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Original Research Article

Utility of Fine Needle Aspiration Cytology in the Diagnosis of Soft Tissue Tumors and Tumor-like Lesions: A One-Year Study at a Tertiary Care Center

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Abstract:

Background: Lesions involving soft tissues encompass a wide range of pathological entities, many of which share similar clinical and imaging characteristics, making early differentiation difficult. Fine needle aspiration cytology has gained importance as a simple, low-risk, and economical diagnostic approach for evaluating such lesions, particularly in tertiary healthcare environments.

Objectives: The objective of this study was to assess the diagnostic value of fine needle aspiration cytology in the evaluation of soft tissue swellings and tumor-mimicking conditions, and to document the range of cytological patterns encountered in a tertiary care setting over a defined period.

Materials and Methods: A forward-looking observational study was carried out in the Department of Pathology at Darbhanga Medical College and Hospital, Laheriasarai, over a duration of one year. A total of 102 patients presenting with clinically suspected soft tissue lesions underwent cytological evaluation using fine needle aspiration techniques. Cytological interpretations were correlated with available clinical and imaging findings. Lesions were grouped into non-neoplastic, suspicious, tumor-like, and malignant categories based on cellular morphology. Histopathological comparison was performed in cases where tissue samples were available.

Results: Adequate cytological material for interpretation was obtained in most cases. Non-neoplastic soft tissue conditions formed the largest category, followed by tumor-like lesions. Malignant lesions constituted a smaller but clinically important subset. Fine needle aspiration cytology proved useful in differentiating benign from malignant processes and in recognizing non-neoplastic conditions, thereby assisting in appropriate clinical decision-making. Strong agreement was observed between cytological and histopathological findings, particularly for clearly benign and malignant lesions.

Conclusion: Fine needle aspiration cytology serves as a dependable, rapid, and minimally invasive technique for the preliminary evaluation of soft tissue swellings and tumor-mimicking lesions. Its effectiveness in distinguishing neoplastic from non-neoplastic conditions supports its use as an initial diagnostic investigation in routine clinical practice.

Keywords: Fine Needle Aspiration Cytology, Soft Tissue Lesions, Tumor-Like Conditions, Cytopathology, Sarcoma, Tertiary Care Hospital.

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Introduction

Lesions arising within soft tissues encompass a broad spectrum of pathological entities originating from mesenchymal components of the body. These include conditions derived from connective tissue elements, muscle, vascular structures, and neural tissues. Such lesions demonstrate wide variation in cellular characteristics and biological behavior, ranging from indolent localized growths to highly aggressive malignancies with the potential for distant spread. In addition to true neoplastic processes, several non-neoplastic conditions such as inflammatory, reactive, and degenerative disorders may closely resemble tumors on clinical examination and imaging studies. For this reason, establishing an accurate diagnosis at an early stage is essential for guiding therapeutic decisions, determining prognosis, and planning appropriate patient care [1].

Establishing the nature of soft tissue lesions often presents diagnostic difficulty due to similarities in clinical appearance and radiological findings across different entities. Although tissue-based evaluation following surgical removal or biopsy remains the definitive method for diagnosis, these approaches are invasive, require more time, and may not always be suitable as an initial investigative step. Within this context, fine needle aspiration cytology has gained recognition as a practical diagnostic alternative. Its role has become increasingly important in tertiary care settings and environments with limited resources, where rapid and minimally invasive diagnostic methods are preferred [2].

Overview of Fine Needle Aspiration Cytology: Fine needle aspiration cytology is a straightforward diagnostic approach that involves the extraction of cellular material from a lesion using a narrow-gauge needle. The procedure may be performed with clinical guidance or with imaging assistance when required. Owing to its simplicity, low cost, and rapid turnaround time, this technique has been widely adopted for the evaluation of superficial lesions affecting various anatomical sites. Over time, improvements in cytological interpretation and supporting techniques have expanded its application to include the assessment of soft tissue lesions, enhancing its diagnostic utility as an adjunct to clinical and radiological evaluation [3].

