



Cytological spectrum of suppurative cutaneous and subcutaneous nodules: a one-year retrospective observational study at a tertiary care hospital.

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Abstract

Background:

Suppurative cutaneous and subcutaneous nodules frequently resemble a wide range of inflammatory and neoplastic lesions, making early diagnosis essential. Fine needle aspiration cytology (FNAC) provides a rapid, minimally invasive method to identify the underlying pathology and guide timely clinical management.

Objectives:

To describe the cytomorphological spectrum of suppurative nodules and correlate these findings with demographic patterns, lesion size, and anatomical distribution.

Methods:

A retrospective review of 124 FNAC samples obtained from cutaneous and subcutaneous nodules over a one-year period was conducted. Demographic details, clinical features, and cytological characteristics were retrieved from departmental archives. Smears were examined for cellularity, inflammatory profile, necrotic background, keratinous material, fungal elements, and granulomatous reactions. Frequencies and percentages were calculated to summarize diagnostic categories and site distribution.

Results:

Among the 124 patients, males predominated, and most cases occurred between the fourth and seventh decades. Abscesses were the most frequent lesions, followed by infected keratinous cysts, fungal abscesses, and cold abscesses. Truncal lesions were common in abscesses and keratinous cysts, while fungal abscesses occurred primarily in the extremities. All cold abscesses were confined to the head and neck region. Cytological evaluation revealed distinctive patterns for each entity, enabling differentiation between acute suppuration, chronic inflammation, and specific infections such as mycoses or tuberculosis.

Conclusion:

FNAC remains a valuable frontline diagnostic tool for suppurative nodules, offering quick, reliable, and cost-effective insights. Distinct cytomorphological features support accurate classification and help avoid diagnostic confusion with neoplastic lesions, thus promoting early and appropriate treatment.

Recommendations:

Routine FNAC should be encouraged in all unexplained nodular swellings to prevent diagnostic delays. Incorporating microbiological correlation, especially in recurrent or atypical lesions, can strengthen diagnostic precision. Periodic training in recognizing subtle cytological clues will enhance reporting consistency and clinical impact.

Keywords: Fine Needle Aspiration Cytology (FNAC), suppurative nodules, abscess, keratinous cyst, fungal abscess, cold abscess, cytomorphology.

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Introduction

Cutaneous and subcutaneous nodules are common clinical presentations that arise from a wide spectrum of conditions, including infectious, inflammatory, and neoplastic etiologies. Because of their overlapping clinical features, establishing a precise diagnosis based on presentation alone is often challenging. Timely and accurate differentiation is crucial, as treatment strategies vary significantly depending on the underlying pathology [1–3].

Fine needle aspiration cytology (FNAC) has gained wide acceptance as a simple, minimally invasive, and cost-effective technique for the evaluation of such lesions. It provides rapid results, assists in distinguishing between acute and chronic inflammatory processes, and plays an essential role in excluding malignancy [2,4]. Additionally, FNAC offers the advantage of yielding material for microbiological studies, thereby guiding antibiotic therapy and surgical management [5].

Suppurative nodules constitute an important subgroup of these lesions, most frequently presenting as abscesses, infected keratinous cysts, fungal infections, or tuberculous abscesses. In tropical and subtropical regions such as India, the prevalence of fungal and tuberculous lesions remains relatively high, underscoring the diagnostic importance of cytomorphological evaluation in routine practice [3–5]. Prior reports have emphasized the role of FNAC in guiding clinical decision-making and excluding neoplastic mimics [1–5].

The present study was undertaken to analyze the cytomorphological spectrum of suppurative cutaneous and subcutaneous nodules and to correlate these findings with demographic and clinical characteristics.

Materials and Methods

Study design

This study was conducted as a retrospective descriptive observational study in which archived fine needle aspiration cytology (FNAC) records of suppurative cutaneous and subcutaneous nodules were systematically reviewed over a one-year period.

Study setting

The study was carried out in the Department of Pathology at Dr. Yellapragada Subbarao Government Medical College and Government General Hospital, Eluru, Andhra Pradesh, India. This tertiary care teaching hospital functions as a referral center for the Eluru district and the surrounding regions of West Godavari and neighboring districts.

