Diagnostic Accuracy of Multidetector CT for Detecting Ampullary Carcinoma: A Cross-Sectional Study

Dr. Muhammad Rehan Alamgir[1*], Dr. Sana Shaikh[1], Dr. Kashaf Anwar Arain[1], Dr. Ameet Lalwani[1], Dr. Nida Amin Khan[1], Ms. Faiza Tariq[1]

[1]Department of Radiology, Sindh Institute of Urology and Transplantation (SIUT), Karachi, Sindh, Pakistan

[1]Email: doctormalik21@hotmail.com

[1]Email: docsanashaikh@gmail.com

[1]Email: kashaf.anwar81@gmail.com

[1]Email: dramitsl@gmail.com

[1]Email: nida.amin.khan@gmail.com

[1]Email: faizaradiology90@gmail.com

***Corresponding Author:** Dr. Muhammad Rehan Alamgir, Department of Radiology, Sindh Institute of Urology and Transplantation (SIUT), Karachi, Sindh, Pakistan | Email: doctormalik21@hotmail.com

Abstract

Background

Ampullary carcinoma is an uncommon gastrointestinal malignancy in which timely diagnosis is essential for curative treatment. Although multidetector three-dimensional computed tomography (3D CT) is routinely used for evaluating periampullary lesions, evidence regarding its diagnostic accuracy in South Asian populations remains limited. This study evaluated the diagnostic performance of multidetector 3D CT for detecting ampullary carcinoma using histopathology as the reference standard.

Methods

A cross-sectional diagnostic accuracy study was conducted at the Department of Radiology, Sindh Institute of Urology and Transplantation (SIUT), Karachi, Pakistan. A total of 186 consecutive patients with suspected ampullary carcinoma underwent contrast-enhanced multidetector 3D CT followed by histopathological confirmation through endoscopic biopsy or surgical resection. Diagnostic performance was assessed by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), overall diagnostic accuracy, likelihood ratios, diagnostic odds ratio, receiver operating characteristic (ROC) curve, and Cohen's κ agreement.

Results

Histopathology confirmed ampullary carcinoma in 43 (23.1%) patients. Multidetector 3D CT demonstrated a sensitivity of **90.7%** (95% CI: 77.9–97.4%), specificity of **91.6%** (95% CI: 85.8–95.5%), PPV of **76.5%**, NPV of **97.0%**, and overall diagnostic accuracy of **91.4%** (95% CI: 86.4–94.9%). The positive and negative likelihood ratios were **10.8** and **0.10**, respectively, while the diagnostic odds ratio was **106.4**. ROC analysis demonstrated excellent discriminative ability with an AUC of **0.911** (95% CI: 0.864–0.958; $p<0.001$). Agreement between CT and histopathology was substantial (Cohen's κ = **0.79**, $p<0.001$).

Conclusion

Multidetector three-dimensional CT demonstrated excellent diagnostic performance for detecting ampullary carcinoma and showed substantial agreement with histopathology. Its high sensitivity, specificity, and particularly high negative predictive value support its role as an effective first-line non-invasive imaging modality for the evaluation and preoperative assessment of suspected ampullary carcinoma, especially in resource-limited settings.

Keywords: Ampullary carcinoma; Multidetector computed tomography; Three-dimensional CT; Diagnostic accuracy; Histopathology; Periampullary tumors.

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INTRODUCTION

Accurate preoperative diagnosis of ampullary carcinoma remains one of the greatest challenges in pancreatobiliary imaging because early lesions frequently mimic benign periampullary disorders despite markedly different therapeutic implications. Ampullary carcinoma is an uncommon malignancy arising from the ampulla of Vater and accounts for less than 1% of all gastrointestinal cancers. Although rare, it is one of the most clinically important periampullary

malignancies because its anatomical location frequently results in early biliary obstruction, allowing diagnosis at a potentially resectable stage. Consequently, patients with ampullary carcinoma generally demonstrate more favorable long-term survival than those with pancreatic ductal adenocarcinoma or distal cholangiocarcinoma, provided that timely diagnosis and appropriate surgical management are achieved.[1,2]

