroma. Cytological smears from a keloid scar showed glassy collagenized material with few scattered spindle cells (Figure 1c). These were mostly diagnosed correctly based on clinico-cytological correlation and later confirmed on histopathology. All 6 cases of elastofibroma characterized by collagenous matrix with degenerated elastic fibers and fibroblast (Figure 1d) were confirmed on histopathology and special stains. All 4 cases of fibroma of tendon sheath and calcifying aponeurotic fibroma showed myxoid material with small clusters of spindle cells which were categorized broadly on cytology as BMT.

Nodular fasciitis on cytology showed pleomorphic spindle cells with open nuclear chromatin and small nucleoli in a myxoid matrix (Figure 1f).

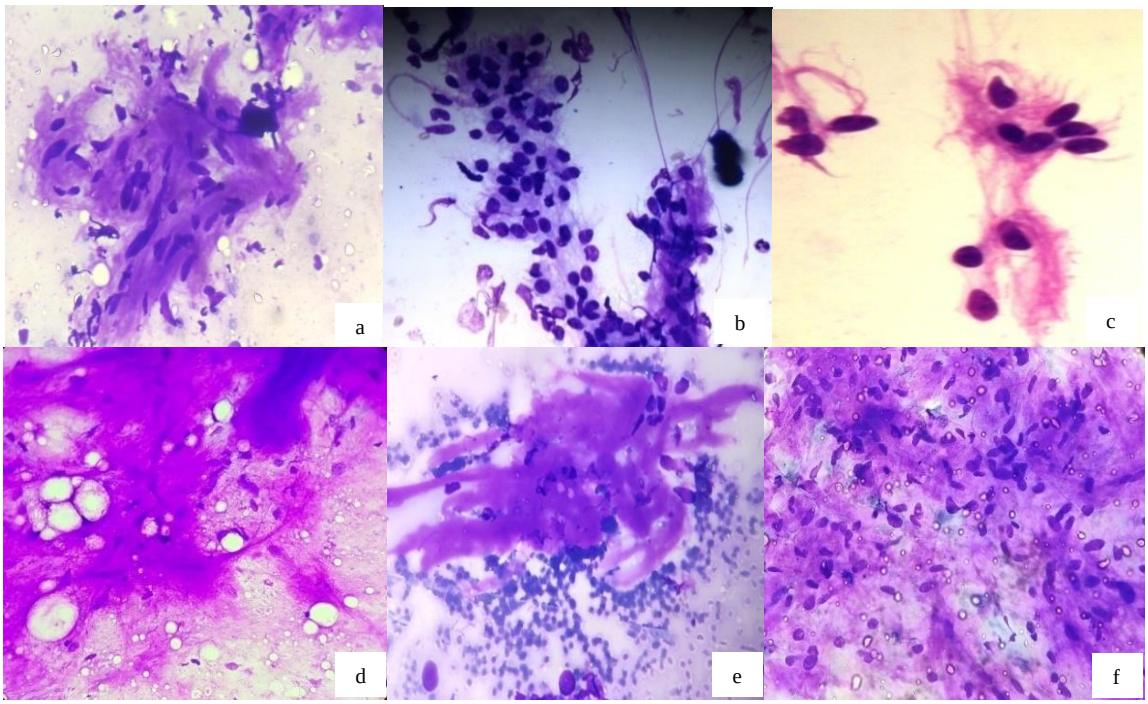

Figure 1. Benign spindle cell tumor on cytology (MGG, HP)

a) Schwannoma (Tissue fragments from Antoni A areas); b) Benign fibrous histiocytoma (cellular smears consisting of plump spindle cells with oval nuclei); c) Desmoid fibromatosis (clusters of ovoid fibroblasts with collagenous stroma) (Pap, HP); d) Spindle cell lipoma; e) Elastofibroma (degenerated elastic fibers are seen.); f) Solitary fibrous tumor (Plump spindle fibroblastic cells arranged in clusters and dispersed in collagenous stroma)

Mitotic activity was high; however, no atypical mitosis was seen. Using cytology, 2 of 3 cases of nodular fasciitis were diagnosed accurately.