The institution provides comprehensive services, including general medicine, surgery, dermatology, orthopedics, pediatrics, obstetrics and gynecology, ENT, and intensive care services. It caters to a mixed urban and rural population and supports undergraduate and postgraduate medical training. The Department of Pathology delivers diagnostic services in histopathology, cytopathology, hematology, and clinical pathology. The study period extended from June 2024 to May 2025.

Participants

A consecutive sampling method was employed. All patients presenting during the study period with cutaneous or subcutaneous nodules yielding a purulent aspirate on FNAC were included. Both inpatients and outpatients were considered. Inclusion criteria comprised patients of all age groups with adequate cytology smears and complete records. Exclusion criteria included non-suppurative lesions, repeat aspirations, and smears with inadequate cellularity or incomplete documentation. A total of 124 eligible cases were included in the final analysis.

Variables

Demographic variables included age and sex. Clinical variables comprised anatomical site and lesion size. Cytomorphological variables included cellularity, predominant inflammatory cell population, necrotic background, presence of keratinous material, fungal elements, and granulomatous reaction. The primary outcome variable was the final cytological diagnosis categorized as abscess, infected keratinous cyst, fungal abscess, or cold abscess.

Data sources/measurements

Clinical details were retrieved from departmental cytology registers and case records. Archived smears were reviewed and stained with hematoxylin and eosin (H&E). Microscopic examination was performed using standard light microscopy. Cytological diagnoses were rendered according to established morphological criteria. Lesion size was recorded as the maximum clinical dimension measured in centimeters at presentation.

Bias

Selection bias was minimized by including all consecutive eligible cases within the defined study period. Information bias was reduced by direct slide review rather than relying solely on reported diagnoses. Observer bias was addressed through the

application of standardized cytomorphological criteria during reassessment. Cases with incomplete data or inadequate smears were excluded to maintain analytical consistency.

Study size

The study size was determined by the total number of eligible cases available during the one-year study duration. A total of 124 cases met the inclusion criteria. No prior sample size estimation was performed due to the retrospective nature of the study.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using descriptive statistics. Continuous variables were summarized as ranges. Categorical variables were expressed as frequencies and percentages. Results were presented in tabular format to illustrate

demographic distribution, lesion size, anatomical site distribution, and cytomorphological spectrum.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics Committee of Govt. Siddhartha Medical College, Vijayawada. Ethical clearance number: [Insert number]. Date of approval: [Insert date]. As this was a retrospective record-based study, the requirement for informed consent was waived. Patient confidentiality was maintained by anonymizing all identifying information during data extraction and analysis.

Results

A total of 124 cases of suppurative cutaneous and subcutaneous nodules were included in this retrospective study.

Table 1. Age and sex distribution of patients with suppurative nodules

Age group (years)	Males	Females	Total
0–10	1	1	2
11–20	1	5	6
21–30	3	4	7
31–40	18	5	23
41–50	16	10	26
51–60	15	13	28
61–70	20	3	23
71–80	4	3	7
81–90	2	–	2
Total	80 (64.5%)	44 (35.5%)	124

Of these, 80 were males (64.5%), and 44 were females (35.5%), yielding a male-to-female ratio of 1.81:1. The patients' ages ranged from the 1st to the 9th decade of life, with the highest frequency observed between the 4th and 7th decades (Table 1).

Table 2. Size of suppurative cutaneous and subcutaneous nodules

Size (cm)	Abscess	Infected keratinous cyst	Fungal abscess	Cold abscess
1	7	11	3	1
2	18	14	8	2
3	11	8	3	1
4	7	3	7	–
5	3	2	3	1
6	3	1	2	–
7	2	–	2	–
>7	1	–	–	–

With respect to the size of the lesions, the majority of abscesses and cysts measured less than 3 cm in diameter, while the largest lesion recorded was 15 cm. Abscesses most frequently measured 2 cm, while infected keratinous

cysts clustered between 1 and 2 cm. Fungal abscesses were also commonly <3 cm, and cold abscesses rarely exceeded 5 cm in size (Table 2).

