DIAGNOSTIC ACCURACY OF FINE NEEDLE ASPIRATION CYTOLOGY IN HEAD & NECK LESIONS TAKING HISTOPATHOLOGY AS GOLD STANDARD

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Abstract

OBJECTIVE: *To determine the diagnostic accuracy of fine needle aspiration cytology in detection of head and neck lesions by taking histopathology as gold standard.*

METHODOLGY: *This research was conducted within the Otolaryngology Department at Civil Hospital Karachi, utilizing a non-probability consecutive sampling approach. The investigation focused on subjects aged from 18 to 70 years of either gender who presented with head and neck masses that had persisted for a minimum duration of one week. Upon obtaining informed consent, each subject underwent ultrasound-guided fine needle aspiration cytology (FNAC), followed by a biopsy for histopathological confirmation. The data was entered and analyzed using SPSS version 26. Descriptive statistics was computed, and the data was analyzed and presented with a 95% confidence interval.*

RESULTS: *Among the cohort of 283 patients, a significant predominance of females was observed, comprising 74.6% of the sample, with a calculated mean age of 42.40 ± 13.75 years. Fine-needle aspiration cytology (FNAC) exhibited a sensitivity of 95.48% and a specificity of 30.65% in the identification of head and neck lesions, yielding a positive predictive value of 83.07% and a negative predictive value of 65.52%. The aggregate diagnostic accuracy was determined to be 81.27%, accompanied by a positive likelihood ratio of 1.38 and a negative likelihood ratio of 0.15.*

CONCLUSION: *Fine-needle aspiration cytology (FNAC) represents an exceptionally sensitive modality for the identification of malignant lesions within the head and neck region, thereby rendering it a significant preliminary diagnostic instrument. Nonetheless, its relatively low specificity is indicative of an elevated false-positive rate, thereby necessitating the necessity for histopathological*

confirmation. The enhancement of specificity through the application of advanced methodologies or supplementary modalities has the potential to further augment its diagnostic accuracy.

INTRODUCTION

Head and neck lesions presently constitute one of the most ubiquitous pathological conditions, exerting a substantial influence on overall health outcomes. Epidemiological studies accentuate the role of demographic variables, as incidence rates demonstrate fluctuations dependent on age, gender, and lifestyle choices [1]. Importantly, the human papillomavirus (HPV) has been explicitly associated with the increasing prevalence of head and neck cancers, thereby creating subsequent therapeutic complexities [2]. A published investigation indicated that the frequency of head and neck surgical interventions within a singular healthcare institution was 44.7%, thereby emphasizing the significant clinical burden imposed by these disorders [3]. Fine needle aspiration cytology (FNAC) is progressively utilized as a principal diagnostic technique for evaluating head and neck lesions, owing to its minimally invasive nature, swift result turnaround, and economic viability [4-5]. FNAC has demonstrated a sensitivity of approximately 75-95% in detecting malignancies within salivary gland lesions, whereas its specificity fluctuates between 85-98% [5-6]. Nevertheless, it is crucial to recognize that the precision of FNAC may vary due to factors such as the lesion type, the clinician's proficiency, and the quality of the specimen acquired [7]. A clinical-pathological study revealed that FNAC's sensitivity for lesions located in the oral cavity hovers around 86%, indicating that FNAC can effectively identify the majority of tumors [8]. An assessment of its accuracy within this context documented a sensitivity of 88% and a specificity of 97% [9]. Likewise, further investigations have corroborated the effectiveness of FNAC, highlighting its importance in informing clinical decision-making and the management of these lesions [9-10]. Significantly, FNAC has proven to be an exceptionally proficient diagnostic tool for a variety of head and neck malignancies, exhibiting a sensitivity of 91.37% and a specificity of 97.62% [11]. Although histopathology remains the benchmark for definitive diagnosis, the integration of FNAC into the diagnostic framework offers numerous clinical

benefits. The prompt delivery of results via FNAC can considerably hasten the commencement of treatment, thereby allowing clinicians to make timely decisions regarding surgical procedures or adjunctive therapies [12]. A systematic review estimated FNAC's cumulative sensitivity for detecting 85% of lymphomas, with a specificity attaining 90% [13]. Fine-needle aspiration cytology (FNAC) is a universally accepted diagnostic modality for head and neck tumors due to its high sensitivity, specificity, cost-effectiveness, and non-invasive attributes. It plays an essential role in distinguishing between inflammatory, benign, and malignant lesions, thereby providing critical information for timely and effective treatment planning [14-15]. While FNAC may not replace histopathology, it serves as a complementary tool that enhances the management of head and neck lesions, especially in resource-limited environments. Despite its advantages, the presence of overlapping characteristics among non-neoplastic, benign, and malignant lesions can occasionally pose diagnostic challenges. FNAC is often the primary investigative modality for head and neck tumors, and this study seeks to assess its diagnostic accuracy by comparing FNAC findings with histopathological outcomes, thereby underscoring the imperative for ongoing improvements to enhance its accuracy and reliability.