Myxofibrosarcoma (MFS) and fibrosarcoma showed cellular smears with elongated spindled shaped nuclei finely granular chromatin and inconspicuous nucleoli with variable degree of nuclear pleomorphism (Figure 2e). The amount of stromal matrix was indirectly proportional to the degree of cellularity. Moreover, 2 of 7 cases of MFS were diagnosed correctly, while the remaining 5 cases were diagnosed as MMT and exact diagnosis was reached on histopathology and IHC.

Giant cell tumor of tendon sheath (GCTTS) showed cellular smears with an admixture of giant cells and oval stromal cells with intranuclear grooves, hemosiderin laden macrophages, and inflammatory cells. Accurate cytological diagnosis was reached in 55.5% (10/18) of the cases, and subsequently, confirmed on histopathology. However, in all 8 cases of benign fibrous histiocytoma (Figure 2e), accurate categorization was not achieved on cytology and they were diagnosed as BMT. Cytological smears of malignant fibrous histiocytoma were cellular and showed pleomorphic bizarre cells with moderate pale blue vacuolated cytoplasm and irregular plump nuclei with prominent nucleoli (Figure 2f). These tumors were diagnosed as pleomorphic sarcoma and the diagnosis was confirmed by IHC.

On FNAC, 50% of cases of tuberous xanthoma were diagnosed accurately based on its classic clinical presentation of multiple soft tissues swelling near the joints and presence of foamy histiocytes and inflammatory cells. The cytohistopathological correlation in the diagnosis of benign STTs is presented in table 2.

Dermatofibrosarcoma protuberans (DFSP) cases revealed moderate cellular smears, consisting of short spindle cells with moderate nuclear pleomorphism against fatty background (Figure 2a).

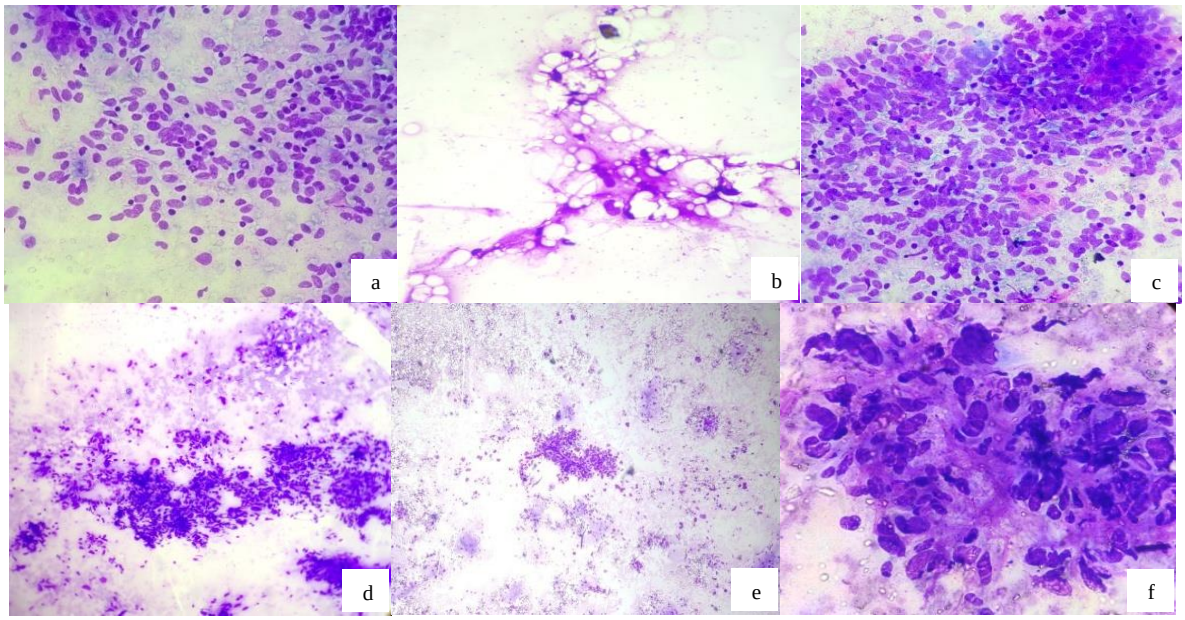

Figure 2. Malignant spindle cell tumor on cytology (MGG LP)