Table 3. Cytomorphological spectrum of suppurative nodules

Type of lesion	No. of cases	Percentage
Abscess	52	41.9%
Infected keratinous cyst	39	31.4%
Fungal abscess	28	22.5%
Cold abscess	5	4.0%
Total	124	100%

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The cytomorphological spectrum demonstrated that abscesses were the most common lesions, constituting 52 cases (41.9%). Infected keratinous cysts were observed in 39 cases (31.4%), fungal abscesses in 28 cases (22.5%), and cold abscesses in 5 cases (4%) (Table 3).

Table 4. Anatomical site distribution of nodules

Site	Abscess	Infected keratinous cyst	Fungal abscess	Cold abscess
Head & Neck	15	8	1	5
Trunk	15	27	1	—
Upper limb	10	3	12	—
Lower limb	12	1	14	—
Total	52	39	28	5

Regarding anatomical site distribution, abscesses and keratinous cysts were found predominantly on the trunk and head and neck regions, whereas fungal abscesses showed a predilection for the extremities. All cold abscesses were localized to the head and neck region. Overall, the trunk accounted for the highest number of keratinous cysts (27/39), while extremities harbored most of the fungal abscesses (26/28) (Table 4).

Additional Results: Correlation with Demographic and Clinical Variables

On descriptive comparison, distinct distributional patterns were observed across lesion categories in relation to demographic and clinical variables.

With respect to gender, abscesses (n = 52) and fungal abscesses (n = 28) were more frequently observed among males, contributing to the overall male predominance (64.5%). Infected keratinous cysts demonstrated a relatively balanced distribution between sexes, while cold abscesses showed no marked gender predilection due to their small number.

In terms of age distribution, the majority of lesions occurred between the fourth and seventh decades of life.

Abscesses were most commonly encountered in individuals aged 31–60 years. Fungal abscesses were predominantly seen in middle-aged patients, whereas cold abscesses were mainly observed in older age groups. Pediatric cases were uncommon across all lesion categories.

Regarding lesion size, most abscesses and infected keratinous cysts measured less than 3 cm in greatest dimension. Fungal abscesses also largely fell within this size range, although a few cases extended up to 5–7 cm. Larger lesions (>7 cm) were rare and observed predominantly in abscesses.

Analysis of anatomical distribution revealed characteristic site predilections. Infected keratinous cysts showed a strong predilection for the trunk (27/39 cases). Fungal abscesses were predominantly localized to the extremities (26/28 cases), involving both upper and lower limbs. Abscesses were distributed across the head and neck, trunk, and extremities without a single dominant site. Notably, all cold abscesses (5/5 cases) were confined to the head and neck region.

These descriptive associations demonstrate that specific cytological diagnoses exhibit recognizable demographic and anatomical patterns within the study population.

Table 5. Cytomorphological features of suppurative nodules

Cytological diagnosis	Cytomorphological features
Abscess	Abundant polymorphs, degenerated cells, few lymphocytes, and histiocytes against a background of necrotic debris. (Figure 1)
Infected keratinous cyst	Anucleated squames with numerous polymorphs, foreign body-type giant cells, and keratin flakes. (Figure 2)
Fungal abscess	Numerous polymorphs, histiocytes, and giant cells, with irregular branching fungal hyphae showing septal constrictions; necrotic background.(Figure 3a& 3b)
Cold abscess	Epithelioid cell granulomas with caseous necrosis, many neutrophils, and a watery necrotic background with degenerating epithelioid cells.(Figure 4a & 4 b)

The cytomorphological features were distinct for each category of lesion. Abscesses exhibited abundant polymorphs with necrotic debris, while infected keratinous cysts showed anucleated squames with neutrophilic infiltration and keratin flakes. Fungal

abscesses were characterized by polymorphs, histiocytes, and giant cells with irregularly branching fungal hyphae. Cold abscesses revealed epithelioid granulomas with caseous necrosis, neutrophils, and watery necrotic background (Table 5).

