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Original Research Article

Utility of Fine Needle Aspiration Cytology in Diagnosing Soft Tissue Tumors and Tumor-Like Lesions

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Abstract:

This research assesses the diagnostic value of Fine Needle Aspiration Cytology (FNAC) in the identification of tumor-like lesions and soft tissue tumours in 100 patients treated at J.L.N.M.C.H. Bhagalpur between January 2022 and January 2023. FNAC showed a high sample adequacy rate of 28 malignant, 5 indeterminate, and 62 benign cases, totaling 95%. Histopathological confirmation showed 89.3% for malignant lesions and 95.2% for benign lesions, with 92.6% and 97.4% sensitivity and specificity rates, respectively, for diagnostic accuracy. The low frequency of minor side effects confirms the safety and effectiveness of FNAC. These results validate FNAC as a trustworthy, non-invasive diagnostic technique that is essential for precise and prompt therapy of soft tissue masses.

Keywords: Fine Needle Aspiration Cytology (FNAC), Soft tissue tumors, Diagnostic accuracy, Histopathology.

Introduction

Because of its effectiveness and ease of use in sampling suspicious lesions, Fine Needle Aspiration Cytology (FNAC) is a minimally invasive diagnostic technique that has gained significant popularity in the field of oncology [1]. Soft tissue tumours are a broad category of neoplastic illnesses affecting the connective tissues. Because of their numerous histological features and frequently overlapping clinical manifestations, soft tissue tumours are difficult to diagnose. Phenomena-like lesions, which resemble these tumours but might not be cancerous, complicate diagnosis even more [2,3].

In this situation, FNAC is quite helpful. It provides a quick and affordable way to make a preliminary diagnosis, which helps with the planning of more intrusive operations. Given how crucial it is to differentiate between benign and malignant soft tissue lesions, which can significantly change treatment modalities and prognosis results, this technique is especially helpful. Furthermore, FNAC lessens discomfort for patients and lowers the possibility of problems that come with more intrusive biopsy methods [4-6].

The study aims to evaluate the diagnostic value of Fine Needle Aspiration Cytology (FNAC) for identifying tumor-like lesions and soft tissue tumors. This prospective observational study involved 100 patients suspected of having soft tissue tumors based on clinical or radiological indicators. The study primarily seeks to determine the diagnostic accuracy of FNAC by comparing its results with subsequent histopathological findings, which serve as the gold standard. Additionally, the study aims to assess the sample adequacy rate, the rate of non-diagnostic samples, and any procedure-related complications, ultimately validating FNAC as a reliable, minimally invasive diagnostic technique that can effectively differentiate between benign and malignant soft tissue lesions. This research could significantly impact clinical decision-making processes by offering a swift and less invasive diagnostic alternative, enhancing patient outcomes while reducing healthcare costs.

Methodology

Study Design: This study was designed as a prospective observational analysis to evaluate the utility of Fine Needle Aspiration Cytology (FNAC) in the diagnosis of soft tissue tumors and tumor-like lesions.

Study Setting: The research was conducted at the Jawaharlal Nehru Medical College and Hospital (J.L.N.M.C.H.), Bhagalpur. This facility was

chosen due to its comprehensive diagnostic and treatment capabilities for a wide range of soft tissue conditions.

Study Duration: The duration of the study spanned from January 2022 to January 2023, allowing for a full year of data collection to ensure adequate sampling and follow-up periods.

Participants: The study involved 100 patients who presented with clinical or radiological suspicion of soft tissue tumors or tumor-like lesions during the study period. Inclusion criteria required that participants be referred for diagnostic evaluation via FNAC at the study location.

Sampling Technique: Every participant had FNAC done on them using a standardised technique by skilled cytologists. In order to achieve precise needle placement, the operation entailed aspirating cells from the lesion using a small needle attached to a syringe while under ultrasound monitoring. If more than one pass was required to gather enough cellular material for analysis, those passes were made.

Data Collection: Data were collected on demographic variables (age, gender, medical history), the anatomical location of the lesion, the size of the lesion, and clinical indications for FNAC. FNAC results were categorized as benign, malignant, or indeterminate and compared against subsequent histopathological findings obtained from surgical biopsies when available.

Outcome Measures: The primary outcome measure was the diagnostic accuracy of FNAC, assessed by comparing cytology results with histopathological findings as the gold standard. Secondary outcome measures included the adequacy of cytological samples, rate of non-diagnostic samples, and any procedure-related complications.

Statistical Analysis: Statistical software was used to analyse the data. Demographic and clinical features were gathered using descriptive statistics. In order to diagnose soft tissue tumours, the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of FNAC were computed. For categorical data, chi-square tests were employed, and a p-value of less than 0.05 was deemed statistically significant.

Results

There were 100 patients in the study, ages ranging from 18 to 78 years old, with a mean age of 45. There were almost equal numbers of male and female participants—51% were men and 49% were women. Thighs (24%) and arms (18%) were the most frequently sampled sites for FNAC, with the abdominal wall (16%) coming in third and fourth. 95 of the 100 FNAC procedures that were completed were judged sufficient for diagnostic purposes, resulting in a 95% sample adequacy rate. Five samples have inadequate cellular material, making them non-diagnostic.