The primary advantage of FNAC lies in its minimally invasive nature, low complication rate, and ability to provide a preliminary diagnosis without the need for anesthesia or hospital admission. It allows for early triaging of patients by distinguishing benign from malignant lesions and identifying non-neoplastic conditions that may not require surgical intervention. This is particularly beneficial in soft tissue tumors, where unnecessary wide excisions can be avoided in benign or reactive conditions [4].

However, the role of FNAC in soft tissue pathology has been debated due to the inherent complexity of these lesions. Soft tissue tumors often display architectural patterns and stromal characteristics that are better appreciated on histology. Despite this limitation, FNAC has demonstrated reasonable diagnostic accuracy when interpreted in conjunction with clinical findings and imaging studies [5].

FNAC in Soft Tissue Tumors and Tumor-like Lesions: Soft tissue tumors account for a relatively small proportion of all neoplasms, but their diagnostic spectrum is broad. FNAC plays a significant role in the initial evaluation of these lesions by categorizing them into benign, malignant, or suspicious groups. In many cases, FNAC can also suggest a specific line of differentiation such as adipocytic, spindle cell, round cell, or pleomorphic tumors based on cytomorphological features [6].

Tumor-like lesions of soft tissue, including ganglion cysts, inflammatory pseudotumors, nodular fasciitis, and benign fibrous proliferations, often present as palpable masses. Clinically and radiologically, these lesions may raise suspicion of malignancy, leading to patient anxiety and potentially aggressive management. FNAC helps in identifying these non-neoplastic conditions by demonstrating characteristic cytological features, thereby preventing overtreatment [7].

In malignant soft tissue tumors, FNAC serves as an effective screening tool that can prompt early referral to specialized centers for definitive diagnosis and management. While exact subtyping may not always be possible on cytology alone, FNAC can reliably identify high-grade malignancies and guide further diagnostic workup, including core biopsy, immunocytochemistry, or molecular studies where indicated [8].

Rationale and Significance of the Study: Although fine needle aspiration cytology is widely used for evaluating soft tissue lesions, its diagnostic performance is known to vary across healthcare centers. This variation is influenced by factors such as patient selection, operator experience, and access to supporting diagnostic facilities. Reports from different regions have shown inconsistent diagnostic accuracy, underscoring the importance of center-specific assessment of this technique in routine clinical practice.

Darbhanga Medical College and Hospital, Laheriasarai, functions as a major referral institution serving patients from both urban and rural regions of North Bihar. A large number of individuals present with soft tissue swellings, many of whom require prompt and economical diagnostic evaluation to guide further management. In such a clinical environment, cytology-based assessment plays a key role as an initial investigative approach.

This study was undertaken to examine the diagnostic performance of fine needle aspiration cytology in the evaluation of soft tissue swellings and lesions that mimic tumors over a one-year period, involving 102 patients. The objectives included documenting the range of lesions encountered, analyzing cytomorphological features, and assessing the practical value of cytology in day-to-day diagnostic work. By correlating cytological findings with clinical characteristics and, where available, histological outcomes, the study aims to define the strengths and constraints of fine needle aspiration cytology in soft tissue evaluation and to clarify its position within the overall diagnostic pathway.

Methodology

The present investigation was designed to assess the role of fine needle aspiration cytology in the assessment of soft tissue swellings and tumor-

mimicking lesions. The study framework emphasized structured case inclusion, uniform cytological assessment, and reliable data interpretation within the setting of routine diagnostic services.

Study Design and Patient Selection: Inclusion criteria comprised patients with palpable or radiologically detected soft tissue swellings referred for FNAC from outpatient and inpatient departments. Lesions arising from skin appendages and primary epithelial tumors were excluded. Recurrent lesions and patients who had received prior chemotherapy or radiotherapy for soft tissue tumors were also excluded to avoid cytological alterations secondary to treatment.