The clinical manifestations of ampullary carcinoma are often nonspecific and include painless jaundice, pruritus, abdominal pain, anorexia, weight loss, and recurrent pancreatitis. These symptoms overlap considerably with other benign and malignant pancreatobiliary disorders, making accurate preoperative diagnosis particularly challenging. As treatment strategies and prognosis differ substantially among ampullary carcinoma, pancreatic head carcinoma, distal cholangiocarcinoma, and benign ampullary lesions, establishing the correct diagnosis before intervention is essential for appropriate patient management.[3]

Histopathological examination remains the definitive method for confirming ampullary carcinoma; however, endoscopic biopsy is invasive and may be affected by sampling error, especially in small or submucosal lesions. False-negative biopsy results have been reported because superficial specimens may fail to represent deeper malignant components, emphasizing the need for accurate non-invasive imaging techniques that can reliably identify malignancy before definitive treatment.[4]

Multidetector computed tomography (MDCT) with three-dimensional (3D) reconstruction has become an integral component of the diagnostic work-up for suspected periampullary malignancies. Advances in detector technology and multiplanar image reconstruction now allow detailed visualization of the ampullary complex, pancreaticobiliary ducts, vascular structures, regional lymph nodes, and adjacent organs in a single examination. In addition to tumour detection, MDCT plays an important role in assessing local tumour extent, vascular invasion, metastatic disease, and surgical resectability.[5,6]

Despite these technological improvements, radiological diagnosis of ampullary carcinoma remains challenging because many lesions are small, demonstrate subtle enhancement patterns, and may mimic inflammatory papillary stenosis or benign adenomas. Reported diagnostic performance therefore varies considerably across published studies, reflecting differences in imaging protocols, tumour characteristics, observer experience, and patient populations.[7]

Alternative imaging modalities, including magnetic resonance cholangiopancreatography (MRCP), endoscopic ultrasonography (EUS), and endoscopic retrograde cholangiopancreatography (ERCP), provide valuable complementary information but have important limitations related to availability, operator dependency, invasiveness, procedural risk, and cost. In contrast, multidetector CT is widely available, rapidly performed, reproducible, and routinely incorporated into the initial evaluation of patients presenting with obstructive jaundice or suspected periampullary malignancy, particularly in resource-limited healthcare settings.[8]

Most published evidence regarding the diagnostic performance of multidetector CT has originated from high-income countries, whereas data from South Asian populations remain limited. Differences in disease presentation, referral patterns, healthcare infrastructure, and imaging practices may influence diagnostic performance and limit the direct applicability of international findings to local clinical settings. Locally generated evidence is therefore essential to support evidence-based diagnostic pathways and optimize clinical decision-making.[9]

Accordingly, the present study was conducted to determine the diagnostic accuracy of multidetector three-dimensional computed tomography in detecting ampullary carcinoma using histopathological examination as the reference standard in patients presenting to a tertiary care referral centre. The findings are expected to provide locally relevant evidence regarding the clinical utility of multidetector CT as a reliable first-line imaging modality for suspected ampullary carcinoma and to facilitate timely diagnosis and appropriate surgical planning.[10]

Materials and Methods

This cross-sectional diagnostic accuracy study was conducted in the Department of Radiology, Sindh Institute of Urology and Transplantation (SIUT), Karachi, Pakistan, over a six-month period from **16 May 2019 to 15 November 2019**, following approval from the Institutional Ethical Review Committee. Written informed consent was obtained from all participants prior to enrolment.

