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DIAGNOSTIC ACCURACY OF ENDOSCOPIC ULTRASOUND-GUIDED FINE NEEDLE ASPIRATION CYTOLOGY TO ASSESS MALIGNANCY IN INTRA-ABDOMINAL MASSES IN TERTIARY CARE HOSPITAL OF RAWALPINDI

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Abstract

Background: *Intra-abdominal masses represent a wide spectrum of benign and malignant lesions. Endoscopic ultrasound-guided fine-needle aspiration cytology (EUS-FNAC) provides real-time imaging and tissue acquisition, potentially improving diagnostic yield over conventional techniques.*

Objective: *To evaluate the diagnostic accuracy of EUS-FNAC in differentiating malignant from non-malignant intra-abdominal masses using histopathology as the gold standard.*

Methods: *This cross-sectional validation study included 95 patients aged 45–70 years presenting with intra-abdominal masses at a tertiary care hospital. All underwent EUS-guided FNAC using a 22-gauge needle with both smear and cell-block preparation. Histopathological examination served as the reference standard. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy were calculated.*

Results: *The mean age of participants was 58.4 ± 6.8 years; 57.9% were male and 63.1% resided in urban areas. Radiologically, 52.6% of lesions were solid, 26.3% cystic, and 21.1% mixed. EUS-FNAC correctly identified 60 malignant and 23 non-malignant lesions, with five false positives and seven false negatives. Among non-malignant cases, benign lesions (33.3%) predominated. The diagnostic performance of EUS-FNAC demonstrated a sensitivity of 89.5%, specificity of 82.1%, PPV of 92.3%, NPV of 76.7%, and overall accuracy of 87.3%.*

Conclusion: *EUS-FNAC is a highly accurate, minimally invasive diagnostic modality for intra-abdominal masses. Adoption of this technique can reduce the need for open biopsies and improve patient management.*

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INTRODUCTION

The masses present at margins of ribs, in the region of the paraspinal muscles limited in the anterior by the iliac wings and the symphysis pubis, are called Intra-abdominal masses [1]. These include various pathological lesion of malignant or benign and solid or cystic masses. The appearances and characteristics of these masses may vary depending upon certain factors such as age, gender, location, and organ [2].

Timely management of these tumors is based on their early detection and diagnosis which can be done via modern diagnostic imaging techniques. One of the most widely used methods is particularly ultrasonography (USG), which easily locates such tumors which are difficult to access for surgical biopsies, and it has opened up several opportunities for fine needle aspiration of deeper structures [3]. Fine Needle Aspiration Cytology determines whether the abdominal mass is cancer or not. FNAC was originally used by Martin and Ellis for the diagnosis of suspected neoplasm, performed under the guidance of palpation [4].

Endoscopic ultrasound-guided fine-needle aspiration biopsy (EUS-FNAB) was first clinically applied in patients with stomach subepithelial lesions, then in patients with pancreatic disease [5]. The diagnostic rate of EUS-FNAB is reportedly dependent on numerous factors such as mass characteristics (location, size, and echogenicity), needle type, and number of passes, stylet and suction, rapid on-site evaluation (ROSE) by an experienced cytopathologist, and endosonographer experience and skill [6]. Pausawasdi and his colleagues reported the sensitivity of 84.6%, specificity of 95.7% of EUS-FNA in diagnosing malignancy [7].

Ding et al examined the diagnostic accuracy of EUS-FNAB for the diagnosis of neoplasm and its associations with age, sex, and target puncture mass size, liver function, tumor marker, albumin, hypertension and diabetes. Okasha et al reported the sensitivity and specificity of EUS-FNAB for cytologic diagnosis as 92.2% sensitivity and 100% specificity respectively with 63.3% prevalence 77.9% taking histopathology as gold standard [8].

The aim of this study is to determine the diagnostic accuracy of Endoscopic Ultrasound Guided Fine needle aspiration cytology for the diagnosis of malignancy in intra-abdominal masses using histopathology as a gold standard. EUS-guided FNAC offers a more cost-effective option than open biopsy and is a less invasive approach. The result of this present study will help to determine the accuracy of this test which will be then recommended to be performed so that more invasive and risky diagnostic procedures like laparotomy can be avoided.