a) Dermatofibrosarcoma protuberans (Streaming arrangement of dispersed single cells and stripped nuclei and moderate anisokaryosis); b) Well differentiated liposarcoma (Smear shows fragments of mature adipose and large atypical cells with hyperchromatic nuclei and distant nucleoli); c) Synovial sarcoma (Cellular areas with admixture of tissue fragments and dispersed cells, and acinar-like structures also seen in the periphery of the tumor fragments); d) Leiomyosarcoma (An oval to spindle cells pattern in necrotic background); e) Low grade fibromyxoid sarcoma (Smear shows spindle shaped/ovoid cells in myxoid background.); f) Pleomorphic sarcoma (Malignant fibrous histiocytoma type) (MGG-HP)

Table 2. Correlation of cytological and histopathological diagnosis in benign tumor

Histopathology	Total cases	Accurately categorized	Diagnosed as benign but not accurately categorized	Diagnosed as malignant on cytology
Adipocytic tumors	177	169	7	1
Fibroblastic tumors	44	16	23	5
Fibrohistiocytic tumors	26	10	10	6
Smooth muscle tumors	6	1	4	1
Vascular tumors	12	7	4	1
Peripheral nerve sheath and related tumors	132	43	82	7
Total	397	246	130	21

Accurate cytological diagnosis was made in only 4 cases, whereas broad categorization was performed in 45% of cases (9/20).

Leiomyosarcoma (LMS) on cytology showed cohesive clusters and fascicles of atypical spindled cells with blunt ended cigar shaped nuclei. Atypical mitotic figures, tumor giant cells and necrosis were also noted (Figure 2d). Only 1 case of LMS was accurately diagnosed on FNAC while the other 3 cases were categorized as MMT. Vascular tumor yielded passive hemorrhagic aspirate; 9 (60%) cases were diagnosed as benign vascular lesion, while 6 cases were categorized as vascular BMT. However, all 3 cases of angiosarcoma were categorized as MMT.

Most of the cases of neurofibroma were accurately categorized. The needling of a neurilemmoma or neurofibroma triggers a sharp pain along the nerve and this valuable sign was present in most of the nerve sheath tumors. The characteristic features of neurilemmoma were fibrillary stromal fragments, and nuclear palisading. Nuclei tend to be long, slender, and comma-shaped or bent like a fishhook (Figure 1a). Exact diagnosis of neurilemmoma was made in 58.4% (31/53) of cases on FNAC, but 13 cases were labeled as BMT.

Malignant peripheral nerve sheath tumor (MPNST) on cytology showed cellular smears with pleomorphic cells and spindled shaped nuclei with indentation and kinking. Mitosis was frequent with background necrosis. In contrast to neurilemmoma, MPNST showed focal or weak positivity to S100. A diagnosis of MMT with possible neurogenic origin was given in 87.5% of cases. Alveolar rhabdomyosarcoma (RMS) cases on cytology were labeled as malignant small round cell tumor and confirmed on IHC.

The FNAC of clear cell sarcoma showed scattered to polygonal and spindle-shaped with abundant vacuolated cytoplasm. MMT diagnosis was given in 6 out of 8 cases, while 2 cases were diagnosed as metastasis of epithelial malignancy. The cytohistopathological correlation in the diagnosis of STSs are presented in table 3.

Table 3. Correlation of cytodiagnosis and histopathological diagnosis in malignant tumors

Histopathology	Total cases	Accurately categorized	Diagnosed as malignant but not accurately categorized	Diagnosed as benign on cytology	Suspicious
Adipocytic tumors	17	10	6	1	
Fibroblastic tumors/myofibroblastic	9	2	5	2	
Fibrohistiocytic tumors	25	4	11	4	6
Smooth muscle tumors	4	1	2	1	0
Vascular tumors	3	0	2	0	1
Peripheral nerve sheath and related tumors	8	1	5	2	
skeletal muscle tumor	4	0	3	0	1
Tumor of uncertain differentiation	20	4	7	2	7
undifferentiated/unclassifiable	39	0	33	0	6
Total	129	22	74	12	21