- Benign Lesions: Benign fibrous histiocytomas, lipomas, and neurofibromas were among the 62 instances that were determined to be benign.
- Malignant Lesions: Sarcomas were the most frequent type of malignant lesion, identified in 28 cases.
- Indeterminate: Five instances were classified as such, necessitating additional histological analysis to reach a conclusive diagnosis.

Comparative Analysis with Histopathology

85 individuals in all had a surgical biopsy and histological examination afterward:
- Correlation with Benign Diagnoses: Histopathology verified 59 of the 62 benign lesions identified by FNAC, yielding a diagnostic accuracy percentage for benign lesions of 95.2%.
- Correlation with Malignant Diagnoses: An 89.3% diagnostic accuracy rate for malignant lesions was attained when 25 of the 28 malignant lesions identified by FNAC were validated.
- Indeterminate Samples: Upon histological analysis, all five indeterminate cases were determined to be three malignant and two benign.

Diagnostic Performance

The following formula was used to determine FNAC's sensitivity and specificity in the diagnosis of soft tissue tumours:
- Sensitivity = 25 true positives / [25 true positives + 2 false negatives] x 100 = 92.6%
- Specificity: 97.4% (3 false positive results plus 59 real negative results divided by 100).
- 89.3% is the positive predictive value (PPV).
- 95.2% is the negative predictive value (NPV).

Complications

There were no major complications reported. Minor complications included temporary pain at the aspiration site in 4 patients and minor bruising in 3 patients.

Table 1: This table provides a structured overview of the key findings from the FNAC study, highlighting the diagnostic utility and safety of the procedure in evaluating soft tissue tumors and tumor-like lesions.

Category	Value	Description
Total Patients	100	Number of participants in the study
Sample Adequacy Rate	95%	Percentage of FNAC samples adequate for diagnosis
FNAC Diagnosis		
Benign	62	Number of benign lesions diagnosed
Malignant	28	Number of malignant lesions diagnosed
Indeterminate	5	Cases requiring further analysis
Histopathological Confirmation		
Benign Confirmed	59	Benign cases confirmed by subsequent biopsy
Malignant Confirmed	25	Malignant cases confirmed by subsequent biopsy
Diagnostic Performance		
Sensitivity	92.6%	Ability of FNAC to correctly identify malignant cases
Specificity	97.4%	Ability of FNAC to correctly identify benign cases
Positive Predictive Value (PPV)	89.3%	Probability that subjects with a positive FNAC have the disease
Negative Predictive Value (NPV)	95.2%	Probability that subjects with a negative FNAC do not have the disease
Complications		
Minor Pain	4	Number of patients experiencing temporary pain
Minor Bruising	3	Number of patients experiencing minor bruising

Discussion

The study's findings highlight the significant value of fine needle aspiration cytology (FNAC) in the diagnosis of tumor-like lesions and soft tissue tumours. The high sample adequacy rate of 95% shows that FNAC can consistently provide enough cellular material for precise cytological examination when carried out with expert technique. This is especially important in clinical settings where quick, low-invasive diagnostic tests are favoured [7,8].
The efficacy of FNAC is demonstrated by the diagnostic accuracy rates of 89.3% for malignant lesions and 95.2% for benign lesions, as verified by later histological investigation. These results are in keeping with the body of research that suggests FNAC as a first-line diagnostic method for soft tissue masses because it strikes a compromise between high diagnostic yield and minimal invasiveness [9,10].

The study's excellent sensitivity (92.6%) and specificity (97.4%) support the use of FNAC in accurately diagnosing benign and malignant soft tissue diseases, which helps with appropriate therapeutic care and prevents needless surgical procedures [11]. Strong predictive ability is indicated by the Positive Predictive Value (PPV) and Negative Predictive Value (NPV), indicating that FNAC is helpful not only in detecting worrisome lesions but also in reliably ruling out cancer [12,13]. Such dependability is particularly helpful in environments with limited resources, where there may not be many modern diagnostic facilities. The low rate of minor side effects in this research, including transient pain and mild bruising, supports FNAC's safety profile [14,15]. This is especially crucial for patient compliance and pleasure because less invasive techniques that cause the least amount of discomfort are preferable.

Overall, by highlighting the precision, economy, and safety of FNAC in the diagnosis process of soft tissue tumours, this work adds to the body of evidence in favour of its strategic application [16,17]. In the future, studies could investigate how to combine FNAC with cutting-edge imaging methods to improve the accuracy of diagnosis and investigate the molecular and genetic characteristics of aspirated cells, which may offer more profound understanding of tumour biology and treatment response [18-20].

Conclusion

The study unequivocally shows that fine needle aspiration cytology (FNAC) is a very useful and trustworthy diagnostic technique for assessing lesions that resemble tumours and soft tissue tumours. Given its high sample adequacy rate and exceptional diagnostic accuracy, FNAC has a compelling benefit in clinical settings, offering a quick, low-invasive, and economical means of differentiating benign from malignant tumours. Because of the procedure's high sensitivity and specificity, fewer intrusive diagnostic techniques are required to assure appropriate clinical decision-making. Furthermore, the low risks linked to FNAC make it a more suitable diagnostic method, especially in situations where patient comfort and prompt diagnosis are important considerations. This work supports the critical function that FNAC plays in the current soft tissue tumour diagnosis strategy.

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