METHODOLOGY:

This cross-sectional validation study was conducted over a period of six months from June 2024 to December 2024 following approval of the synopsis by the Institutional Research Forum of Rawalpindi Medical University and the Research Evaluation Unit of CPSP. The study was carried out in the Histopathology and Gastroenterology Departments of Holy Family Hospital, Rawalpindi. A total of 95 patients, aged 45–70 years of both genders [8], with radiologically proven abdominal lesions, proper bowel preparation, anesthesia fitness, and stable vital signs, were enrolled using non-probability consecutive sampling. Patients with deranged coagulation profiles, inadequate gastric emptying, or inaccessible lesions were excluded. After obtaining informed consent and observing strict aseptic precautions, A 22-gauge needle was then advanced via the shortest route and the lesion targeted at the center of the EUS image closest to the transducer. Aspirated material was smeared onto at least three to four slides, with half immediately fixed in 95% ethanol for hematoxylin and eosin staining and the remaining slides air-dried for Hemacolor staining. The residual aspirated material was rinsed in normal saline, centrifuged, and mixed with human plasma and thromboplastin suspension to form a clot. The clot was fixed in 10% formalin, processed, impregnated with paraffin wax, and embedded to create a cell block for histopathological examination. Sections of 3–5 µm thickness were cut using a microtome and stained with hematoxylin and eosin for microscopic evaluation. Data were entered and analyzed in SPSS version 24.0.

RESULTS

A total of 95 patients were enrolled with a mean age of 58.4 ± 6.8 years. Of these, 57.9% (n=55) were male and 42.1% (n=40) were female. The majority of

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participants belonged to urban areas (63.1%, n=60), while the remainder were from rural areas (36.9%, n=35). Regarding radiological assessment, 52.6% of the lesions were solid, 26.3% were cystic and 21.1% were mixed in consistency (Table 1). The anatomical distribution of lesions detected by EUS is shown in Figure 1.

When EUS-guided FNAC findings were compared with histopathology, 60 cases were true positives, 23 were true negatives, 5 were false positives and 7 were false negatives, yielding 67 malignant and 28 non-malignant cases on histopathology (Table 2). Among the non-malignant cases on FNAC, the most common diagnosis was benign lesion (33.3%), followed by inflammatory (26.7%), atypical cells (16.7%), hemorrhagic material (13.3%) and degenerated material (10.0%) (Table 3).

The diagnostic performance of EUS-guided FNAC in identifying malignancy demonstrated a sensitivity of 89.5%, specificity of 82.1%, positive predictive value of 92.3%, negative predictive value of 76.7%, and an overall diagnostic accuracy of 87.3% (Table 4).

Variable	Result
Age (years) (Mean ± SD)	58.4 ± 6.8
Gender (n (%))	
• Male	55 (57.9%)
• Female	40 (42.1%)
Residence (n (%))	
• Urban	60 (63.1%)
• Rural	35 (36.9%)
Radiological findings	
• Solid lesion	52.6
• Cystic lesion	26.3
• Mixed lesion	21.1