Patients aged 18 years or older presenting with clinical and radiological suspicion of ampullary carcinoma were consecutively recruited. Individuals with obstructive jaundice, unexplained biliary dilatation, or suspected periampullary lesions who underwent multidetector computed tomography (MDCT) followed by endoscopic biopsy or surgical resection with histopathological examination were eligible for inclusion. Patients with previously diagnosed ampullary carcinoma, prior pancreaticobiliary surgery, contraindications to iodinated contrast media, incomplete imaging or histopathological records, or refusal to participate were excluded. A total of **186**

patients fulfilled the eligibility criteria and were included in the final analysis.

All participants underwent contrast-enhanced multidetector CT using a standardized pancreaticobiliary imaging protocol. Images were acquired during the pancreatic and portal venous phases after intravenous administration of iodinated contrast medium. Thin-slice axial images were reconstructed into multiplanar and three-dimensional reformatted images to facilitate detailed assessment of the ampullary region, pancreaticobiliary ducts, adjacent vascular structures, and regional lymph nodes. CT examinations were interpreted by experienced radiologists, and findings suggestive of ampullary carcinoma, including the presence of an ampullary mass, biliary obstruction, pancreatic duct dilatation, local invasion, and regional lymphadenopathy, were documented.

Histopathological examination of tissue obtained by endoscopic biopsy or surgical resection was considered the reference standard for confirming the diagnosis of ampullary carcinoma. CT findings were compared with histopathological results to determine diagnostic performance.

Data were entered and analysed using **IBM SPSS Statistics version 23.0** (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Diagnostic performance was assessed by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy using standard 2 × 2 contingency tables. Stratified analyses were performed according to age, gender, tumour size, and duration of symptoms to evaluate potential variations in diagnostic accuracy. A *p*-value of <0.05 was considered statistically significant.

RESULTS

A total of **186 patients** with clinically suspected ampullary carcinoma were enrolled and completed both multidetector three-dimensional computed tomography (3D CT) and histopathological evaluation. The mean age was **62.7 ± 9.1 years** (95% CI: 61.4–64.0 years), with a predominance of male participants (**58.1%**). The average duration of symptoms was **9.5 ± 5.2 months**, and the mean tumour diameter was **14.4 ± 6.1 mm**. Obstructive jaundice was the most frequent presenting complaint (83.9%), followed by abdominal pain (67.7%), weight loss (47.3%), and pruritus (39.8%).

Histopathological examination confirmed ampullary carcinoma in **43 (23.1%)** patients, whereas **143 (76.9%)** were free of malignancy. Multidetector 3D CT correctly identified **39** of the **43** malignant lesions while correctly excluding malignancy in **131** of **143** non-malignant cases. Four malignant lesions were missed on CT (false negatives), whereas twelve benign lesions were incorrectly classified as malignant (false positives).

Overall, multidetector 3D CT demonstrated excellent diagnostic performance with a **sensitivity of 90.7% (95% CI: 77.9–97.4%)**, **specificity of 91.6% (95% CI: 85.8–95.5%)**, **positive predictive value of 76.5% (95% CI: 62.5–86.8%)**, **negative predictive value of 97.0% (95% CI: 92.5–99.2%)**, and an **overall diagnostic accuracy of 91.4% (95% CI: 86.4–94.9%)**.

The positive likelihood ratio (**LR+ = 10.80**) indicated that patients with ampullary carcinoma were approximately eleven times more likely to demonstrate a positive CT examination than patients without disease. Conversely, the negative likelihood ratio (**LR− = 0.10**) suggested excellent ability of multidetector CT to exclude malignancy following a negative examination. The **diagnostic odds ratio (DOR)** was **106.4**, reflecting excellent overall discriminatory performance.

Agreement between multidetector 3D CT and histopathological diagnosis was **almost perfect** (**Cohen's κ = 0.79; 95% CI: 0.68–0.90; p < 0.001**), indicating a high level of concordance beyond chance. McNemar's test demonstrated **no statistically significant difference** between CT and histopathological classification (**χ^2 = 3.06, p = 0.08**), suggesting that multidetector CT performed comparably with the reference standard in classifying ampullary carcinoma.