Overall accurate categorization (to categorize the tumor as adipose tissue connective tissue, skeletal muscle, blood vessels, and peripheral nerves) showed 50.95% (268/526) STTs, 61.96% (246/397) benign STT and 17.05% (22/129) malignant STT. The 22 cases of malignant STT were diagnosed accurately on cytology, including 10 cases of liposarcoma, 4 cases of DFSP (Figure 3a), 4 cases of synovial sarcoma (Figure 2c), 2 cases of MFS, 2 cases of MPNST (Figure 2b), and 2 cases of LMS. However, 73.64% of malignant STTs were diagnosed as MMT. Moreover, 21 (16.27%) cases of the 129 cases reported as suspicious for malignancy were malignant on histopathology, whereas 12 cases labeled as benign tumor on cytology were found to be malignant on histopathology, most of which were low-grade sarcoma such as DFSP and synovial sarcoma. Furthermore, 6 cases diagnosed as MMT on cytology were found to be BMT on histopathology, which included 2 cases of nodular fasciitis, 2 cases of cellular neurofibroma, 1 case of ancient schwannoma, and 1 case of BFH.

All malignant STT were positive for vimentin thereby confirming the sarcomatous nature of the tumor.

Among the individual benign STT categories, adipocytic tumor had the best cytohistological correlation [95.8% (169/177)], followed by benign vascular tumor [58.3% (7/12)], fibro histiocytic tumor [38.46% (10/26)], and PNST [32.57% (43/132)]. The least cytohistological correlation was noted for smooth muscle tumor [16.66% (1/6)].