Table 1: Baseline Demographic Characteristics of Study Participants

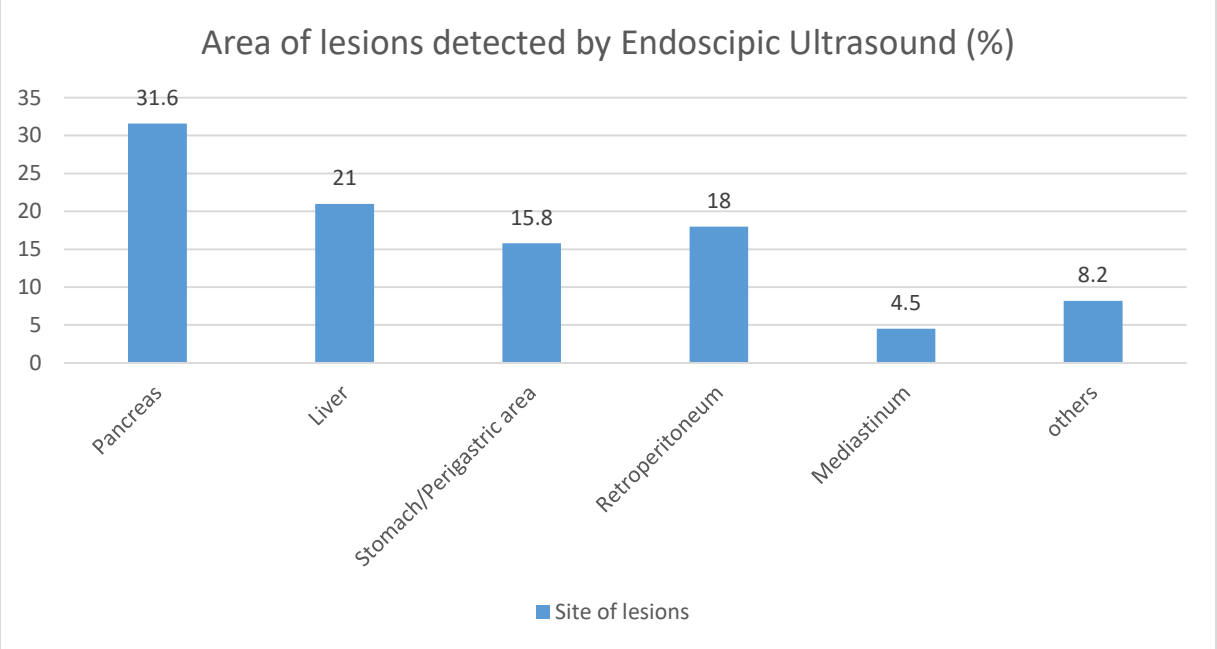

Figure 1: Site of Lesion Detected by EUS (n=95)

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Variable	Histopathology Malignant	Histopathology Non-Malignant	P-value
EUS-FNAC Malignant (65)	60 (TP)	5 (FP)	0.0012
EUS-FNAC Non-Malignant (30)	7 (FN)	23 (TN)	
Total	67	28	

Table 2: Cross Tabulation of EUS-Guided FNAC vs Histopathology (n=95)

Non-Malignant Diagnosis	n (%)
Benign	10 (33.3%)
Inflammatory	8 (26.7%)
Atypical Cells	5 (16.7%)
Hemorrhage/Blood Clots	4 (13.3%)
Degenerated Material	3 (10.0%)

Table 3: Non-Malignant Diagnoses on EUS-Guided FNAC (n=30)

Parameter	Value (%)
Sensitivity	89.5%
Specificity	82.1%
Positive Predictive Value (PPV)	92.3%
Negative Predictive Value (NPV)	76.7%
Overall Accuracy	87.3%

Table 4: Diagnostic Accuracy of EUS-Guided FNAC (n=95)

DISSCUSSION

In this cross-sectional validation study of 95 patients, EUS-guided fine-needle aspiration cytology (EUS-FNAC) demonstrated high diagnostic performance for distinguishing malignant from non-malignant intra-abdominal masses, yielding a sensitivity of **89.5**%, specificity of **82.1**%, PPV of **92.3**%, NPV of **76.7**%, and overall accuracy of **87.3**%. These results support the role of EUS-FNAC as an effective frontline diagnostic modality and are broadly consistent with previously reported ranges for EUS-guided sampling of solid abdominal and pancreatic