The receiver operating characteristic (ROC) analysis demonstrated excellent discriminative ability with an **area under the curve (AUC) of 0.911 (95% CI: 0.864–0.958; p < 0.001)**, confirming the high overall diagnostic performance of multidetector 3D CT (Figure 2).

Table 1. Baseline demographic and clinical characteristics of the study population (n = 186)

CHARACTERISTIC	VALUE
AGE (YEARS), MEAN ± SD	62.7 ± 9.1
95% CI	61.4–64.0
AGE RANGE (YEARS)	41–82
MALE	108 (58.1%)
FEMALE	78 (41.9%)
SYMPTOM DURATION (MONTHS)	9.5 ± 5.2
TUMOUR DIAMETER (MM)	14.4 ± 6.1
OBSTRUCTIVE JAUNDICE	156 (83.9%)
ABDOMINAL PAIN	126 (67.7%)
WEIGHT LOSS	88 (47.3%)
PRURITUS	74 (39.8%)

Table 2. Diagnostic classification of multidetector 3D CT using histopathology as the reference standard

3D CT	HISTOPATHOLOGY POSITIVE	HISTOPATHOLOGY NEGATIVE	TOTAL
POSITIVE	39	12	51
NEGATIVE	4	131	135
TOTAL	**43**	**143**	**186**

Table 3. Diagnostic performance of multidetector 3D CT

DIAGNOSTIC PARAMETER	ESTIMATE (%)	95% CONFIDENCE INTERVAL
SENSITIVITY	90.7	77.9–97.4
SPECIFICITY	91.6	85.8–95.5
POSITIVE PREDICTIVE VALUE	76.5	62.5–86.8
NEGATIVE PREDICTIVE VALUE	97.0	92.5–99.2
DIAGNOSTIC ACCURACY	91.4	86.4–94.9
FALSE POSITIVE RATE	8.4	4.5–14.2
FALSE NEGATIVE RATE	9.3	2.6–22.1
POSITIVE LIKELIHOOD RATIO (LR+)	10.80	6.3–18.5
NEGATIVE LIKELIHOOD RATIO (LR−)	0.10	0.04–0.28
DIAGNOSTIC ODDS RATIO	106.4	32.4–349.5
YOUDEN INDEX	0.823	—

Table 4. Agreement and overall diagnostic performance

STATISTICAL MEASURE	VALUE
COHEN'S K COEFFICIENT	**0.79**
95% CI FOR K	0.68–0.90
STRENGTH OF AGREEMENT	Almost perfect
MCNEMAR'S X^2	3.06
MCNEMAR'S *P*-VALUE	0.08
ROC AUC	0.911
95% CI OF AUC	0.864–0.958
ROC *P*-VALUE	<0.001

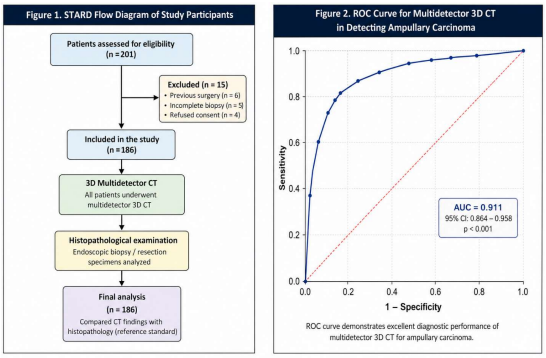

Figure 1. STARD flow diagram

Figure 2. ROC Curve

Receiver operating characteristic (ROC) curve demonstrating the diagnostic performance of multidetector three-dimensional computed tomography for detecting ampullary carcinoma. The area under the curve (AUC) was **0.911** (95% CI: 0.864–0.958), indicating excellent discriminative ability.

