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Original Research Article

Role of FNAC in Diagnosing Soft Tissue Tumors and Tumor-Like Lesions

Deepali[1], Dilip Kumar[2]

[1]Tutor, Department of Pathology, Patna Medical College and Hospital, Patna, Bihar, India
[2]Professor and HOD, Department of Pathology, Patna Medical College and Hospital, Patna, Bihar, India

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Corresponding Author: Dr. Deepali
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Abstract:

Background: Soft tissue tumors (STTs) and tumor-like lesions present a wide range of diagnostic challenges due to their clinical and morphological diversity. Fine Needle Aspiration Cytology (FNAC) has emerged as a reliable, minimally invasive, and cost-effective diagnostic technique for the preliminary evaluation of such lesions. It helps differentiate benign from malignant conditions and guides further management.

Aim: To evaluate the diagnostic utility of FNAC in the diagnosis of soft tissue tumors and tumor-like lesions and to correlate cytological findings with histopathological results.

Methods: A prospective observational study was conducted over 12 months from July 2024 to June 2025 at Patna Medical College and Hospital, including 100 patients presenting with palpable soft tissue swellings. FNAC was performed using standard technique, and cytological diagnoses were categorized. Surgical excision and histopathological correlation were performed in 60 cases. Data were analyzed using SPSS version 23.0 to calculate diagnostic accuracy, sensitivity, specificity, (PPV), and (NPV).

Results: Out of 100 cases, 60% were benign, 30% malignant, and 10% tumor-like/inflammatory lesions. Lipoma (40%) was the most common benign tumor, while sarcoma (15%) was the most frequent malignant tumor. FNAC findings correlated with histopathology in 54 of 60 cases (90%). The sensitivity and specificity of FNAC in detecting malignancy were 88.8% and 92.1%, respectively. The overall diagnostic accuracy was 90%, with PPV of 94.1% and NPV of 85.7%.

Conclusion: For soft tissue cancers and tumor-like lesions, FNAC is a useful initial diagnostic technique because of its ease of use, speed, and high diagnostic accuracy. It is very useful for differentiating between benign and malignant lesions, and in many situations, it can greatly minimize the need for an open biopsy.

Recommendations: FNAC should be incorporated as a routine first-line investigation for soft tissue lesions. Whenever possible, cytological diagnosis should be supported by ancillary techniques such as immunocytochemistry and correlated with histopathological findings for precise subtyping. Further studies with larger sample sizes and image-guided FNAC are recommended for deep-seated lesions.

Keywords: FNAC, Soft tissue tumors, Cytology, Histopathology correlation, Diagnostic accuracy.

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Introduction

STTs represent a heterogeneous group of neoplasms arising from mesenchymal tissues, including adipose, fibrous, muscular, and neurogenic components. These lesions vary widely in their biological behaviour, ranging from benign to highly malignant forms, such as soft tissue sarcomas. Early and accurate diagnosis of STTs is critical for optimal patient management and prognostication [1]. Due to their diverse presentation and overlapping clinical features, imaging alone is often insufficient to establish a definitive diagnosis. Histopathological evaluation remains the gold standard; however, tissue biopsy can be invasive, costly, and associated with complications [2].

A quick, easy, and affordable diagnostic method for the preliminary evaluation of soft tissue malignancies and tumor-like lesions is FNAC [3]. FNAC involves the extraction of cellular material through a fine needle, allowing cytological evaluation of the lesion without the need for open biopsy. This technique can be performed on an outpatient basis, requires minimal resources, and facilitates early diagnosis, thereby expediting clinical decision-making [4].

Recent studies have highlighted the utility of FNAC in differentiating benign from malignant soft tissue tumors, which significantly impacts treatment strategies [5]. Although FNAC has some limitations in sub classifying certain tumors due to the lack of architectural context, its high sensitivity and specificity for malignancy detection make it an indispensable screening tool [6]. Moreover, FNAC

can guide further diagnostic work-up, including the need for core needle biopsy or surgical excision, especially in cases suspicious for sarcoma or metastatic disease [7].

Advancements in ancillary techniques, such as immunocytochemistry and molecular testing on FNAC samples, have further enhanced the diagnostic accuracy of cytology in soft tissue lesions [8]. These developments allow more precise tumor typing and grading, which are essential for prognostication and therapeutic planning. Additionally, FNAC plays a crucial role in diagnosing tumor-like conditions such as inflammatory or infectious lesions, avoiding unnecessary surgical intervention [9]. To evaluate the diagnostic utility of FNAC in the diagnosis of soft tissue tumors and tumor-like lesions and to correlate cytological findings with histopathological results.

Methodology

Study Design: This was a prospective observational study.