A detailed clinical history was recorded for each patient, including age, sex, duration of swelling, site, size, rate of growth, pain, and associated symptoms. Relevant radiological findings were noted wherever available. Informed consent was obtained from all patients prior to the procedure, and the study was conducted in accordance with institutional ethical guidelines.

FNAC Procedure and Cytological Evaluation: Fine needle aspiration cytology was performed using a 22–23 gauge needle attached to a 10 mL disposable syringe. The procedure was carried out under aseptic precautions. For superficial and palpable lesions, FNAC was performed using palpation guidance, while deep-seated lesions were aspirated under ultrasonographic guidance when required.

Multiple passes were made to ensure adequate sampling, especially in larger or heterogeneous lesions. The aspirated material was expelled onto clean glass slides. Both air-dried and alcohol-fixed smears were prepared. Air-dried smears were stained with May–Grünwald–Giemsa stain, while alcohol-fixed smears were stained with Papanicolaou and hematoxylin and eosin stains, as per standard laboratory protocols.

Smears were evaluated for adequacy, cellularity, cell arrangement, cytomorphological features, background elements, and the presence of necrosis, inflammation, or matrix material. Based on cytological findings, lesions were categorized as benign, malignant, suspicious for malignancy, or tumor-like lesions. Wherever possible, an attempt was made to suggest the probable histogenetic origin of the lesion, such as adipocytic, spindle cell, round cell, or pleomorphic type. In cases where smears were inadequate or non-diagnostic, repeat aspiration was advised. All cytological diagnoses were rendered by experienced cytopathologists, and challenging cases were reviewed collectively to minimize interobserver variability.

Data Analysis and Diagnostic Correlation: Clinical and cytological data were entered into a structured proforma and analyzed systematically. The distribution of cases was studied with respect to age, sex, anatomical site, and cytological diagnosis. The frequency of various benign, malignant, and tumor-like lesions was calculated.

Wherever histopathological follow-up was available, cytological diagnoses were correlated with histopathological findings to assess diagnostic accuracy. Sensitivity, specificity, and overall diagnostic utility of FNAC were evaluated in cases with available tissue diagnosis. Discrepant cases were analyzed in detail to identify possible causes such as sampling error, overlapping cytological features, or lesion heterogeneity.

Statistical evaluation was carried out using basic summary techniques. Observations were presented as numerical counts and proportional values. Interpretation of the findings was undertaken within the framework of everyday diagnostic practice, with particular attention to the practical role and constraints of cytology-based assessment in soft tissue pathology.

Results

During the one-year study interval, 102 individuals with suspected soft tissue–related swellings underwent cytological examination using fine needle aspiration techniques. Diagnostic material suitable for interpretation was obtained in most instances. Only a limited number of cases required repeat sampling due to insufficient cellular yield or blood-contaminated smears.

Demographic and Clinical Profile: Participants represented a wide age range, extending from early adulthood to older age groups, with the highest concentration observed among middle-aged individuals. A slight predominance of male patients was noted. The majority of cases presented as slowly enlarging, non-tender swellings. The reported duration of symptoms varied considerably, ranging from short-term complaints to lesions present for several years. Regarding anatomical distribution, lesions most frequently involved the extremities, followed by the trunk and cervical region. A summary of case distribution based on age, sex, and lesion location is provided in Figure 1.