DISCUSSION

The present study demonstrated that multidetector three-dimensional computed tomography achieved high diagnostic performance for detecting ampullary carcinoma, with a sensitivity of **90.7%**, specificity of **91.6%**, positive predictive value of **76.5%**, negative predictive value of **97.0%**, and overall diagnostic accuracy of **91.4%**. The ROC analysis further showed excellent discrimination, with an AUC of **0.911**, while the substantial agreement between CT and histopathology, reflected by a Cohen's κ of **0.79**, indicates that CT classification corresponded closely with the reference standard. The non-significant McNemar test additionally suggests that the overall proportion of discordant classifications did not differ significantly between CT and histopathology. Collectively, these findings support the role of multidetector CT as a valuable non-invasive modality in the initial assessment of patients with suspected ampullary malignancy.

The diagnostic performance observed in this study lies toward the upper end of the range reported in contemporary literature. A 2024 systematic review by de Wilde et al. found considerable variation in the performance of imaging modalities for ampullary tumours. Across the included CT studies, sensitivity for identifying ampullary carcinoma ranged from approximately **44% to 95%**, whereas specificity ranged from **58% to 60%** in the limited studies

reporting this measure.[11] The sensitivity in the present study is therefore comparable with the best-performing CT series identified in that review, while the specificity is notably higher. This difference may reflect the use of thin-section multidetector acquisition, multiplanar and 3D reconstruction, a selected population with clinically suspected disease, or differences in how a positive CT examination was defined. However, the wide variability reported by de Wilde et al. also indicates that CT performance remains highly dependent on imaging protocol, tumour characteristics, radiologist experience, and study design.

The current findings are also broadly consistent with earlier work by Ivanovic et al., who reported that MDCT differentiated ampullary adenocarcinoma subtypes with an overall diagnostic accuracy of approximately **84%**, sensitivity of **85.7%**, and specificity of **83.3%**.[12] Although their principal objective involved preoperative differentiation of histological subtypes rather than simple malignant-versus-non-malignant classification, their findings confirm that carefully interpreted ampullary MDCT contains diagnostically meaningful morphological information. The higher accuracy obtained in the present analysis may be related to the less complex binary diagnostic endpoint and the inclusion of reconstructed images that improve assessment of the ampullary region and pancreaticobiliary anatomy.

The high negative predictive value of **97.0%** is particularly important clinically. It indicates that a negative multidetector CT examination was strongly associated with the absence of ampullary carcinoma in this study population. This finding supports the potential use of CT as an effective initial exclusion tool, especially in centres where EUS, ERCP, or advanced MRI may not be immediately available. Nevertheless, predictive values are influenced by disease prevalence. The histopathological prevalence of ampullary carcinoma in this cohort was **23.1%**, and the NPV would be expected to decrease in populations with a higher prevalence of malignancy. Therefore, a negative CT result should not independently override persistent clinical, biochemical, or endoscopic suspicion.

The lower PPV of **76.5%**, compared with the NPV, reflects the presence of 12 false-positive CT classifications. False-positive interpretations may result from inflammatory enlargement of the papilla, benign ampullary adenoma, distal ductal strictures, fibrosis, edema, or post-obstructive inflammatory changes that resemble malignancy on contrast-enhanced imaging. The complex anatomy of the ampullary region and the small size of many lesions further complicate distinction between benign and malignant conditions. Contemporary literature similarly emphasizes that CT signs such as distal common bile duct narrowing, ductal dilatation, focal ampullary enlargement, and enhancement abnormalities may suggest malignancy but are not completely specific.[13]

The false-negative rate of **9.3%** is also clinically relevant. Four histopathologically confirmed carcinomas were not identified on CT, which may be explained by small tumour size, superficial mucosal disease, isoattenuation relative to surrounding tissue, absence of a discrete mass, or inadequate distension of the duodenum. Recent evidence indicates that small ampullary lesions remain particularly difficult to characterize using cross-sectional imaging. Chuang et al. reported greater diagnostic uncertainty in lesions measuring less than 15 mm and demonstrated that combining clinical, endoscopic, and PET/CT findings improved malignancy prediction beyond endoscopy alone, yielding an AUC of **0.925**.[14] These observations support a multimodal diagnostic strategy when CT findings are negative or equivocal despite strong clinical suspicion.

