RESEARCH ARTICLE

DOI: 10.4274/AdvRadiolImaging.galenos.2026.44153
Adv Radiol Imaging 2026;3(1):8-14

Reassessment of CT Images in Choledocholithiasis: Analysis of Missed Findings and Associated Factors

Bahadır Reis, Faruk Enes Yazar

Kastamonu University Faculty of Medicine, Department of Radiology, Kastamonu, Türkiye

Abstract

Objectives: Computed tomography (CT) is frequently the first cross-sectional imaging modality obtained in patients presenting with suspected biliary obstruction, yet its sensitivity for direct detection of common bile duct (CBD) stones is known to be variable. This study aimed to determine the rate of CT-missed findings in patients with magnetic resonance cholangiopancreatography (MRCP)-confirmed choledocholithiasis and to identify stone and protocol characteristics associated with CT nondetection.

Methods: In this single-center retrospective study, 33 adults with MRCP-confirmed choledocholithiasis who had undergone abdominal CT within seven days of MRCP were included. CT images were independently re-evaluated by two blinded radiologists; discordant readings were resolved by consensus. MRCP served as the reference standard. CT sensitivity and its 95% confidence intervals (CI) were calculated using the Wilson method. Intergroup comparisons were performed using the Mann-Whitney U test and Fisher's exact test. Agreement between MRCP and CT measurements of CBD diameter was assessed by Spearman correlation and Bland-Altman analysis.

Results: CT sensitivity was 48.5% (16/33; 95% CI, 32.5-64.8%), corresponding to a missed finding rate of 51.5%. MRCP stone diameter was significantly larger in the CT-detected group (median 9.0 mm vs. 5.0 mm; p=0.001), and CT-measured CBD diameter was likewise larger (median 14.0 mm vs. 10.0 mm; p=0.017). Stones measuring ≤5 mm were missed on CT in 83.3% of cases versus 33.3% for stones larger than 5 mm (odds ratio, 10.00; p=0.010). MRCP and CT CBD diameters were strongly correlated (Spearman r=0.793; p<0.001), with negligible bias on Bland-Altman analysis (+0.18 mm). The Median stone attenuation in CT-detected cases was 78 hounsfield units (HU) (interquartile range, 56-114 HU).

Conclusion: CT failed to identify CBD stones in more than half of patients with MRCP- confirmed choledocholithiasis. Stone diameter ≤5 mm was the strongest predictor of CT non-detection. These findings support a low threshold for MRCP referral when CT does not directly demonstrate a CBD stone in patients with clinically suspected biliary obstruction.

Keywords: Choledocholithiasis, computed tomography, magnetic resonance cholangiopancreatography, sensitivity, missed diagnosis, common bile duct

Introduction

Cholelithiasis affects approximately 10-15% of the adult population in Western countries, and choledocholithiasis the presence of stones within the common bile duct (CBD) develops in 10-20% of patients with gallbladder stones at some point during their disease course.[1,2] Left unrecognised or inadequately managed, CBD stones predispose to serious biliary complications including acute cholangitis, acute biliary pancreatitis, and secondary biliary cirrhosis, all of which are associated with substantial morbidity and, in severe cases, mortality.[3] Timely identification and appropriate triage of patients for further evaluation by magnetic resonance cholangiopancreatography (MRCP), endoscopic ultrasound (EUS), or therapeutic endoscopic retrograde cholangiopancreatography (ERCP) is therefore a clinical priority.[4]

In current clinical practice, transabdominal ultrasonography is the first line imaging modality for suspected biliary pathology; however, its sensitivity for direct CBD stone visualisation is limited, ranging from 22% to 55% in published series, largely owing to acoustic shadowing from overlying bowel gas and operator dependence.[5,6]

Abdominal CT is widely obtained in emergency department patients presenting with non-specific abdominal pain, right upper quadrant discomfort, jaundice, or suspected acute pancreatitis, owing to its broad anatomical coverage and rapid acquisition.[7] While CT can simultaneously evaluate a wide differential diagnosis and detect indirect biliary signs notably CBD dilatation the direct visualisation of a CBD stone on CT is considerably less reliable and is influenced by a complex interplay of stone composition, size, location, and technical imaging factors.[8-10]

Cite this article as: Reis B, Yazar FE. Reassessment of CT images in choledocholithiasis: analysis of missed findings and associated factors. Adv Radiol Imaging. 2026;3(1):8-14

Address for Correspondence: Bahadır Reis MD, Kastamonu University Faculty of Medicine, Department of Radiology, Kastamonu, Türkiye
E-mail: bahadirreis@hotmail.com **ORCID ID:** orcid.org/0009-0003-7260-6917
Received: 19.02.2026 **Accepted:** 24.04.2026 **Published:** 30.04.2026