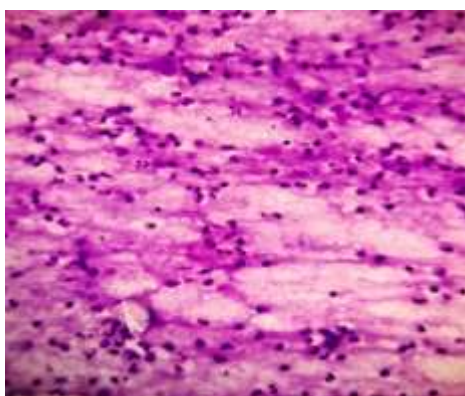


Figure 1: H&E-stained smear of abscess showing neutrophils and histiocytes (100X)

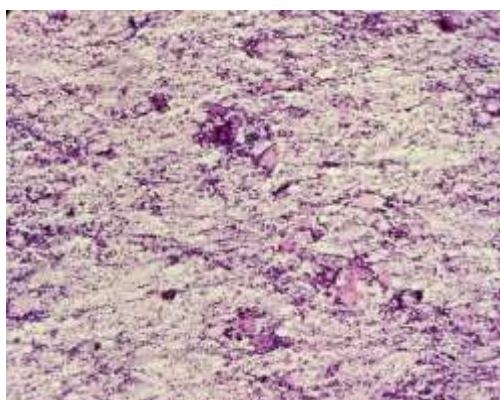


Figure.2: H&E- stained smear of infected keratinous cyst showing anucleate squames admixed with plenty of neutrophils (40X)

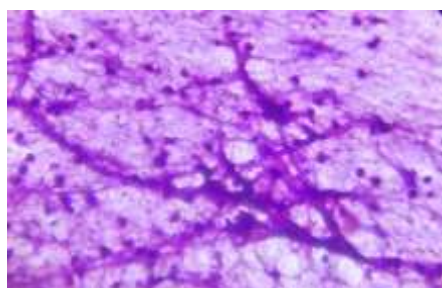


Figure 3a: H&E-stained smear of fungal abscess showing hyphae with irregular branches against necrotic debris (100X)

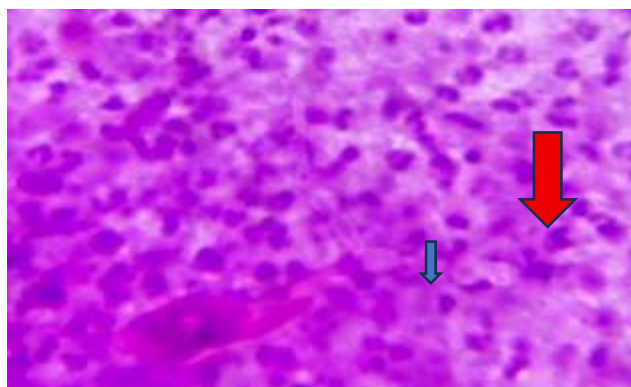


Figure 3b: H&E-stained smear of fungal abscess (400X) showing negatively stained hyphae with constrictions at septae (red arrow) with an adjacent giant cell (blue arrow).

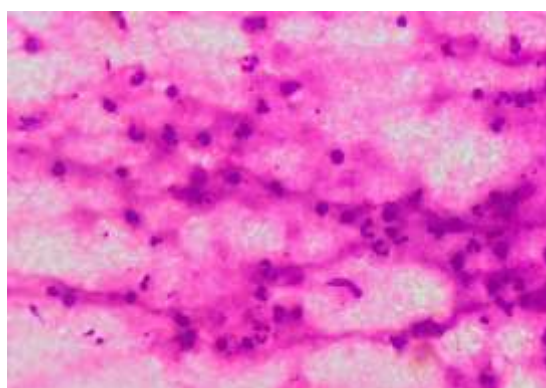


Fig 4a: H&E-stained smear of cold abscess showing neutrophils and a discrete epithelioid cell (400X)