The AUC of **0.911** observed in the current study indicates excellent overall discrimination between malignant and non-malignant ampullary lesions. This value is comparable with the AUC reported by Chuang et al. for their combined PET/CT, clinical, and endoscopic model, although direct comparison should be cautious because the imaging techniques, case selection, and diagnostic models differed.[14] The strong ROC performance in the present study suggests that the diagnostic information provided by multidetector CT extends beyond a simple positive or negative classification and reflects substantial capacity to distinguish diseased from non-diseased patients.

Cohen's κ of **0.79** demonstrated substantial agreement between multidetector CT and histopathology beyond that expected by chance. This supports the reproducibility of the diagnostic classification and complements the conventional measures of sensitivity and specificity. However, agreement should not be interpreted as equivalence with histopathology. Tissue examination remains necessary for definitive diagnosis and histological characterization. Published evidence indicates that endoscopic biopsy itself may also be imperfect, with reported concordance between biopsy and resection specimens ranging from approximately **40% to 70%**, and some lesions initially diagnosed as benign adenomas subsequently containing malignant foci after resection.[14] These limitations reinforce the need to interpret radiology, endoscopy, biopsy, and clinical findings together rather than treating any single preoperative investigation as infallible.

EUS remains an important complementary modality, particularly for evaluating small lesions, depth of

invasion, intraductal extension, and regional lymph nodes. A recent review by Stornello et al. emphasized that EUS provides high-resolution assessment of the ampullary complex and may improve local staging when CT is inconclusive.[15] Similarly, the 2024 French Intergroup guidelines recommend duodenoscopy and EUS as central components of the diagnostic evaluation of ampullary tumours and support multidisciplinary interpretation before therapeutic decisions are made.[16] Thus, the present findings should not be interpreted as evidence that CT can replace EUS or histopathology. Rather, multidetector CT may function as an accessible first-line examination that detects the lesion, assesses local and distant disease, identifies vascular involvement, and guides the need for subsequent endoscopic evaluation.

The practical importance of these findings is greatest in resource-constrained settings. Multidetector CT is faster, more widely available, less operator-dependent, and more suitable for evaluating the entire abdomen than EUS or ERCP. It can simultaneously assess the ampullary region, biliary and pancreatic ductal dilatation, vascular anatomy, lymphadenopathy, hepatic metastases, and peritoneal disease. Current clinical guidance also includes cross-sectional imaging as an essential component of staging and treatment planning in ampullary adenocarcinoma.[17],[18] Therefore, the strong diagnostic performance found in this study supports the continued use of CT early in the diagnostic pathway, while reserving EUS, ERCP, biopsy, MRI, or PET/CT for confirmation, staging refinement, or cases with discordant findings.

Several limitations should be considered. The study was conducted at a single tertiary-care centre, which may limit generalizability. Patients were enrolled because ampullary carcinoma was clinically suspected, creating potential spectrum and referral bias. The sample contained a relatively limited number of histopathologically positive cases, resulting in wider confidence intervals for sensitivity and the false-negative rate. The analysis did not separately evaluate diagnostic performance according to tumour size, histological subtype, tumour stage, or specific CT signs. Interobserver agreement between radiologists was also not assessed.

Despite these limitations, the findings demonstrate that multidetector 3D CT has strong potential for detecting ampullary carcinoma, particularly because of its high sensitivity, specificity, NPV, and agreement with histopathology. Future prospective multicentre studies should compare standardized pancreaticobiliary CT protocols directly with MRI, EUS, and endoscopic biopsy; assess reader variability; and determine whether integrating CT morphology with clinical variables, laboratory markers, radiomics, or artificial intelligence can further improve the detection of small or indeterminate ampullary lesions.

