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UTILITY OF FINE NEEDLE ASPIRATION CYTOLOGY (FNAC) FOR DIAGNOSIS OF TUBERCULOSIS IN PEDIATRIC AGE GROUP: A CROSS-SECTIONAL STUDY

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Abstract

Background: Tuberculosis (TB) remains a significant public health issue, particularly in developing countries like Pakistan, where pediatric TB often presents with diagnostic challenges. Fine Needle Aspiration Cytology (FNAC) offers a minimally invasive method for diagnosing TB in children, especially in cases with lymphadenopathy. This study aims to evaluate the efficacy of FNAC in diagnosing pediatric TB.

Material & Methods: This cross-sectional study was conducted in the Department of Pathology, Bahawal Victoria Hospital, Bahawalpur from January 2022 to December 2023. The study included 150 pediatric patients aged 1-16 years who presented with lymphadenopathy and were suspected of TB. FNAC was performed on all patients, and cytological findings were analyzed for evidence of TB. Data were collected on patient demographics, clinical presentation, and FNAC results. Descriptive statistics were used to summarize the data, and the sensitivity and specificity of FNAC for diagnosing TB were calculated.

Results: The study included 150 children with a mean age of 9.3 ± 4.1 years. The most common cytological findings were granulomas with caseous necrosis in 92 (61.4%) cases, with a sensitivity of 85% and specificity of 92%. Cervical lymph nodes were the most commonly affected sites, accounting for 65% of cases. FNAC was particularly effective in diagnosing TB in cases with significant lymphadenopathy and constitutional symptoms such as fever and weight loss.

Conclusion: FNAC is a reliable and effective tool for diagnosing TB in the pediatric age group, offering high sensitivity and specificity. Its minimally invasive nature makes it particularly suitable for children, providing a valuable diagnostic alternative in resource-limited settings. The study supports the use of FNAC as a frontline diagnostic tool for pediatric TB in clinical practice.

Keywords: FNAC, Tuberculosis

Introduction

Tuberculosis (TB) remains a significant global health concern, particularly in low- and middle-income countries where the disease burden is high. According to the World Health Organization, millions of new TB cases are reported annually, with a substantial proportion occurring in the pediatric population [1]. Children are especially vulnerable to TB due to their underdeveloped immune systems, which often leads to atypical clinical manifestations and increased difficulty in diagnosis. In countries like Pakistan, where TB remains endemic, the timely and accurate diagnosis of TB in children is a major public health challenge.

Pediatric TB commonly present in extrapulmonary forms, with lymphadenopathy being one of the most frequent clinical features [2]. Diagnosing TB in children is particularly complex because they often exhibit nonspecific symptoms such as low-grade fever, weight loss, and night sweats, which may mimic other common childhood illnesses [3]. Furthermore, standard diagnostic methods such as sputum smear microscopy and culture are less effective in children, as they often fail to produce sputum and tend to have paucibacillary disease [2,4].

Fine Needle Aspiration Cytology (FNAC) has emerged as a useful diagnostic modality for evaluating lymphadenopathy in suspected TB cases. It is minimally invasive, cost-effective, and can yield rapid results. FNAC involves aspirating material from affected lymph nodes and examining the smears cytologically for evidence of granulomatous inflammation and caseous necrosis [3,4]. Compared to more invasive procedures like excisional biopsy, FNAC offers the advantage of being well tolerated in children and can often be performed in outpatient settings.

Several studies have demonstrated the diagnostic utility of FNAC in TB lymphadenitis, highlighting its high sensitivity and specificity in both adult and pediatric populations [4,5]. Given its diagnostic accuracy and practicality, FNAC is especially valuable in resource-limited settings where access to advanced diagnostic tools is restricted. This study was designed to evaluate the efficacy of FNAC in diagnosing TB in the pediatric age group, focusing on its role in identifying cytological features consistent with TB and its potential as a frontline diagnostic tool in clinical practice.

Material & Methods

This cross-sectional study was conducted at the Department of Pathology, Bahawal Victoria Hospital, Bahawalpur, a tertiary care hospital serving the pediatric population of South Punjab, Pakistan. The study period was from January 2022 to December 2023.

The study included 150 pediatric patients aged 1-16 years who presented with lymphadenopathy and were suspected of having TB. Patients were selected using consecutive sampling based on their clinical presentation and a high index of suspicion for TB. Inclusion criteria were children with palpable lymphadenopathy, a history of contact with TB, and/or constitutional symptoms such as fever, night sweats, and weight loss. Exclusion criteria included patients with a known diagnosis of TB already on anti-TB treatment and those with lymphadenopathy due to other confirmed causes such as malignancies.

FNAC was performed on all patients using a 22-gauge needle attached to a 05 ml syringe. Aspirates were obtained from the most prominent lymph nodes and smeared onto glass slides. The smears were stained using Diff Quik (DQ) stains. Cytological findings were categorized into granulomatous inflammation with or without caseous necrosis and other nonspecific findings.

Data were collected on patient demographics, clinical symptoms, FNAC findings, and additional laboratory results where available. The data were entered into a structured proforma for analysis.

Descriptive statistics were used to summarize patient demographics, clinical presentation, and FNAC findings. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of FNAC in diagnosing TB were calculated using standard formulas. The data analysis was conducted using SPSS version 21.0.

Results

The study included 150 children with a mean age of 9.3 ± 4.1 years. There were 85 (56.7%) males and 65 (43.3%) females, with the majority of cases (62%) occurring in children aged 5-12 years. Table 1 summarizes the demographic characteristics of patients.