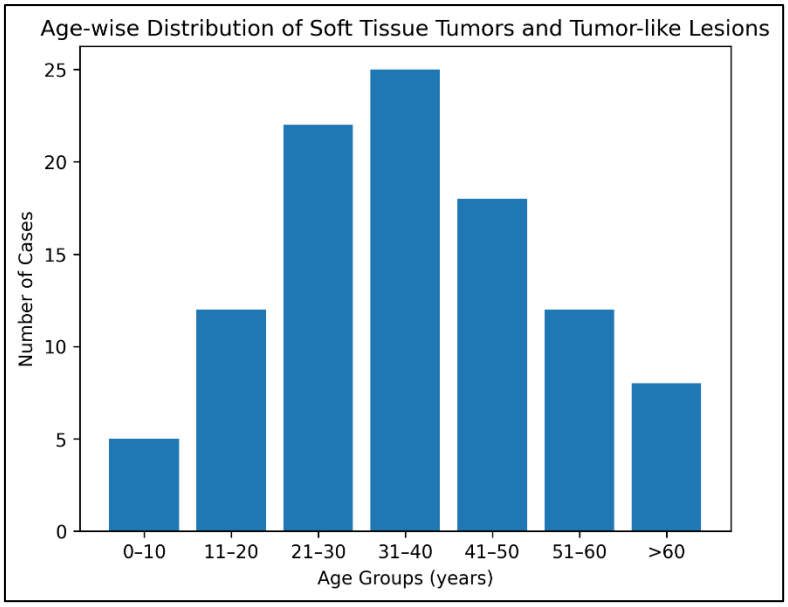

Figure 1: Distribution of cases according to age among individuals evaluated for soft tissue–related swellings (n = 102)

Based on cytological assessment, lesions were grouped into non-neoplastic, malignant, indeterminate, and tumor-mimicking categories. Lesions without malignant features represented the largest proportion of cases, followed by conditions that clinically resembled tumors. Malignant lesions accounted for a smaller yet clinically relevant fraction. The overall pattern demonstrates the usefulness of cytology as an initial diagnostic approach in evaluating soft tissue swellings and in distinguishing non-neoplastic processes that resemble true tumors.

Cytological Spectrum of Soft Tissue Lesions: Within the non-malignant category, lesions composed of adipose tissue were most frequently encountered. Smears from these cases typically demonstrated cohesive groups of mature fat cells with consistent nuclear features and abundant cytoplasmic clearing. Benign spindle cell lesions formed another prominent subgroup, characterized by elongated cells arranged in loose groupings with minimal nuclear irregularity and no evidence of tissue necrosis or heightened proliferative activity.

Conditions simulating tumors included inflammatory and reactive processes, fibrous proliferations, and cystic lesions. Cytological preparations from these cases showed variable cellular content, admixtures of inflammatory cells, stromal fragments, and background material consistent with reactive or degenerative change. Cytological examination was particularly valuable in recognizing these entities and in avoiding misclassification as neoplastic lesions.

Lesions with malignant features demonstrated marked cellularity and pronounced nuclear abnormalities. Smears showed pleomorphic cell populations with irregular nuclear contours, coarse chromatin patterns, and frequent mitotic figures. Some malignant lesions displayed dispersed populations of relatively uniform round cells with limited cytoplasm, whereas others exhibited highly atypical, multinucleated cells with necrotic background material. The proportional representation of benign, malignant, and tumor-mimicking lesions identified on cytology is illustrated in Figure 2.