The reported sensitivity of CT for choledocholithiasis varies widely across the literature, from approximately 40% to 80% depending on the study cohort, CT protocol, and reference standard used.[8-11] Isoattenuating stones, stones smaller than 5 mm, and stones situated in the distal CBD are particularly prone to being overlooked.[8,10] MRCP provides non-invasive high resolution depiction of the biliary tree and has been validated as a highly accurate reference standard for choledocholithiasis, with pooled sensitivity and specificity exceeding 90%.[12] Current European Society of Gastrointestinal Endoscopy (ESGE) guidelines endorse MRCP or EUS as the preferred diagnostic tools for intermediate-probability patients before therapeutic ERCP.[4]

Despite these well-established limitations, CBD stones are frequently not reported on CT examinations that precede or coincide with an eventual MRCP diagnosis of choledocholithiasis. The aim of this study was to determine the frequency of missed CBD stones on abdominal CT in a cohort of patients with MRCP-confirmed choledocholithiasis, and to compare CT-detected and CT-missed cases with respect to stone size and attenuation, CBD diameter, and CT acquisition protocol characteristics.

Methods

This was a single-center retrospective observational study conducted at Kastamonu Training and Research Hospital. Ethical approval was granted by the Kastamonu University Non-Interventional Clinical Research Ethics Committee (approval no: 2026-18, date 19.02.2026). The requirement for individual informed consent was waived given the retrospective nature of the study and the use of anonymised archival data. All data were handled in accordance with applicable data protection legislation.

Electronic medical records and the picture archiving and communication system were searched to identify patients who underwent MRCP between 1 January 2023 and 31 December 2025 for whom choledocholithiasis was confirmed. Eligibility required age ≥18 years, MRCP findings consistent with CBD stones, and at least one abdominal CT performed within seven days before or after MRCP in DICOM format. Patients were excluded if ERCP or surgical stone extraction had been performed between CT and MRCP, if biliary stenting or an artefact precluded CBD assessment, or if image quality was insufficient. The full criteria are summarised in Table 1. Thirty-three patients constituted the final cohort.

All CT examinations were performed for routine clinical indications on a 64-detector, 128-slice scanner (Revolution EVO; GE Healthcare, Chicago, IL, USA). Both contrast-enhanced (portal venous phase) and unenhanced acquisitions were represented. Axial images were acquired at 1.25 mm; multiplanar reconstructions were reviewed when available. MRCP was performed on a 1.5 Tesla system (SIGNA Victor; GE Healthcare). MRCP served as the reference standard.

CT images were independently reevaluated by two blinded radiologists with 1 and 11 years of abdominal imaging experience, respectively. Discordant readings were resolved by consensus. CT positivity was defined as direct visualization of a CBD stone, either as a hyperdense intraluminal focus or as a filling defect (target/crescent sign). A missed CBD stone was defined as a case in which MRCP confirmed choledocholithiasis and retrospective CT rereading identified findings compatible with a stone that had not been reported on the original interpretation.

Statistical Analysis

All analyses were performed using IBM SPSS Statistics (version 26.0). Normality was assessed using the Shapiro-Wilk test. Results are reported as mean ± standard deviation (SD) or median [interquartile range (IQR)] as appropriate. CT sensitivity and 95% confidence intervals (CIs) were calculated using the Wilson method. Continuous variables were compared using the Mann-Whitney U test, and categorical variables were compared using Fisher's exact test. MRCP and CT CBD diameter correlation was assessed by Spearman coefficient; agreement by Bland Altman analysis.[12] The association between stone diameter (≤5 mm vs. >5 mm) and CT non-detection was evaluated by Fisher exact test with odds ratio (OR) and 95% CI. $p<0.05$ was considered statistically significant.

Results

The cohort comprised 33 patients (17 men, 16 women; mean age, 68.1±17.3 years; range, 32-93 years). Baseline characteristics are shown in Table 2. Intrahepatic ductal dilatation was present in 27 patients (81.8%). Contrast-enhanced CT was performed in 20 (60.6%) patients and unenhanced CT in 13 (39.4%) patients. Periduodenal gas was identified on CT in 7 patients (21.2%). Median MRCP stone count was 1 (IQR, 1-2), median stone diameter was 7.0 mm (IQR, 4.0-9.0), and mean MRCP CBD diameter was 11.7±3.7 mm.