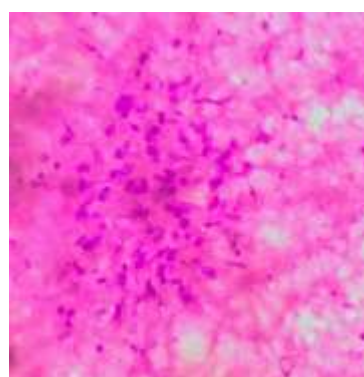


Fig 4b: H&E-stained smear of cold abscess showing epithelioid cell granuloma against caseous necrotic background (100X)

Discussion

Suppurative cutaneous and subcutaneous nodules represent a practical diagnostic challenge because they often overlap clinically with benign cysts, chronic inflammatory swellings, and occasionally neoplastic lesions. In this context, fine needle aspiration cytology (FNAC) remains a valuable first-line test because it is rapid, minimally invasive, and can provide etiologic clues that directly influence therapy, including the need for drainage, antibiotics, antifungals, or anti-tubercular treatment.

In the present study, male predominance was observed (80/124; 64.5%) with a male-to-female ratio of 1.81:1, and the bulk of cases clustered between the fourth and

seventh decades. This pattern is broadly consistent with previous cytology-based institutional experiences reporting a higher frequency of inflammatory and infective soft tissue/head-neck swellings in middle-aged and older individuals [6,7]. A plausible explanation is higher occupational exposure to minor trauma and environmental pathogens in men, along with age-associated alterations in local immunity and skin barrier integrity that may predispose to infection and abscess formation [6,7].

A central finding of this work is the distribution of diagnostic categories: abscesses 41.9% (52/124), infected keratinous cysts 31.4% (39/124), fungal abscesses 22.5% (28/124), and cold abscesses 4.0% (5/124). This hierarchy

supports the interpretation that acute bacterial suppurative remains the dominant pathology among purulent nodules encountered in routine FNAC practice, while keratinous cyst infection and mycotic lesions constitute a substantial secondary burden. Comparable literature emphasizes FNAC's clinical utility in suppurative lesions, including situations where repeat aspiration supports management decisions and improves diagnostic confidence [8]. The predominance of abscess smears rich in neutrophils and necrotic debris is in line with an acute inflammatory milieu typically driven by pyogenic organisms, even when culture correlation is not uniformly available [8].

The study also demonstrates meaningful clinicocytological correlations. Anatomically, infected keratinous cysts showed a strong truncal predilection (27/39), a distribution that is clinically intuitive given the density of pilosebaceous units and the tendency for epidermoid/keratinous lesions to occur on sebaceous-rich sites. In contrast, fungal abscesses showed a striking preference for the extremities (26/28 involving upper and lower limbs), while abscesses were more evenly distributed across head-neck, trunk, and limbs. These trends mirror regional cytopathology reports of cutaneous/subcutaneous mycoses that frequently involve limbs and highlight the benefit of early cytologic recognition of hyphal forms to prevent diagnostic delay and inappropriate surgical pathways [9]. From a mechanistic standpoint, extremity involvement may reflect inoculation following minor trauma, soil exposure, agricultural work, or contact with organic matter—factors that are particularly relevant in tropical settings [9].

Cold abscesses formed a small yet clinically important subset (5/124; 4%) and were confined to the head and neck in this series. Cytology demonstrating granulomas with a necrotic background supports a tuberculous etiology and reinforces FNAC's role in identifying granulomatous infections promptly. Similar cytology-driven diagnostic utility has been described in settings where nerve or soft tissue abscesses arise in chronic infections and where early categorization facilitates targeted therapy rather than empirical drainage alone [10]. The head-neck localization may reflect regional lymphatic drainage patterns and the common clinical pathway of cervicofacial tuberculous involvement presenting as fluctuant swellings [10].

Lesion size patterns add another interpretive layer. Across categories, lesions were largely <3 cm, especially abscesses and infected keratinous cysts, whereas larger swellings were uncommon. This size clustering suggests that FNAC is commonly utilized early in the evaluation of small, clinically ambiguous nodules, where it can rapidly separate simple pyogenic abscesses from infected cysts and from specific infections such as mycoses or tuberculosis. That practical role is consistent with broader

head-neck cytology experiences emphasizing FNAC as a first-contact diagnostic test that can guide downstream microbiology, imaging, and surgery [11].