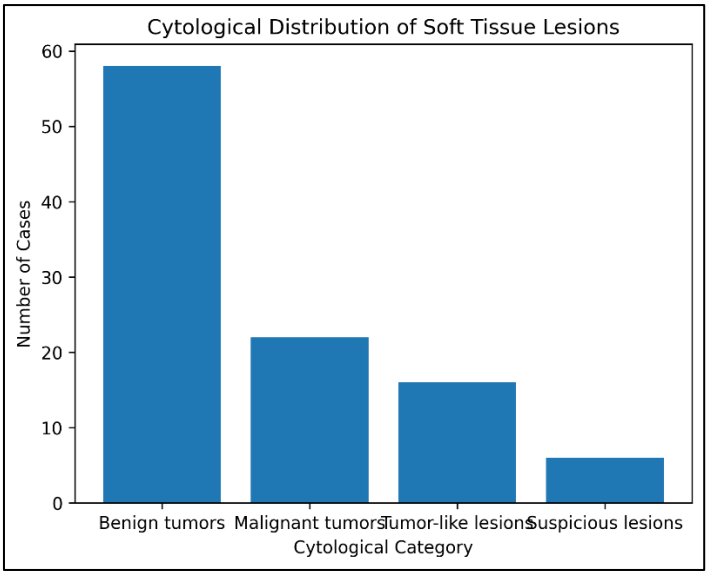

Figure 2: Cytological distribution of soft tissue tumors and tumor-like lesions (n = 102)

A small number of cases were categorized as suspicious for malignancy due to overlapping cytological features or inadequate sampling. These cases were advised for further histopathological evaluation.

Diagnostic Yield and Histopathological Correlation: FNAC provided a definitive cytological diagnosis in the majority of cases. Repeat aspiration improved diagnostic yield in initially inadequate cases. Histopathological follow-up was available in a subset of patients who underwent surgical excision or biopsy.

A strong agreement was noted between cytological findings and tissue-based diagnoses, particularly in cases involving benign adipose lesions and definitively malignant tumors. Cytological assessment proved useful in distinguishing non-malignant from malignant processes, which is essential for appropriate clinical decision-making. Instances of diagnostic mismatch were largely attributable to factors such as inadequate sample material, variability within the lesion itself, or lesions located in anatomically challenging areas. Overall, the findings support the value of cytology as a practical and dependable diagnostic approach for soft tissue swellings and tumor-mimicking conditions. Its contribution to early identification, prioritization of patient care, and direction of subsequent management strategies was clearly evident in this study.

Discussion

In the present study, FNAC provided diagnostically adequate material in the majority of cases. This high adequacy rate highlights the practicality of FNAC when performed with proper technique and interpreted in conjunction with clinical and radiological findings. Similar adequacy rates have been reported in earlier studies, emphasizing that FNAC can be reliably applied to soft tissue lesions, particularly superficial and palpable masses [9].

The demographic profile observed in this study showed a higher incidence of soft tissue lesions in the third to fifth decades of life, which is consistent with previously published data. Several studies have documented that benign soft tissue tumors and tumor-like lesions are more commonly encountered in this age group, whereas malignant tumors tend to occur at relatively higher ages [10]. The slight male predominance noted in the present study has also been reported by other authors and may reflect occupational exposure, health-seeking behavior, or referral bias rather than true biological variation.

Benign soft tissue tumors constituted the largest diagnostic category in this study. Adipocytic tumors were the most frequently encountered lesions, followed by spindle cell tumors. This finding is in agreement with the established literature, which identifies lipomatous tumors as the most common soft tissue neoplasms encountered in routine practice [11]. The cytological features of benign adipocytic tumors are usually distinctive, allowing confident diagnosis in most cases. This contributes significantly to the high diagnostic accuracy of FNAC for benign lesions.

Tumor-like lesions formed a substantial proportion of cases in the present study. These lesions often present as clinically suspicious masses and may be radiologically indistinguishable from true neoplasms. FNAC proved particularly useful in identifying these non-neoplastic conditions by demonstrating inflammatory, reactive, or degenerative cytological patterns. Early recognition of tumor-like lesions is clinically important, as it helps avoid unnecessary surgical procedures and reduces patient anxiety. Similar observations have

been made in previous studies that emphasize the value of FNAC in differentiating reactive and inflammatory lesions from neoplastic processes [12].

Malignant soft tissue tumors accounted for a smaller but clinically significant proportion of cases. FNAC was effective in identifying malignancy based on features such as high cellularity, marked nuclear atypia, pleomorphism, necrosis, and mitotic activity. Although exact histological subtyping was not always possible, FNAC reliably categorized lesions as malignant, thereby facilitating early referral and further diagnostic evaluation. This finding aligns with earlier reports that support the role of FNAC as a screening and triaging tool in suspected soft tissue sarcomas [13].