CT sensitivity was 48.5% (16/33; 95% CI, 32.5-64.8%), corresponding to a missed finding rate of 51.5% (17/33; 95% CI, 35.2-67.5%). Specificity, positive predictive value, and negative predictive value could not be derived because the cohort consisted exclusively of MRCP-positive patients.

Group comparisons are shown in Table 3. MRCP stone diameter was significantly larger in the CT-detected group [median: 9.0 mm (IQR, 7.8-11.2) vs. 5.0 mm (IQR, 3.0-7.0); U=232; p=0.001]. CT-measured CBD diameter was likewise larger [median, 14.0 mm (IQR, 10.8-16.0) vs. 10.0 mm (IQR, 8.0-12.0); U=202; p=0.017]. Stone count, MRCP CBD diameter, and age did not differ significantly between groups. Intrahepatic ductal dilatation (OR, 2.15; p=0.656), contrast-enhanced CT (OR, 1.17; p=1.000), and periduodenal gas (OR, 3.41; p=0.225) were comparable between groups.

Table 1. Patient inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Age ≥18 years	MRCP to CT interval >7 days
MRCP confirmed choledocholithiasis within the study period	Endoscopic (ERCP) or surgical stone extraction performed between CT and MRCP
At least one abdominal CT examination available within ±7 days of MRCP	Biliary stent, metallic implant, or dense artefact precluding biliary assessment
CT images accessible in DICOM format via PACS	Inadequate image quality, incomplete series, or corrupted DICOM data
	MRCP findings attributable solely to stricture or periampullary neoplasm without concurrent stones

CBD: Common bile duct, CT: Computed tomography, DICOM: Digital Imaging and Communications in Medicine, ERCP: Endoscopic retrograde cholangiopancreatography, MRCP: Magnetic resonance cholangiopancreatography, PACS: Picture archiving and communication system

Table 2. Baseline clinical and imaging characteristics (n=33)	
Variable	**All patients (n=33)**
Age (years), mean ± SD	68.1±17.3
Male sex, n/N (%)	17/33 (51.5%)
MRCP stone count, median (IQR)	1 (1-2); range 1-6
MRCP largest stone diameter (mm), median(IQR)	7.0 (4.0-9.0); range 3-35
MRCP CBD diameter (mm), mean ± SD	11.7±3.7; range 6-20
Intrahepatic ductal dilatation, n (%)	27 (81.8%)
Contrast enhanced CT, n (%)	20 (60.6%)
Unenhanced CT, n (%)	13 (39.4%)
Periduodenal gas on CT, n (%)	7 (21.2%)

Data are mean ± SD or median (IQR) unless stated otherwise
CBD: Common bile duct, IQR: Interquartile range, MRCP: Magnetic resonance cholangiopancreatography, SD: Standard deviation

MRCP and CT CBD diameters were strongly correlated (Spearman r=0.793; p<0.0001). Bland-Altman analysis showed a mean bias of +0.18 mm, SD of differences of 2.34 mm, and 95% LoA of -4.40 to +4.76 mm (Figure 1).

Stratification by MRCP stone diameter showed that CT missed stones ≤5 mm in 10 of 12 patients (83.3%) versus 7 of 21 patients (33.3%) with stones >5 mm (OR, 10.00; p=0.010) (Figure 2).

Among the 16 CT- detected stones, the median attenuation was 78 hounsfield units (HU) (IQR, 56-114 HU; range, 13-505 HU; Shapiro-Wilk p<0.001). Eight stones (50.0%) showed mixed or partially calcified attenuation (20-99 HU), 6 (37.5%) were densely calcified (≥100 HU), and 2 (12.5%) were near isoattenuating (<20 HU) (Table 4, Figure 3-5).

Discussion

The principal finding of this study is that CT failed to identify CBD stones in more than half of the patients with MRCP-confirmed choledocholithiasis, yielding an overall sensitivity of 48.5%. This figure falls within the range reported in the published literature, toward the lower end. Anderson et al.[7] found a sensitivity of 77.2% for multidetector CT in a dedicated prospective series, while Soto et al.[8] reported sensitivities as low as 46% for unenhanced helical CT. A more recent comparative analysis by Al-Dulaimi et al.[11] confirmed that CT performs substantially worse than magnetic resonance imaging/MRCP for CBD stone detection in a real world emergency cohort. The comparatively low sensitivity observed in the present study is consistent with real- world retrospective series and likely attributable to the stone characteristics of the study population, in which small and mixed-attenuation calculi predominated, rather than to systematic technical inadequacy. The heterogeneity across published estimates underscores that CT sensitivity for choledocholithiasis is not a fixed diagnostic property but is heavily dependent on stone characteristics, patient selection, and protocol optimization.