METHODOLOGY

This cross-sectional study was conducted within the Department of Otorhinolaryngology (ENT) at Civil Hospital Karachi, which is affiliated with Dow University of Health Sciences, utilizing a non-probability consecutive sampling technique. Participants aged between 18 and 70 years, irrespective of gender, who exhibited persistent head and neck masses for a minimum duration of one week, were included in the research. In contrast, individuals with a previous diagnosis of malignancy, a history of chemotherapy or radiotherapy, pregnancy or lactation, autoimmune disorders that may affect cytological or histopathological results, and those who opted out of participation were excluded from the

analysis. Prior to their inclusion, written informed consent was obtained following a thorough elucidation of the study's aims, and both demographic and clinical information were systematically recorded. Each participant underwent ultrasound-guided fine-needle aspiration cytology (FNAC) performed by an experienced radiologist, with lesions being categorized as either benign or malignant based on recognized cytological criteria. Benign lesions were distinguished by rounded nuclei and a wealth of finely granulated cytoplasm, whereas malignant lesions were identified if at least two of the following features were present: granuloma formation, the presence of epithelioid histiocytes (with or without multinucleated giant cells), nuclear enlargement, or the existence of microfollicular structures. Subsequent to FNAC, a biopsy was executed, and the collected samples were sent for histopathological analysis, which served as the definitive diagnostic standard. Lesions were histopathologically classified as benign if they exhibited well-defined cellular borders, follicular proliferation, or micro-/macrofollicular architecture, whereas malignant lesions required the presence of nuclear alterations (enlargement, elongation, overlapping), neoplastic cells organized in macro-/microfollicles containing central colloid, and a dense hyper-eosinophilic colloid (inspissated colloid). Data were subjected to analysis utilizing IBM SPSS version 26, with descriptive statistics applied to evaluate both demographic attributes and lesion characteristics. The metrics of sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of fine needle aspiration cytology (FNAC) were systematically assessed, employing histopathology as the gold standard for comparative analysis.

RESULTS

The research cohort comprised 283 subjects, exhibiting a notable predominance of females (74.6%) in comparison to their male counterparts (25.4%). The average age of the subjects was 42.40 ± 13.75 years, with 43.5% classified within the 18–40 years age bracket and 56.5% exceeding 40 years of age. In terms of residential classification, the preponderance of subjects (62.2%) hailed from urban locales, whereas 37.8% inhabited rural territories. A positive familial history of neoplasm was documented in 26.9% of the subjects, in contrast to 73.1% who reported an absence of such a history. The most common site of lesions was the thyroid gland, accounting for 110 cases (38.9%). Lesions in the salivary glands were observed in 80 cases (28.3%), with the parotid gland involved in 60 cases (21.2%) and the submandibular gland in 20 cases (7.1%). The cervical region was affected in 93 cases (32.8%), including 69 cases (24.4%) involving lymph nodes and 24 cases (8.4%) presenting as other types of neck swellings as illustrated in TABLE I.

The comparative analysis of Fine Needle Aspiration Cytology (FNAC) and histopathology in the detection of head and neck lesions among a cohort of 283 patients yielded noteworthy results. FNAC identified 211 cases (74.6%) as benign, a classification that was corroborated by subsequent histopathological evaluation. Nonetheless, 43 cases (15.2%) that were initially designated as benign by FNAC were ultimately determined to be malignant following histopathological scrutiny. In contrast, FNAC accurately classified 19 cases (6.7%) as malignant, whereas 10 cases (3.5%) were categorized as malignant by FNAC but were subsequently verified as benign via histopathological assessment, as delineated in TABLE II.

Table III elucidates the diagnostic precision of Fine Needle Aspiration Cytology (FNAC) in the identification of head and neck lesions, as evaluated in a cohort of 283 patients. FNAC exhibited a substantial sensitivity of 95.48% (95% CI: 92.73–98.22), signifying its robust capacity to accurately recognize malignant instances. Nonetheless, the specificity was comparatively diminished at 30.65% (95% CI: 19.17–42.12), indicating an elevated likelihood of false-positive outcomes. The positive predictive value (PPV) was recorded at 83.07% (95% CI: 78.46–87.68), implying that the majority of cases classified as malignant by FNAC were indeed confirmed as malignant through histopathological evaluation. The negative predictive value (NPV) was determined to be 65.52% (95% CI: 48.22–82.82), suggesting that a significant fraction of cases identified as benign by FNAC were, in fact, benign. The overall diagnostic accuracy of FNAC in discerning head and neck lesions was calculated to be 81.27% (95% CI: 76.73–85.82), underscoring its dependability as a diagnostic screening instrument. The positive

likelihood ratio was measured at 1.38, indicating that a positive FNAC result moderately enhances the probability of malignancy. In contrast, the negative likelihood ratio was ascertained to be 0.15, denoting that a negative FNAC result markedly diminishes the probability of malignancy.