Finally, the broader significance of these findings lies in FNAC's ability to differentiate infective/inflammatory lesions from neoplastic mimics, particularly when suppurative obscures underlying pathology. Prior work continues to support FNAC's diagnostic performance across soft tissue lesions and emphasizes structured cytomorphological interpretation to reduce diagnostic ambiguity [6,11]. In endemic settings, FNAC has also been documented to identify less common etiologies of subcutaneous nodules, including parasitic lesions such as cysticercosis, underlining its versatility when morphology is interpreted in a clinical context [12]. Moreover, evidence from meta-analyses in other domains demonstrates that FNAC can be reliable in detecting malignancy even in challenging metastatic settings, reinforcing the principle that careful cytological assessment retains value beyond purely inflammatory disease [13]. Stepwise diagnostic approaches in lymph node cytology similarly highlight how systematic morphology-based triage improves classification and reduces missed diagnoses [14].

Overall, this study strengthens the practical conclusion that suppurative nodules are not a single entity but a spectrum with recognizable demographic and anatomical patterns and distinct cytomorphological signatures. These patterns can be leveraged to improve reporting consistency, prompt appropriate ancillary testing, and enable earlier, targeted clinical management in tertiary-care settings.

Generalizability:

The findings of this retrospective study can be applied to similar tertiary-care settings where suppurative nodules form a substantial portion of cytology referrals. The clear cytomorphological patterns observed across lesion types offer practical value for routine diagnostic practice in regions with comparable infectious profiles. Although the patient mix and disease prevalence may vary across institutions, the diagnostic principles demonstrated here remain broadly relevant for clinicians and cytopathologists evaluating purulent cutaneous and subcutaneous swellings.

Conclusion

Fine needle aspiration cytology remains an invaluable, minimally invasive, and cost-effective diagnostic tool in evaluating suppurative cutaneous and subcutaneous nodules. In this study, abscesses were the most common lesions, followed by infected keratinous cysts, fungal abscesses, and cold abscesses, each demonstrating distinct cytomorphological patterns. The ability of FNAC to



differentiate acute from chronic inflammatory conditions and to suggest infectious etiology, such as fungal or tubercular origin, highlights its clinical relevance. Rapid diagnosis not only facilitates early, targeted therapy but also prevents misinterpretation of neoplastic pathology. This reinforces the importance of FNAC as a frontline investigation in modern clinical practice.

Limitations:

This study is limited by its retrospective design, which restricts real-time clinical correlation and uniform documentation across cases. Microbiological confirmation was not available for all lesions, reducing the ability to link cytological patterns with specific pathogens. Histopathological follow-up was not performed in every case, limiting deeper diagnostic validation. Being a single-center study, the findings reflect the local disease profile and patient demographics, which narrows external comparison. Despite these constraints, the study provides valuable insights into the cytological features of suppurative nodules.

Recommendations:

Routine FNAC should be incorporated into the evaluation of all unexplained cutaneous and subcutaneous nodules to ensure early and accurate diagnosis. Linking cytological findings with microbiological studies strengthens pathogen identification and supports targeted therapy, particularly in recurrent or atypical lesions. Establishing standardized reporting formats enhances clarity and reduces interpretative variation across institutions. Regular training programs in cytopathology help clinicians and laboratory staff recognize subtle morphological cues. Multidisciplinary discussion involving dermatology, surgery, and infectious disease teams improves clinical decision-making. Expanding future research to multicenter datasets will generate broader evidence and refine diagnostic accuracy for suppurative nodules.

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Abbreviations:

FNAC – Fine Needle Aspiration Cytology

H&E – Hematoxylin and Eosin

TB – Tuberculosis

ESR – Erythrocyte Sedimentation Rate

CRP – C-Reactive Protein

MNCs – Mononuclear Cells

GMC – Government Medical College

HOD – Head of Department

WHO – World Health Organization

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Conflict of interest:

The authors declare no conflict of interest.

Author contributions:

SM-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. **CSB**-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript, revision of the manuscript. **KR**-Review of literature and preparing the first draft of the manuscript. Statistical analysis and interpretation.

Data availability:

Data available on request.

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