Stone diameter on MRCP emerged as the most robust discriminator between CT-detected and CT-missed cases. The CT-detected group had a significantly larger median stone diameter (9.0 mm vs. 5.0 mm; p=0.001), and when a clinically relevant threshold of 5 mm was applied, the odds of CT non-detection were ten times higher for small stones (OR, 10.00; p=0.010). This finding is consistent with the well established principle that CBD stones smaller than 5 mm are substantially harder to identify on axial CT owing to partial volume averaging and the limited attenuation contrast between small calcifications and surrounding bile at standard reconstruction thicknesses.[7,10] Moreover, small CBD stones carry significant clinical risk microlithiasis is a recognised precipitant of acute biliary pancreatitis and cholangitis even in the absence of substantial ductal dilatation[3,13,14] making their CT invisibility a clinically consequential limitation. These results support a low threshold for MRCP referral in patients with symptoms consistent with biliary obstruction, in whom CT shows no direct evidence of stones but cannot confidently exclude small calculi.

The attenuation profile of CT-detected stones was predominantly mixed or partially calcified, with a median of 78 HU (IQR, 56-114 HU). Only 37.5% of CT visible stones were densely calcified (≥100 HU), while 12.5% exhibited near isoattenuating characteristics. This distribution reflects the known compositional heterogeneity of CBD stones, which range from purely cholesterol (low attenuation, often isoattenuating with bile) to pigment dominant varieties.[7,8] The two near isoattenuating stones identified on CT rereading represent cases in which the diagnosis was recoverable only through systematic scrutiny, careful biliary windowing, and attention to subtle intraluminal filling defects. The 17 stones missed entirely in the original reporting presumably included a disproportionate number of isoattenuating or very small calcifications not visible under standard reporting conditions, which reinforces the conclusion that the diagnostic gap reflects both a physical limitation of CT and a partially addressable reporting behaviour.

Table 3. Comparison of CT detected and CT missed groups			
Variable	**CT detected (n=16)**	**CT missed (n=17)**	**p value**
Continuous variables: Mann-Whitney U test, median (IQR)			
MRCP stone diameter (mm)	9.0 (7.8-11.2)	5.0 (3.0-7.0)	**0.001**
CT CBD diameter (mm)	14.0 (10.8-16.0)	10.0 (8.0-12.0)	**0.017**
MRCP CBD diameter (mm)	11.5 (10.0-15.0)	11.0 (9.5-12.0)	0.338
MRCP stone count	1.0 (1.0-3.0)	1.0 (1.0-2.0)	0.439
Age (years)	63.5 (53.2-78.0)	74.5 (61.2-82.5)	0.377
Categorical variables: Fisher exact test, n (%)			
Intrahepatic ductal dilatation	14 (87.5%)	13 (76.5%)	0.656
Contrast enhanced CT	10 (62.5%)	10 (58.8%)	1.000
Periduodenal gas on CT	5 (31.3%)	2 (11.8%)	0.225

Significant p values are shown in bold. Continuous variables reported as median (IQR)
CBD: Common bile duct, IQR: Interquartile range, MRCP: Magnetic resonance cholangiopancreatography, CT: Computed tomography

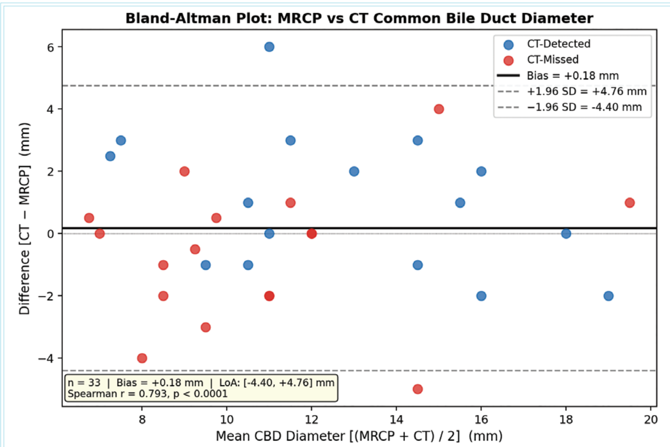

Figure 1. Bland-Altman plot for MRCP and CT CBD diameter agreement (n=33). Solid line=mean bias (+0.18 mm); dashed lines=95% LoA (-4.40 to +4.76 mm). Blue circles, CT detected; red circles, CT missed

CBD: Common bile duct, LoA: Limits of agreement, MRCP: Magnetic resonance cholangiopancreatography, CT: Computed tomography