The diagnostic accuracy of FNAC was higher for distinguishing benign from malignant lesions than for specific tumor typing. This limitation is well recognized and is largely attributable to the absence of architectural details and the inherent heterogeneity of soft tissue tumors. Certain entities, particularly spindle cell and pleomorphic tumors, pose diagnostic challenges due to overlapping cytomorphological features. Previous studies have similarly noted that while FNAC is highly effective for broad categorization, histopathological examination remains essential for definitive classification and grading [14].

Histopathological correlation, where available, demonstrated a high level of concordance with cytological findings in the present study. Discrepant cases were mainly due to sampling error, deep-seated location, or mixed tumor components. Sampling error is a known limitation of FNAC, especially in large or heterogeneous lesions where representative areas may not be adequately sampled. The use of imaging guidance and multiple passes can reduce this limitation, as suggested by earlier studies [15].

Another important consideration is the role of ancillary techniques. Although immunocytochemistry and molecular studies were not routinely employed in the present study, their integration with FNAC has been shown to significantly enhance diagnostic accuracy in soft tissue pathology. Several authors have highlighted that FNAC, when combined with clinical data, imaging findings, and ancillary techniques, can approach the diagnostic reliability of core needle biopsy in selected cases [16].

Despite its limitations, FNAC offers several advantages that are particularly relevant in resource-limited settings. It is cost-effective, minimally invasive, and can be performed on an outpatient basis with minimal discomfort to the patient. In high-volume tertiary care centers, FNAC helps in rapid patient triaging and prioritization for further management. The findings of the present study reinforce the view that FNAC is an indispensable first-line investigation in the evaluation of soft tissue tumors and tumor-like lesions [17].

The present study has certain limitations. Histopathological follow-up was not available in all cases, which restricted comprehensive assessment of diagnostic accuracy. Exact subtyping of malignant tumors was limited in some cases due to overlapping cytological features and lack of ancillary studies. Additionally, the study was conducted at a single center over a limited duration, which may influence the generalizability of the results. Despite these limitations, the study provides valuable insight into the practical utility of FNAC in routine diagnostic settings.

Overall, the findings reinforce the usefulness of cytology-based assessment as an initial investigative approach for soft tissue swellings and conditions that mimic tumors. While definitive diagnosis often requires tissue confirmation and correlation with clinical and imaging findings, cytological evaluation provides valuable early guidance in patient management.

Conclusion

Cytological assessment using fine needle techniques represents an effective, low-risk, and economical approach for the preliminary assessment of soft tissue lesions. The present study demonstrates that this method yields diagnostically adequate material in most cases and plays an important role in distinguishing benign conditions from malignant processes, as well as in recognizing non-neoplastic entities that may resemble tumors on clinical examination. The ability to rapidly stratify lesions based on cytological features supports timely clinical decision-making, appropriate referral, and prioritization of further diagnostic or therapeutic interventions. The technique was particularly informative in cases involving adipose-derived lesions and well-defined spindle cell proliferations, where characteristic cellular features allowed confident interpretation. Although precise subtyping of malignant lesions may be challenging due to overlapping cytological appearances and limited architectural detail, cytology remains effective in identifying malignancy at an early stage. In tertiary care settings, especially where access to advanced diagnostic resources may be limited, cytological evaluation serves as a practical screening tool that aids in reducing unnecessary surgical procedures, shortening diagnostic delays, and optimizing use of healthcare resources. Limitations related to sampling adequacy, lesion heterogeneity, and lack of ancillary studies highlight the importance of integrating cytological findings with clinical assessment and imaging data, and of pursuing

histological confirmation when indicated. In summary, cytology-based evaluation continues to hold a central position as an initial diagnostic step in the assessment of soft tissue lesions, contributing meaningfully to patient care through early risk stratification and informed clinical management.

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