Table 1: Demographic Characteristics of Patients (n=150)

Characteristic	Number (%)
Age (years)	
1-4	30 (20%)
5-8	55 (36.7%)
9-12	38 (25.3%)
13-16	27 (18%)
Gender	
Male	85 (56.7%)
Female	65 (43.3%)

The most common cytological finding was granulomatous inflammation with caseous necrosis, observed in 61.4% cases. The cervical lymph nodes were the most frequently involved site, accounting for 65% of cases, followed by axillary (20%) and inguinal (15%) lymph nodes. The distribution of FNAC findings is detailed in Table 2 and Figure 1.

Table 2: FNAC Findings in Pediatric TB (n=150)

Cytological Finding	Number (%)
Granulomas with Caseous Necrosis	92 (61.4%)
Granulomas without Caseous Necrosis	25 (16.6%)
Nonspecific Inflammation	19 (12.6%)
Reactive Lymphoid Hyperplasia	14 (9.3%)

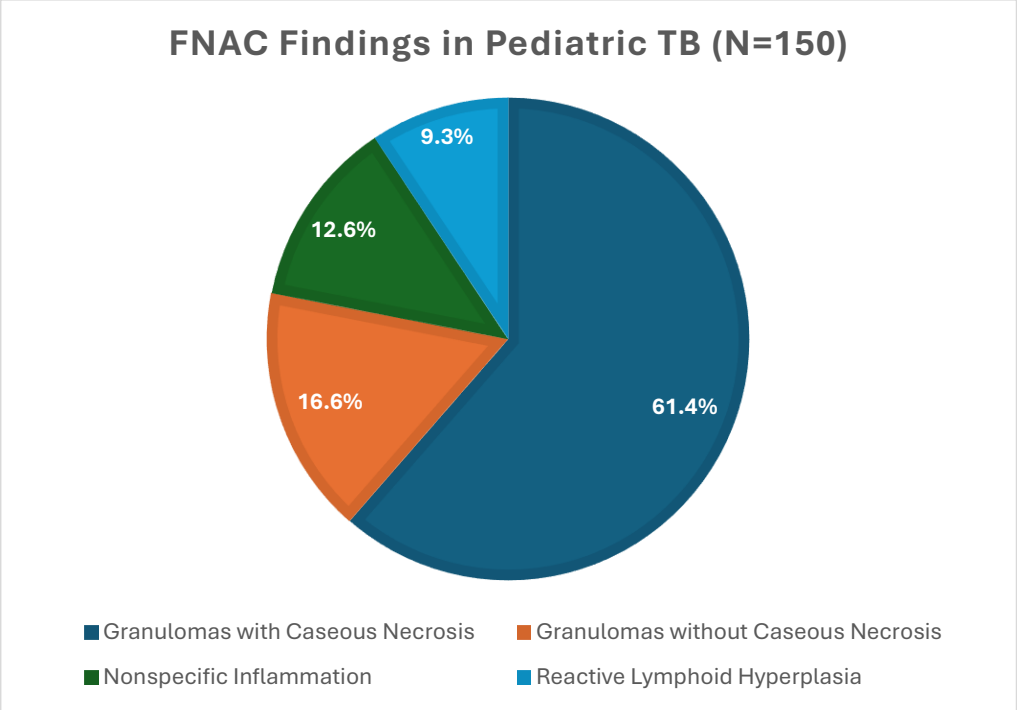

Figure 1: FNAC Findings in Pediatric TB

The sensitivity of FNAC for diagnosing TB in this study was calculated at 85%, with a specificity of 92%. The positive predictive value (PPV) was 94%, and the negative predictive value (NPV) was 80%. FNAC showed high diagnostic accuracy, particularly in cases with significant lymphadenopathy and clinical symptoms consistent with TB.

Discussion

This study highlights the utility of FNAC as a reliable diagnostic tool for TB in the pediatric age group. The high sensitivity and specificity observed in this study are consistent with previous research, underscoring FNAC's value in resource-limited settings where more invasive or expensive diagnostic procedures may not be feasible [6-8]. The predominance of granulomatous inflammation with caseous necrosis in our findings aligns with the typical cytological features of TB and supports the use of FNAC in routine clinical practice for pediatric TB diagnosis [9,10].

The majority of TB cases in this study involved cervical lymphadenopathy, which is consistent with the known distribution of TB lymphadenitis in children [11,12]. The high prevalence of TB in the cervical region may reflect the common sites of primary infection and subsequent spread via lymphatic channels [13].

FNAC's minimally invasive nature makes it particularly suitable for children, who may not tolerate more invasive procedures well. This study supports the role of FNAC as a frontline diagnostic tool, providing rapid and accurate results that can guide timely initiation of anti-TB therapy [14-16].

Conclusion

The findings of this study underscore the value of Fine Needle Aspiration Cytology (FNAC) as an effective diagnostic tool for tuberculosis in the pediatric population. With high sensitivity and specificity demonstrated in this cohort, FNAC offers a reliable, minimally invasive method for diagnosing TB in children presenting with lymphadenopathy. The ability of FNAC to detect characteristic cytological features such as granulomatous inflammation and caseous necrosis enhances its diagnostic utility, especially in resource-limited settings where access to advanced molecular or histopathological diagnostics may be restricted.

The study also highlights that cervical lymph nodes are the most frequently involved sites, supporting the utility of FNAC in evaluating accessible superficial lymphadenopathy. Its quick turnaround time and outpatient applicability make it particularly suitable for pediatric cases, where more invasive procedures may not be feasible or well tolerated. The diagnostic accuracy shown in this study reinforces the role of FNAC in early identification of TB, which is critical for timely initiation of anti-tuberculous therapy and improved clinical outcomes.

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