The CT-measured CBD diameter was significantly larger in the CT-detected group (median, 14.0 mm vs. 10.0 mm; p=0.017). A plausible physiological explanation is that a larger stone is more likely to cause upstream biliary dilatation, increasing duct caliber and improving the conspicuity of an intraluminal filling defect. Conversely, smaller stones may cause only mild or intermittent dilatation. MRCP and CT CBD diameters were strongly correlated (Spearman r=0.793; p<0.0001), and Bland-Altman analysis demonstrated a negligible mean bias of +0.18 mm with 95% LoA of -4.40 to +4.76 mm.[12] Although the wide limits of agreement indicate that individual measurements may deviate by up to approximately 5 mm, the absence of systematic bias confirms that CT reliably tracks CBD diameter at the population level. The broad LoA most likely reflects differences in measurement planes, distension state, and respiratory phase, rather than any fundamental inaccuracy of CT choledochometry.

Neither the use of contrast-enhanced CT (OR, 1.17; p=1.000) nor the presence of periduodenal gas (OR, 3.41; p=0.225) was associated with a significantly higher CT detection rate. These null results must be interpreted with caution, given the limited statistical power of this pilot study. The existing literature suggests that portal venous phase CT can meaningfully improve stone detection by optimising the attenuation contrast between CBD contents and surrounding structures.[10] Systematic use of multiplanar coronal and sagittal reformations has similarly been shown to improve detection of biliary and abdominal pathology compared with axial-only review.[15-19] The failure to detect protocol-related effects in the present series most likely reflects an insufficient sample size rather than a genuine absence of effect, and should not be construed as evidence that contrast enhancement and MPR review are unimportant in biliary CT evaluation.

The rate of missed findings documented here reflects a combination of physical imaging limitations and reporting practices. CBD stones represent one of the more common sources of missed or delayed diagnoses on abdominal CT, partly because the interpreter's attention is directed toward the primary clinical question and the biliary tree receives only secondary scrutiny, a phenomenon analogous to satisfaction of search errors described in other CT contexts.[20] The disparity in experience between the two rereading radiologists (1 year vs. 11 years) reflects the heterogeneity of expertise in real clinical settings.[21] In the present consensus-based design, the potential negative influence of inexperience was mitigated by joint resolution of discordant cases, but in routine single-reader reporting, which characterises most emergency CT workloads, the risk of perceptual oversight remains a real, modifiable component of the diagnostic gap.

The clinical implications of these findings are relevant to several intersecting practice decisions. Current ESGE guidelines recommend MRCP or EUS for patients with intermediate pretest probability of choledocholithiasis before proceeding to ERCP.[4] EUS has demonstrated high sensitivity and specificity for CBD stones in systematic reviews, with particular utility for small stones and borderline ductal dilatation.[13-17] The results of the present study support the view that a CT showing no direct stone evidence should not confidently exclude choledocholithiasis,