DISCUSSION

The current investigation sought to assess the diagnostic precision of Fine Needle Aspiration Cytology (FNAC) in identifying lesions of the head and neck, employing histopathological analysis as the definitive benchmark. FNAC is extensively adopted due to its minimally invasive characteristics, economic viability, and prompt outcomes, rendering it an indispensable diagnostic instrument within clinical environments [4,5]. Our results indicated a high sensitivity (95.48%) while exhibiting a low specificity (30.65%), thereby emphasizing FNAC's robust capacity to identify malignant cases while simultaneously revealing its shortcomings in distinguishing benign from malignant lesions. A comparative analysis with an existing study demonstrated a comparable sensitivity of 96.8%, thereby affirming FNAC's dependability in malignancy identification, while both investigations exhibited low specificity (~30%), suggesting a considerable false-positive incidence [7]. The Positive Predictive Value (PPV) of 83.07% in our research was marginally superior to the 79.2% observed in the comparative study, indicating FNAC's capability to accurately forecast malignancy in the majority of instances. Conversely, our Negative Predictive Value (NPV) was recorded at 65.52%, which is lower than the 77.7% reported in the comparative analysis, indicating an elevated risk of false negatives and underscoring the necessity for histopathological verification to ensure accurate diagnosis. The overall diagnostic accuracy was determined to be 81.27%, slightly surpassing the 79.1% observed in the comparative study, thereby reinforcing FNAC's reliability as an initial screening instrument [7]. These results are congruent with extant literature, wherein FNAC has demonstrated high sensitivity but variable specificity, which is frequently affected by factors such as lesion type, adequacy of samples, and the expertise of the interpreter [6,8]. While certain studies indicate elevated specificity levels (85%-98%) in salivary gland

lesions, the discrepancies observed in our findings may be attributable to variations in sample composition and technical constraints [5,6]. The positive likelihood ratio (1.38) identified in our study implies that a positive FNAC outcome moderately enhances the probability of malignancy, while the negative likelihood ratio (0.15) denotes that a negative FNAC outcome significantly diminishes the probability of malignancy [10,14]. These findings underscore FNAC's function as a proficient screening tool rather than a conclusive diagnostic approach, accentuating the necessity for histopathological corroboration in ambiguous cases. From a clinical perspective, FNAC continues to serve as a valuable diagnostic asset due to its expedient turnaround time and non-invasive characteristics, particularly in resource-constrained contexts where early detection of malignancy is paramount [4,5]. Nevertheless, in light of its low specificity and moderate NPV (65.52%), clinicians are urged to interpret negative findings with caution, considering supplementary diagnostic methodologies such as core needle biopsy or advanced imaging techniques when warranted [7,10]. The advantages of FNAC encompass its high sensitivity, cost-effectiveness, prompt availability of results, and minimal discomfort to patients, thereby establishing it as a critical first-line diagnostic evaluation [7,8,9]. However, its low specificity, elevated false-positive rate, dependency on the operator, and inability to evaluate tissue architecture inhibit its independent diagnostic accuracy, necessitating correlation with clinical assessments and histopathological findings [5,6,7]. FNAC is an exceptionally effective screening instrument; however, it should be utilized in conjunction with histopathological evaluation to substantiate malignancies and mitigate false-positive diagnoses. Prospective advancements, such as molecular markers, enhancements in cytological methodologies, and integration with core needle biopsy, may augment FNAC's diagnostic accuracy [7,10].

CONCLUSION

Fine-needle aspiration cytology (FNAC) represents an exceptionally sensitive modality for the identification of malignant lesions within the head and neck region, thereby rendering it a significant preliminary diagnostic instrument. Nonetheless, its relatively low

specificity is indicative of an elevated false-positive rate, thereby necessitating the necessity for histopathological confirmation. The enhancement of specificity through the application of advanced methodologies or supplementary modalities has the potential to further augment its diagnostic accuracy.

Table I: Demographic and Clinical Data of the Study Population (n=283)		
Variable		**Frequency (%)**
Gender		
Male		72 (25.4)
Female		211 (74.6)
Age (Mean ± SD) = 42.40 ± 13.75 years		
18 - 40 years		123 (43.5)
> 40 years		160 (56.5)
Residential Status		
Urban		176 (62.2)
Rural		107 (37.8)
Family History of Malignancy		
Positive		76 (26.9)
Negative		207 (73.1)
Site of Lesions		
Thyroid Gland		110 (38.9)
Salivary Gland	Parotid Gland	60 (21.2)
	Submandibular Gland	20 (7.1)
Cervical Region	Lymph Nodes	69 (24.4)
	Other Neck Swelling	24 (8.4)

Table II: Comparison of FNAC & Histopathology in detecting head and neck lesions (n=283)		
FNAC	**Histopathology**	
	Benign	Malignant
Benign	211 (74.6)	43 (15.2)
Malignant	10 (3.5)	19 (6.7)

Diagnostic Accuracy of Fine Needle Aspiration Cytology (FNAC) in detecting head and neck lesions (n=283)		
Diagnostic Variables	**FNAC**	**95% Confidence Interval**
Sensitivity	95.48%	92.73 ~ 98.22
Specificity	30.65%	19.17 ~ 42.12
Positive Predictive Value	83.07%	78.46 ~ 87.68
Negative Predictive Value	65.52%	48.22 ~ 82.82
Diagnostic Accuracy	81.27%	76.73 ~ 85.82
Positive Likelihood Ratio	1.38	N/A
Negative Likelihood Ratio	0.15	N/A

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