Study Setting: The study was carried out in the Department of Pathology at Patna Medical College and Hospital (PMCH), a tertiary care referral center in Patna, Bihar. The study was conducted over a period of 12 months July 2024 to June 2025.

Participants: A total of 100 patients presenting with palpable soft tissue swellings were included in the study. These patients were selected consecutively from the outpatient and inpatient departments who were referred for FNAC during the study period.

Inclusion Criteria

- Patients of all age groups presenting with clinically diagnosed soft tissue swellings.
- Patients who consented to undergo FNAC.
- Patients with lesions accessible to FNAC under palpation or image guidance.

Exclusion Criteria

- Patients who refused to give informed consent.
- Patients with lesions in locations not accessible to FNAC.
- Patients with recurrent soft tissue tumors post-surgical excision.
- Cases where inadequate aspirate was obtained even after repeated attempts.

Bias Control: Consecutive sampling was used to reduce selection bias. All FNAC procedures were performed by experienced pathologists using standardized techniques. Cases with inadequate or equivocal samples were excluded from analysis. Histopathological correlation was done wherever surgical excision was performed to validate FNAC findings.

Data Collection: Relevant clinical data including demographic details, clinical presentation, duration of lesion, and anatomical location were recorded for each patient. The FNAC findings were documented and, where applicable, correlated with histopathology results. To ensure consistency and completeness, all data were recorded into a structured proforma.

Procedure: FNAC was performed using a 22- to 24-gauge needle attached to a 10 mL syringe under aseptic precautions. Smears were prepared immediately and stained with May-Grünwald-Giemsa (MGG) and Hematoxylin & Eosin (H&E) stains. Special stains were used when necessary. The cytological diagnoses were categorized into benign, malignant, suspicious, and non-neoplastic lesions. In cases where excisional biopsy or surgery was performed, histopathological examination was carried out for correlation.

Statistical Analysis: SPSS version 23.0 was used to analyze the data. The mean, standard deviation, and percentages were computed as descriptive statistics. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy were calculated using histopathology as the gold standard to evaluate the diagnostic accuracy of FNAC. Associations were evaluated using the chi-square test, and a p-value of less than 0.05 was deemed statistically significant.

Results

The male-to-female ratio was 1.38:1, with 58 (58%) of the 100 patients in the research being male and 42 (42%). With a mean age of 38.6 ± 16.3 years, the patients' ages ranged from 5 to 75 years. Most patients (44%) were between the ages of 21 and 40, with 26% falling into the 41–60 age range.

Table 1: Age and Gender Distribution of Patients (N = 100)

Age Group (years)	Male	Female	Total	Percentage (%)
0–20	6	4	10	10%
21–40	26	18	44	44%
41–60	16	10	26	26%
>60	10	10	20	20%
Total	58	42	100	100%

The highest incidence of soft tissue lesions was found in young adults (21–40 years), with a slight male preponderance.

Anatomical Site of Lesions: The upper limb accounted for 30% of soft tissue lesions, with the lower limb coming in second at 25%, the trunk at 20%, the head and neck at 15%, and the back at 10%.

Table 2: Distribution of Lesions According to Anatomical Site

Site	Number of Cases	Percentage (%)
Upper Limb	30	30%
Lower Limb	25	25%
Trunk	20	20%
Head & Neck	15	15%
Back	10	10%
Total	100	100%

Extremities were the most common sites involved, accounting for more than 50% of the cases.

Cytological Diagnosis: FNAC classified the lesions into benign (60%), malignant (30%), and tumor-like/inflammatory lesions (10%).

Table 3: Cytological Diagnosis Categories

Diagnosis Category	Number of Cases	Percentage (%)
Benign Tumors	60	60%
Malignant Tumors	30	30%
Tumor-like/Inflammatory	10	10%
Total	100	100%

Benign tumors were more common than malignant ones, indicating FNAC's usefulness in preliminary diagnosis and differentiation.

Distribution of Specific Lesions on FNAC: Among benign tumors, the most frequent was lipoma (40 cases, 66.7%), followed by neurofibroma (12 cases, 20%). Among malignant lesions, sarcoma (15 cases, 50%) and metastatic deposits (10 cases, 33.3%) were the most common.

Table 4: Specific Cytological Diagnoses

Diagnosis	Number of Cases	Percentage (%)
Lipoma	40	40%
Neurofibroma	12	12%
Schwannoma	8	8%
Sarcoma (unspecified)	15	15%
Metastatic deposits	10	10%
Abscess/Granuloma	10	10%
Fibrosarcoma	5	5%
Total	100	100%

Lipoma emerged as the most common benign soft tissue tumor. FNAC proved to be a useful screening tool for identifying lipomatous and neurogenic tumors.

Correlation with Histopathology: Out of 100 FNAC cases, 60 underwent surgical excision and histopathological evaluation. Histopathological diagnosis correlated with FNAC in 54 out of 60 cases (90%).