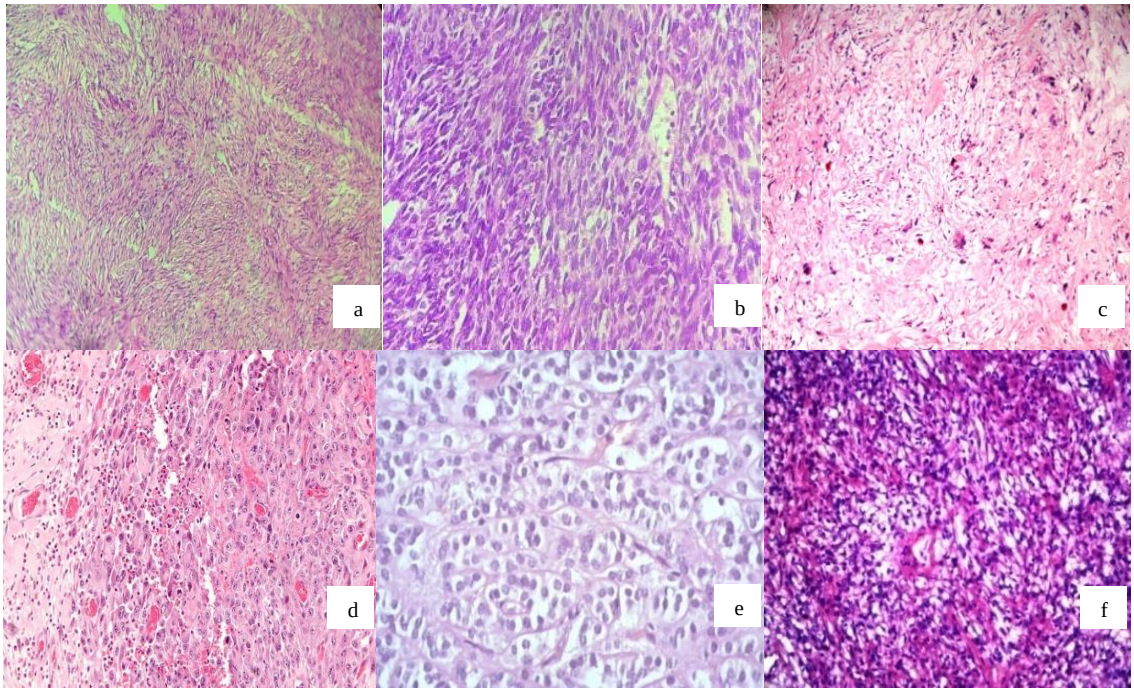

Figure 3: a) Dermatofibrosarcoma protuberans (hypercellular areas with storiform pattern of growth); b) MPNST (Section shows hypercellularity; the dark hyperchromatic nuclei and pale cytoplasm is typical of MPNST.) c) Pleomorphic Rhabdomyosarcoma (Section shows pleomorphic tumor cells with presence of tumor giant cells.) d) Epithelioid sarcoma (tight clusters of epithelioid cells with prominent nucleoli and abundant deep eosinophilic cytoplasm) e) Clear cell sarcoma of soft part (Solid nests and fascicles of pale cuboidal cells with prominent deep basophilic cytoplasm) f) Hemangiopericytoma (Diffusely arranged spindle cells surrounding hyalinised collapsed thin wall blood vessels) (H&E, LP)

Table 4. Diagnostic accuracy of FNAC for soft tissue tumor

Cytology	Histopathology		Total
	Benign	Malignant	
Benign	380	17	397
Malignant	13	116	129
Total	393	133	526
Sensitivity			87.21%
Specificity			96.69%
Positive predictive value			89.92%
Negative predictive value			95.71%
Cytohistopathological correlation			P value < 0.05

On histopathology, 74.71% (393/526) of the STT were benign and 25.28% (133/526) were malignant STT. The common pattern observed was a spindled cell pattern in 56.8% of cases, followed by lipomatous in 30.4%, myxoid in 8.5%, and pleomorphic in 4.1% of cases.

The overall diagnostic accuracy of FNAC was 93.5% for STT. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were 87.21%, 97.6.69%, 89.92%, and 95.71%, respectively. The p value was < 0.001 which shows a statistically significant correlation. The diagnostic accuracy of FNAC for STT has been shown in table 4.

Discussion

In the present study, the determination of the cytohistological correlation of STT was undertaken with the aim to evaluate the acceptability, reliability, and accuracy of cytodiagnosis in comparison to biopsy.

FNAC is a valuable investigation and it helps cytologists differentiate primary malignant STT from benign STT and from other malignancies, metastasis tumors, lymphomas, and tumors of dermal appendages.[6] FNAC has numerous advantages over open biopsy, as its inexpensive outpatient department (OPD) procedure is easy to perform and yields clinically useful results with a rapid turnaround time.[6] Furthermore, it can provide an immediate interpretation, especially in pediatric sarcoma, thus making other ancillary studies and planning of surgical intervention and/or neoadjuvant therapy possible at the initial presenting clinic visit.[4,6] In spite of these benefits of FNAC, there is some reluctance among clinicians and cytologists to use FNAC for the diagnosis of STT.[3,6]

The incidence of STT is difficult to determine accurately as benign tumors are underrepresented in hospital materials and usually not included in cancer registries, while sarcomas ultimately come to medical attention.[8] The incidence of STS varies with age, with a rate of 0.9/100000 among children and 18.2/100000 among adults over the age of 70 years.[9,10] In recent years, the incidence of STT has increased, but it is unclear whether this represents a true increase or reflects better diagnostic capabilities and greater interest in STT.[11]

STT were more common in men, but gender and age-related incidences vary among the histological types.[9] In the present study, STT were more prevalent in men with an M:F ratio of 1.4:1. Our finding was in agreement with that of Nayak et al.,[12] Beg et al.,[13] Sharanabasav and Rangappa [14] However, Nagira et al.[15] reported a female predominance in this regard. Benign and malignant STT were most common in the age groups of 31-40 (26.70%) and 51-60 (21.7%) years, respectively. Our observations were consistent with that of Nayak et al.[12] However, Roy et al.[7] found that benign STT was relatively common after the third decade of life, whereas malignant STT occurred in all age groups. The lower extremity was the commonest site for both benign [27.9%

(111/397)] and malignant STT [51.8% (56/108)]; this finding was in line with that of the studies conducted by Chandralekha et al.[16] and Dash et al.[17]

Benign STT were more common than malignant STT with a ratio of at least 10:1 to 100:1;[5] this ratio was 3:1 in our study. Recent studies by Nayak et al.[12] and Nagira et al.[15] also reported a higher number of benign tumors than malignant tumors with a ratio of 4.7:1 and 3.3:1, respectively. However, Rekhi et al. [18] found that malignant STT was more common than benign STT as their study was conducted in higher referral centers where mostly malignant tumors were encountered.