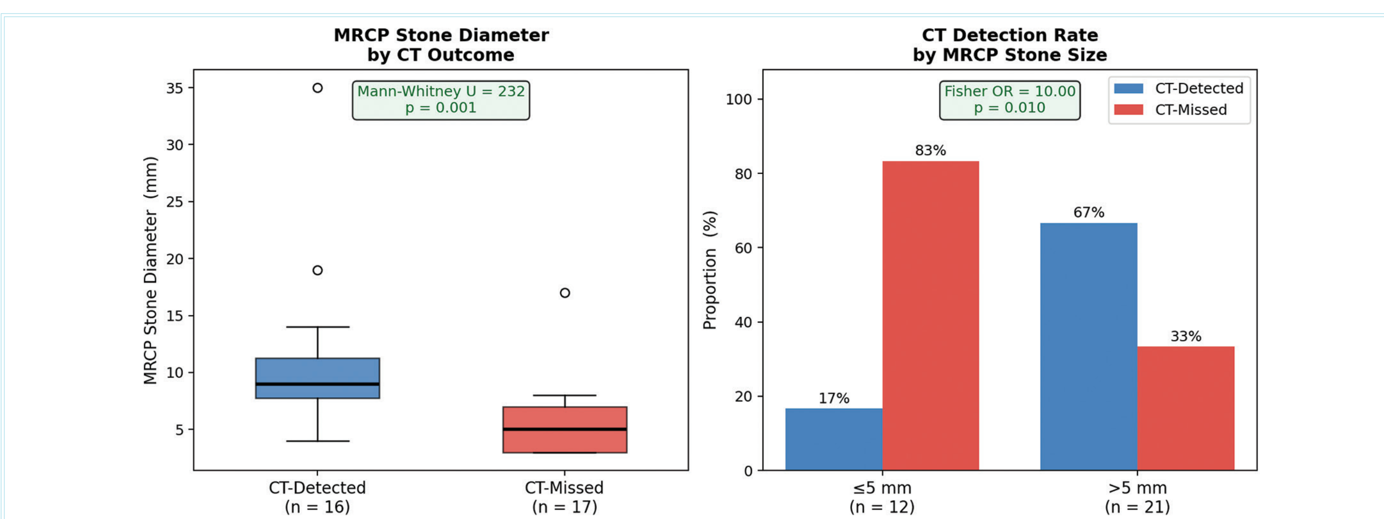

Figure 2. Left: MRCP stone diameter in CT detected (blue, n=16) vs. CT missed (red, n=17) groups (U=232; p=0.001). Right: CT detection rate by stone size (≤5 mm vs. >5 mm; OR=10.00; p=0.010)

MRCP: Magnetic resonance cholangiopancreatography, CT: Computed tomography, OR: Odds ratio particularly in patients with stones ≤5 mm, mildly dilated ducts around 10 mm, or a syndrome consistent with biliary obstruction. In these cases, proceeding directly to MRCP or EUS where available is likely to reduce diagnostic delay, prevent unnecessary repeat imaging, and facilitate timely biliary drainage.[4,14]

Study Limitations

This study has several limitations. The sample size of 33 patients is small, and the study should be considered a pilot and hypothesis-generating study rather than definitive. The absence of an MRCP negative control group precluded the calculation of specificity, positive predictive value, or negative predictive value. The retrospective single-centre design limits generalisability. Formal interobserver kappa statistics were not calculated as a primary endpoint, as the consensus design precluded separate analysis of individual reader performance; future prospective studies should incorporate inter rater agreement as a designated outcome.[21] The heterogeneous CT protocols reflect real- world practice, but limit protocol- specific subgroup analyses. Finally, laboratory covariates prespecified in the original study design were not available in a sufficiently complete form for inclusion. Despite these limitations, the study provides quantitative real-world data on CT missed-finding rates in MRCP-confirmed choledocholithiasis and identifies stone size as the primary determinant of CT detectability, generating specific hypotheses for adequately powered prospective investigation.

Table 4. CT stone attenuation in the CT detected subgroup (n=16)

Attenuation category	n	%
Densely calcified (≥100 HU)	6	37.5
Mixed/partially calcified (20-99 HU)	8	50.0
Near isoattenuating (<20 HU)	2	12.5
Median attenuation, HU (IQR; range)	**78 (56-114; 13-505)**	

HU: Hounsfield units, IQR: Interquartile range, CT: Computed tomography

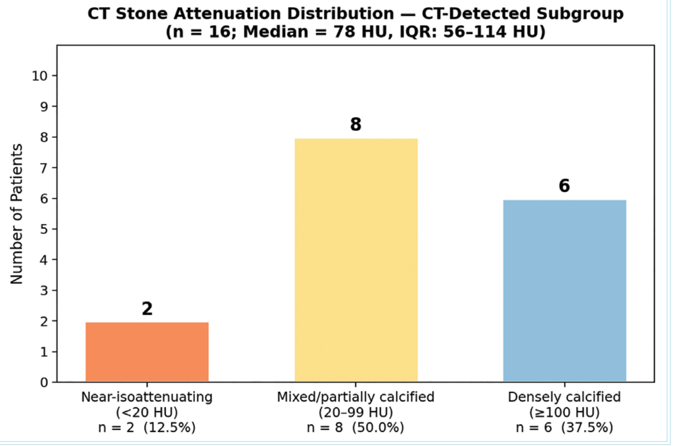

Figure 3. CT stone attenuation distribution in the CT detected subgroup (n=16). Median=78 HU (IQR, 56-114 HU)