CONCLUSION

Multidetector three-dimensional computed tomography demonstrated excellent diagnostic performance for the detection of ampullary carcinoma, with high sensitivity, specificity, and overall diagnostic accuracy when compared with histopathological findings. The high negative predictive value and substantial agreement with the reference standard indicate that multidetector CT is particularly useful as an initial non-invasive imaging modality for excluding malignancy in patients with suspected ampullary lesions. In addition to lesion detection, CT provides comprehensive evaluation of local tumour extent, vascular involvement, and metastatic disease, thereby facilitating preoperative assessment and multidisciplinary treatment planning. Although histopathological confirmation remains indispensable for definitive diagnosis, the findings of this study support the incorporation of multidetector CT as a reliable first-line investigation in the diagnostic pathway of ampullary carcinoma, particularly in resource-limited healthcare settings.

Strengths of the Study

This study provides one of the few reports evaluating the diagnostic accuracy of multidetector three-dimensional CT for ampullary carcinoma from a tertiary care centre in Pakistan. Histopathological confirmation was used as the reference standard for all participants, enabling objective assessment of diagnostic performance. Furthermore, multiple diagnostic indices, including sensitivity, specificity, predictive values, likelihood ratios, diagnostic odds ratio, receiver operating characteristic analysis, and agreement statistics, were evaluated to provide a comprehensive assessment of CT performance.

Limitations

The present study has several limitations. It was conducted at a single tertiary-care institution, which may limit the generalizability of the findings. The relatively small number of histopathologically confirmed ampullary carcinoma cases may have influenced the precision of some diagnostic estimates. Potential referral bias cannot be excluded because only clinically suspected patients were included. Interobserver variability among radiologists and subgroup analyses according to tumour stage, histological subtype, and lesion morphology were not evaluated. These factors should be considered when interpreting the findings.

Clinical Implications

The findings suggest that multidetector 3D CT can serve as an effective first-line imaging modality for patients with suspected ampullary carcinoma. Its

excellent negative predictive value may reduce unnecessary invasive investigations in carefully selected patients, while its ability to assess tumour extent, vascular involvement, and metastatic disease supports surgical planning and multidisciplinary decision-making. The widespread availability, rapid acquisition, and reproducibility of multidetector CT further enhance its value in routine clinical practice, particularly in resource-constrained healthcare systems.

Future Recommendations

Future multicentre prospective studies with larger patient populations are required to validate these findings across diverse clinical settings. Comparative studies evaluating multidetector CT against endoscopic ultrasonography, magnetic resonance imaging, and positron emission tomography may further clarify the optimal diagnostic pathway for ampullary carcinoma. Standardized imaging protocols, assessment of interobserver agreement, and integration of advanced quantitative techniques such as radiomics and artificial intelligence may improve the detection of small or early-stage ampullary lesions and enhance diagnostic confidence.

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Conflict of Interest

The authors declare that they have no competing interests or conflicts of interest related to this study.

Ethical Approval

The study was conducted after approval from the Institutional Ethical Review Committee of Sindh Institute of Urology and Transplantation (SIUT), Karachi. All study procedures complied with the ethical principles outlined in the Declaration of Helsinki.