In the present study, adipocytic tumors were the most prevalent followed by BMT and MPNST. Similar observations were also made by Dash et al.[17] and Parajuli and Lakhey[19] However, for malignant STT, tumors of uncertain differentiation (25/129) were the commonest tumors followed by fibrohistiocytic (20/129) and adipocytic tumors (17/129), this finding was similar to the findings of the study by Soni et al.[6]

In our study, the diagnostic accuracy of FNAC was 93.5%. Its accuracy in diagnosing benign STT and malignant STT was 94.2% and 91.4%, respectively. In the studies by Rekhi et al.[18] and Soni et al.,[6] the diagnostic accuracy of FNAC in STT was 98%, whereas in the study by Parajuli and Lakhey,[19] it was only 80%. Similarly, Jain and Agarwal[20] and Akerman et al.[21] reported an overall accuracy of 97.7% and 94% in diagnosing STT through FNAC, respectively. However, Palmer et al.[24]and Sapi et al.[25] observed 100% sensitivity and around 95% specificity in the diagnosis of STT through cytology. Our findings are consistent with the findings of Kulkarni et al. (93.33%[2])[2] and Roy et al. (90.8%).[7] Therefore, FNAC should be considered as a beneficial and cost effective procedure for the diagnosis of STTs.[7]

The present study showed a sensitivity, specificity, PPV, and NPV of 87.21%, about 96.69%, about 89.92%, and 95.71%, respectively, for FNAC. Our findings were in line with that of the studies by Nagira et al.,[15] Chandralekha et al.,[16] Dey et al.[23], Fathimanifra et al.,[26] and Roy et al. (90.8%).[7] Similarly, Fathimanifra et al. (2021)[26] found that FNAC has excellent diagnostic accuracy (96%), sensitivity (84.2%), and specificity (98.8%) in the classification of a mesenchymal tumor.[26] Sahu et al. reported a sensitivity, specificity, PPV, NPV, and overall diagnostic accuracy of 87.5%, 98.7%, 91.3%, 98.1%, and 97.3% for FNAC, respectively. They reported a statistically significant difference between the cytological diagnosis and the final histological diagnosis ($\chi^2 = 35.5$; $P < 0.05$). They recommend FNAC for initial diagnostic work-up, and histopathology along with immunostaining for the final diagnosis of STT.[27]

Soni et al. (2014)[6] reported a sensitivity, specificity, PPV, NPV, and efficiency of 70%, 100%, 97.90%, 100%, and 98%, respectively, for FNAC. They concluded that FNAC is an important preliminary diagnostic tool in palpable STT with a high degree of correlation with the final histopathology report.[6] Trovik et al.[28] and Dey et al.[23] recommended FNAC for the documentation of locally recurrent STT and for confirmation of metastatic tumors in soft tissue.

Despite these benefits, FNAC has certain limitations regarding the histological grading and subtyping of subgroups of sarcomas. Though FNAC is helpful in differentiating benign and malignant STT, it is difficult to distinguish low-grade sarcomas from benign or borderline cellular tumors especially with the spindle cell sarcoma pattern.[25]

Suggestions: Most of the studies in the literature have a relatively small sample size and cross-sectional design; thus, larger prospective studies should be conducted in this regard.

Limitations: The incidence of STT is difficult to determine accurately, as benign

tumors are underrepresented and are not included in cancer registries.

The false negative results are due to a borderline or low-grade spindle cell sarcoma being classified as benign on FNAC.

Conclusion

FNAC has proved to be an important diagnostic tool in differentiating benign and malignant STT and helpful in the diagnosis of local recurrence and metastatic tumors in the soft tissue. FNAC has a specificity of more than 90%, and it can be used in any subcutaneous lesion of smaller than 5 cm, in all pediatric tumors, in patients with advanced stage tumors, or whenever incision biopsy is contraindicated. Furthermore, FNAC has a diagnostic yield nearly identical with core biopsy, thereby avoiding significant clinical complication associated with it. Thus, in conjunction with other ancillary techniques, FNAC by an experienced cytopathologist has a diagnostic accuracy of higher than 90% for the diagnosis of STT.

Conflict of Interests

Authors have no conflict of interests.

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