HU: Hounsfield units, IQR: Interquartile range, CT: Computed tomography

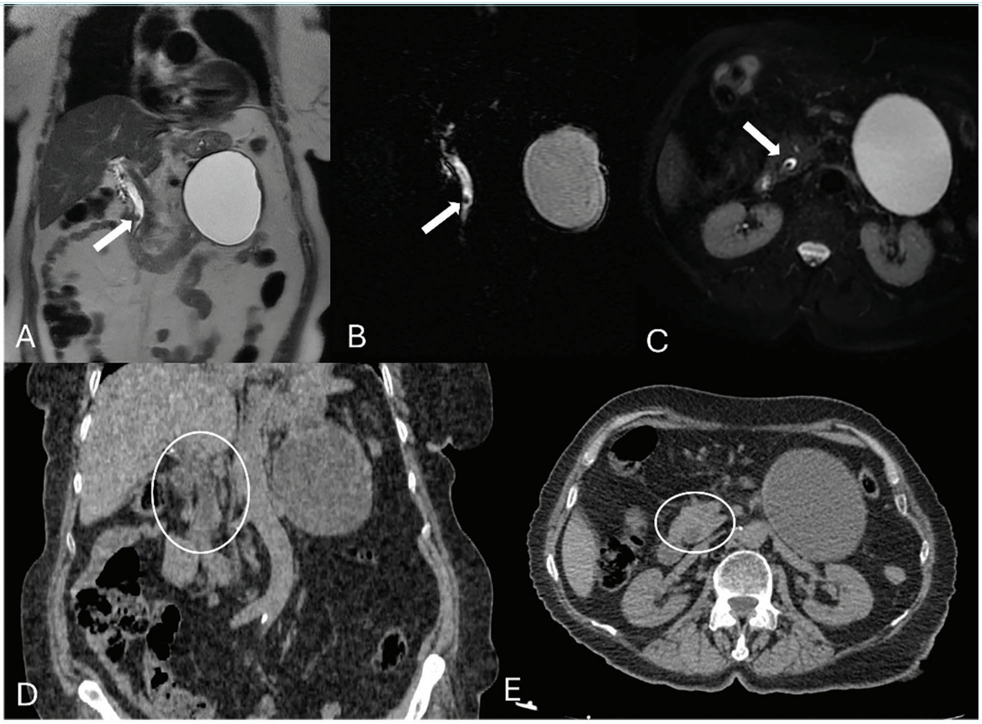

Figure 4. Small distal common bile duct (CBD) stone detected on magnetic resonance cholangiopancreatography but missed on unenhanced computed tomography (CT). Coronal fat suppressed T2-weighted (A), coronal three dimensional magnetic resonance cholangiopancreatography (B), and axial fat suppressed T2-weighted (C) images demonstrate a 4.5 mm hypointense filling defect at the distal CBD (arrows), surrounded by hyperintense bile, consistent with choledocholithiasis. Coronal (D) and axial (E) unenhanced CT images at the corresponding level show a mildly dilated CBD without an identifiable hyperdense focus, filling defect, or target sign; the stone was not reported on the original clinical interpretation or identified on retrospective rereading