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lesions, which generally report pooled sensitivities between ~82% and 92% and specificities frequently approaching the high 80s to near 100% depending on technique and study population [9]. Earlier pooled analyses estimated pooled sensitivity and specificity for EUS-FNA in solid pancreatic masses at approximately 89–91% and 96–100%, respectively, while other systematic reviews found more variable sensitivity (73–96%) influenced by lesion type, needle type, and operator factors [10]. Our sensitivity (89.5%) falls comfortably within these pooled ranges, and our specificity (82.1%) — while somewhat lower than the highest pooled specificities in some meta-analyses — remains acceptable and likely reflects the real-world heterogeneity of lesions (including necrotic/degenerated samples and inflammatory mimics) encountered at our tertiary center. Several technical and biological factors influence diagnostic performance of EUS-FNAC. Needle type (FNA vs FNB), needle gauge, number of passes, lesion characteristics (necrosis, cystic change), presence of rapid on-site evaluation (ROSE), and the experience of endoscopists and cytopathologists all affect sensitivity and specificity. Recent evidence suggests that newer fine-needle biopsy (FNB) needles may provide improved tissue architecture and higher diagnostic yield for histology, with multiple meta-analyses showing FNB frequently matching or exceeding FNA for diagnostic accuracy in solid pancreatic lesions [11]. In our study the use of a 22-gauge needle with combined smear and cell-block preparation likely contributed to the high PPV (92.3%) and overall accuracy, as cell blocks increase the chances of obtaining material suitable for histological assessment and ancillary testing. The availability of ROSE has been variably associated with improved adequacy and reduced need for repeat procedures in some series, but several systematic reviews and trials report little or inconsistent benefit of ROSE for overall diagnostic yield when modern sampling techniques and cell-block processing are used. [12] Similarly, evidence suggests that 3–4 needle passes are often sufficient for solid lesions when FNB needles or cell-block processing are performed; additional passes rarely yield appreciable incremental benefit. These findings are relevant to resource-limited settings where ROSE is not always feasible; our study's approach (smears + cell block) aligns with strategies shown to maintain high diagnostic accuracy without ROSE. In our cohort we observed seven false negatives and five false positives. False negatives typically arise from sampling error (missed viable tumor due to necrosis or small lesion size), suboptimal needle targeting, cystic or necrotic tumor components, or interpretative limitations. False positives are less common but may result from over-interpretation of atypical/reactive changes, poor preservation, or misclassification of certain spindle/atypical lesions. Targeted strategies to reduce false negatives include using FNB needles where histology is essential, ensuring adequate number of passes, utilizing suction or capillary techniques as appropriate, and close clinicopathologic correlation. Follow-up or repeat sampling should be considered when clinical suspicion is high despite negative cytology. The high PPV observed (92.3%) means a malignant cytology result on EUS-FNAC can be used with confidence to proceed to definitive oncologic management, including staging and planning of surgery or oncologic therapy. The lower NPV (76.7%) indicates that negative FNAC results — particularly in patients with high clinical or radiological suspicion — should prompt consideration of further evaluation (repeat EUS sampling, core biopsy, surgical biopsy, or close imaging follow-up). This approach aligns with recommendations from multiple series that emphasize the importance of integrating clinical, imaging, and cytopathology results when planning patient care. [13] Strengths of our study include prospective case capture according to predefined inclusion/exclusion criteria, the use of histopathology/cell-block material as the reference standard, and systematic data collection enabling calculation of standard diagnostic metrics. However, several limitations merit mention: (1) the single-center design may limit generalizability, (2) the sample size (n=95) — while adequate to estimate diagnostic indices — is modest compared with large pooled analyses, (3) we lacked ROSE in many cases (which might have reduced immediate adequacy reporting), and (4) some FNAC samples were described as "other/degenerated" or hemorrhagic which likely contributed to misclassification. Finally, inter-observer variability among cytopathologists was not formally assessed. Future work should focus on

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(1) prospective comparison of 22-G FNA versus modern FNB needles in our population to see if FNB raises sensitivity and NPV substantially, (2) evaluating the incremental value of ROSE or macroscopic on-site evaluation in our setting, and (3) exploring adjunct techniques (immunocytochemistry, molecular markers) on cell blocks to improve accuracy in diagnostically challenging cases. Multicenter collaboration with larger sample sizes would also help validate these findings in the regional context.

CONCLUSION

The present study demonstrated that endoscopic ultrasound-guided fine-needle aspiration cytology (EUS-FNAC) is a highly effective diagnostic modality for evaluating intra-abdominal masses. Notably, the technique allowed for precise categorization of both malignant and non-malignant lesions, thereby facilitating appropriate therapeutic decision-making and minimizing unnecessary invasive procedures. Given its minimally invasive nature, real-time visualization, and ability to procure adequate tissue samples, EUS-FNAC should be considered a frontline diagnostic tool in tertiary care settings for intra-abdominal masses.

CONFLICT OF INTEREST

None

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