Table 5: FNAC and Histopathology Correlation (n = 60)

FNAC Diagnosis	Confirmed by Histopathology	Discrepant Cases	Concordance Rate (%)
Benign	35	3	92.1%
Malignant	16	2	88.9%
Tumor-like Lesions	3	1	75.0%
Total	54	6	90.0%

FNAC showed a high diagnostic accuracy when compared with histopathological examination, supporting its utility as a first-line investigation.

Diagnostic Accuracy of FNAC: Based on histopathological confirmation in 60 cases, the following diagnostic parameters were calculated:

- **Sensitivity:** 88.8%
- **Specificity:** 92.1%
- **(PPV):** 94.1%
- **(NPV):** 85.7%
- **Overall Diagnostic Accuracy:** 90%

Summary of Key Findings

- FNAC was particularly useful in distinguishing benign from malignant lesions.
- Lipomas were the most common benign tumors, while sarcomas were the predominant malignant lesions.
- FNAC showed a high concordance rate (90%) with histopathological diagnosis.
- FNAC was minimally invasive, cost-effective, and well tolerated by all patients.

Discussion

The findings showed that FNAC is a useful technique for the early detection and categorization of tumor-like lesions and soft tissue tumors. The male-to-female ratio was 1.38:1, with 58% of the patients being male. The age range of 21–40 years old had the most cases, indicating that soft tissue lesions are more common in younger persons.

In terms of anatomical distribution, lesions were most commonly found in the upper (30%) and lower limbs (25%), followed by the trunk (20%), head and neck (15%), and back (10%). This pattern aligns with clinical experience, where extremities are the most accessible and frequently involved sites for soft tissue masses.

Cytologically, benign tumors accounted for the majority of cases (60%), with lipomas being the most frequent (66.7% of benign tumors). Malignant tumors comprised 30% of the cases, with sarcomas and metastatic deposits being the predominant subtypes. Tumor-like/inflammatory lesions, such as abscesses and granulomas, made up the remaining 10% of cases. These findings highlight the diagnostic spectrum of FNAC and its utility in distinguishing neoplastic from non-neoplastic lesions.

Histopathological correlation was performed in 60 cases where excisional biopsy was available. A strong correlation was found between cytological and histological diagnoses, with an overall concordance rate of 90%. FNAC demonstrated a high diagnostic accuracy, with a sensitivity of 88.8%, specificity of 92.1%, (PPV) of 94.1%, and (NPV) of 85.7%. These results indicate that FNAC is highly reliable, especially in confirming benignity or malignancy.

Recent studies have consistently demonstrated that FNAC is a highly effective tool for the initial diagnosis and classification of soft tissue tumors. For instance, Padmanabhan et al. reported successful differentiation between neoplastic and non-neoplastic soft tissue lesions in 170 cases, showing strong correlation with histopathological findings [10]. Similarly, Pandit et al. documented FNAC's high specificity (100%) and diagnostic accuracy (98.6%) in distinguishing benign from malignant soft tissue lesions [11]. FNAC also shows good concordance with histopathology in diagnosing soft tissue tumors. Chaithanya and Dinesh found a 100% concordance rate in malignant tumors, with similarly high accuracy in benign tumors [12]. Boni et al. reported FNAC sensitivity of 82.6% and specificity of 100% in a series of 105 cases, confirming its reliability [13]. However, certain tumor subtypes, such as myxoid and spindle cell tumors, remain challenging to diagnose accurately via FNAC alone. Studies by Padmanabhan et al. and Joshi highlighted lower diagnostic accuracy for these lesions, suggesting the necessity of adjunctive diagnostic techniques like histochemistry for improved evaluation [10,14].

Combining FNAC with imaging modalities significantly enhances diagnostic yield. Kitagawa et al. showed that the combined use of FNAC and magnetic resonance imaging (MRI) increased diagnostic accuracy to 92.2%, outperforming either modality used independently [15]. Finally, FNAC's cost-effectiveness and safety have been reaffirmed by multiple studies, emphasizing its role as a low-cost, minimally invasive, and convenient first-line diagnostic method in outpatient settings [16]. In conclusion, FNAC remains a reliable, cost-effective diagnostic method for soft tissue tumors, especially useful in differentiating benign from malignant lesions. While diagnostic challenges persist with myxoid and spindle cell tumors, the integration of FNAC with imaging and adjunct techniques substantially improves diagnostic precision.

Conclusion

For the evaluation of soft tissue cancers and tumor-like lesions, FNAC was found to be a minimally invasive, safe, economical, and effective diagnostic method. As a frontline examination, it helps clinicians plan for future care and prevent needless procedures in benign patients because of its strong connection with histopathology.

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