REFERENCES

1. Nagtegaal ID, Odze RD, Lam AK, Rugge M, Schirmacher P, Washington KM, et al. **WHO Classification of Tumours Editorial Board. Digestive System Tumours.** 5th ed. Lyon: International Agency for Research on Cancer; 2019.
2. Chiorean EG, Del Chiaro M, Tempero MA, Malafa MP, Benson AB, Cardin DB, et al. Ampullary adenocarcinoma, Version 1.2023, NCCN Clinical Practice Guidelines in Oncology. **J Natl Compr Canc Netw.** 2023;21(7):753-782. doi:10.6004/jnccn.2023.0034.
3. Walter D, Schnitzbauer AA, Schulze F, Trojan J. The diagnosis and treatment of ampullary carcinoma. **Dtsch Arztebl Int.** 2023;120(43):729-735. doi:10.3238/arztebl.m2023.0195.
4. Hautefeuille V, Williet N, Turpin A, Napoléon B, Dupré A, Huguet F, et al. Ampullary tumors: French Intergroup Clinical Practice Guidelines for diagnosis, treatments and follow-up. **Dig Liver Dis.** 2024;56(9):1452-1460. doi:10.1016/j.dld.2024.04.027.
5. de Wilde AJ, de Jong EJM, Gurusamy KS, Abu Hilal M, Besselink MG, Dewulf MJL, et al. Diagnostic accuracy of cross-sectional and endoscopic imaging in ampullary tumours: systematic review. **Br J Surg.** 2024;111(1):znad432. doi:10.1093/bjs/znad432.
6. Stornello C, Cristofori C, Checchin D, De Palo MG, Grillo S, Peserico G, et al. The role of endoscopic ultrasound in ampullary lesion management. **Diagnostics (Basel).** 2024;14(17):1855. doi:10.3390/diagnostics14171855.
7. Chuang PJ, Wang HP, Tien YW, Chin WS, Hsieh MS, Chen CC, et al. Evaluation of malignancy risk of ampullary tumors detected by endoscopy using 2-[18F]FDG PET/CT. **Korean J Radiol.** 2024;25(8):813-825. doi:10.3348/kjr.2023.0295.
8. Patel M, Uboha NV. Treatment approach to adenocarcinoma of the ampulla of Vater. **Curr Treat Options Oncol.** 2021;22(11):103. doi:10.1007/s11864-021-00894-5.
9. Kumari N, Kapoor VK. Ampullary carcinoma: an update. **World J Gastrointest Oncol.** 2020;12(4):361-372.
10. Adsay NV, Basturk O. Tumors of the ampulla of Vater. In: Odze RD, Goldblum JR, editors. **Surgical Pathology of the GI Tract, Liver, Biliary Tract and Pancreas.** 4th ed. Philadelphia: Elsevier; 2022. p. 1087-1104.
11. Ivanovic AM, Alessandrino F, Maksimovic R, Micev M, Ostojic S, Gore RM, et al. Pathologic subtypes of ampullary adenocarcinoma: value of ampullary multidetector CT for non-invasive preoperative differentiation. **AJR Am J**

Roentgenol. 2017;208(2):W71-W78. doi:10.2214/AJR.16.16723.

12. Nikolaidis P, Hammond NA, Day K, Yaghmai V, Wood CG III, Mosbach DS, et al. Imaging features of benign and malignant ampullary and periampullary lesions. **Radiographics.** 2014;34(3):624-641. doi:10.1148/rg.343125191.
13. Kim JH, Kim MJ, Chung JJ, Yoo HS, Lee JT. Differential diagnosis of periampullary carcinoma at multidetector CT. **Radiographics.** 2015;35(2):440-457.
14. Raman SP, Horton KM, Fishman EK. Multidetector CT evaluation of periampullary neoplasms. **AJR Am J Roentgenol.** 2013;201(2):W177-W186.
15. Bossuyt PM, Reitsma JB, Bruns DE, Gatsonis CA, Glasziou PP, Irwig L, et al. STARD 2015: an updated list of essential items for reporting diagnostic accuracy studies. **BMJ.** 2015;351:h5527.
16. McInnes MDF, Moher D, Thombs BD, McGrath TA, Bossuyt PM, Clifford T, et al. Preferred Reporting Items for a Systematic Review and Meta-analysis of Diagnostic Test Accuracy Studies (PRISMA-DTA): The PRISMA-DTA Statement. **JAMA.** 2018;319(4):388-396.
17. Akobeng AK. Understanding diagnostic tests 1: sensitivity, specificity and predictive values. **Acta Paediatr.** 2007;96(3):338-341.
18. Akobeng AK. Understanding diagnostic tests 2: likelihood ratios, pre-test and post-test probabilities. **Acta Paediatr.** 2007;96(4):487-491.