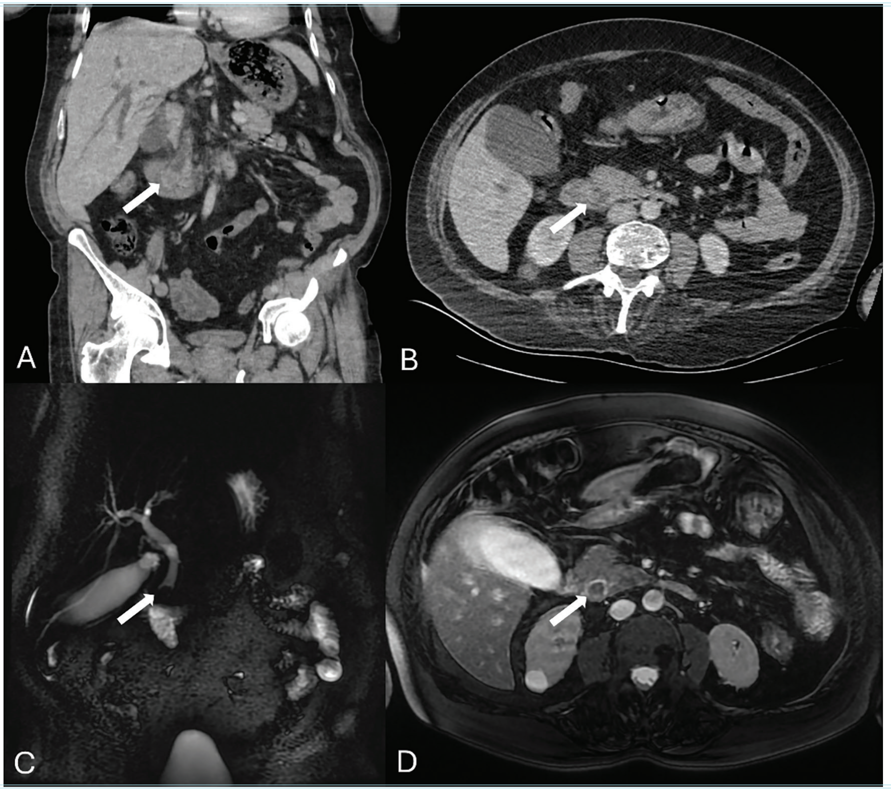

Figure 5. Isoattenuating common bile duct (CBD) stone detected on contrast enhanced CT and confirmed on MRCP. Coronal (A) and axial (B) contrast enhanced CT images demonstrate a 12 mm near isoattenuating intraluminal filling defect within a dilated CBD (arrows), identifiable as a subtle soft tissue density structure surrounded by contrast opacified bile. Coronal radial two dimensional thick slab magnetic resonance cholangiopancreatography (C) and axial fat suppressed T2-weighted (D) images confirm a well defined hypointense filling defect at the distal CBD (arrows), consistent with choledocholithiasis

Conclusion

CT failed to identify CBD stones in more than half of patients with MRCP confirmed choledocholithiasis in this single centre retrospective cohort, yielding a sensitivity of 48.5%. Stone diameter ≤5 mm was the strongest predictor of CT non-detection, with an OR of 10.00 compared with stones larger than 5 mm. MRCP and CT measurements of CBD diameter were strongly correlated, with negligible systematic bias, supporting the reliability of CT choledochometry at the population level. These results reinforce current guideline recommendations in favour of early MRCP referral for patients with a clinical presentation consistent with biliary obstruction, in whom CT does not directly demonstrate a CBD stone. Larger prospective multicentre studies are warranted to confirm these findings, to evaluate the independent contribution of CT protocol factors such as phase selection and slice thickness, and to develop evidence-based reporting standards for biliary CT evaluation.

Ethics

Ethics Committee Approval: Ethical approval was granted by the Kastamonu University Non-Interventional Clinical Research Ethics Committee (approval no: 2026-18, date 19.02.2026).

Informed Consent: Since the study was a retrospective study, informed consent was not required by the ethics committee.

Footnotes

Authorship Contributions

Concept: B.R, F.E.Y., Design: B.R., F.E.Y., Data Collection or Processing: B.R., F.E.Y., Analysis or Interpretation: B.R., F.E.Y., Literature Search: B.R., F.E.Y., Writing: B.R., F.E.Y.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Stinton LM, Shaffer EA. Epidemiology of gallbladder disease: cholelithiasis and cancer. Gut Liver. 2012;6:172-87.
2. ASGE Standards of Practice Committee; Maple JT, Ben-Menachem T, Anderson MA, et al. The role of endoscopy in the evaluation of suspected choledocholithiasis. Gastrointest Endosc. 2010;71:1-9.
3. Kimura Y, Takada T, Kawarada Y, et al. Definitions, pathophysiology, and epidemiology of acute cholangitis and cholecystitis: Tokyo Guidelines. J Hepatobiliary Pancreat Surg. 2007;14:15-26.
4. Manes G, Paspatis G, Aabakken L, et al. Endoscopic management of common bile duct stones: European Society of Gastrointestinal Endoscopy (ESGE) guideline. Endoscopy. 2019;51:472-91.

5. Gurusamy KS, Giljaca V, Takwoingi Y, et al. Ultrasound versus liver function tests for diagnosis of common bile duct stones. Cochrane Database Syst Rev. 2015;2015:CD011548.

6. Gans SL, Pols MA, Stoker J, Boermeester MA; expert steering group. Guideline for the diagnostic pathway in patients with acute abdominal pain. Dig Surg. 2015;32:23-31.

7. Anderson SW, Lucey BC, Varghese JC, Soto JA. Accuracy of MDCT in the diagnosis of choledocholithiasis. AJR Am J Roentgenol. 2006;187:174-80.

8. Soto JA, Alvarez O, Múnera F, Velez SM, Valencia J, Ramírez N. Diagnosing bile duct stones: comparison of unenhanced helical CT, oral contrast-enhanced CT cholangiography, and MR cholangiography. AJR Am J Roentgenol. 2000;175:1127-34

9. Romagnuolo J, Bardou M, Rahme E, Joseph L, Reinhold C, Barkun AN. Magnetic resonance cholangiopancreatography: a meta-analysis of test performance in suspected biliary disease. Ann Intern Med. 2003;139:547-57.

10. Anderson SW, Rho E, Soto JA. Detection of biliary duct narrowing and choledocholithiasis: accuracy of portal venous phase multidetector CT. Radiology. 2008;247:418-27.

11. Al-Dulaimi M, Ibraheem M, Abdulkareem M, Al-Dujaili A, Abdulkareem A. Comparative diagnostic accuracy of clinical assessment, computed tomography (CT), and magnetic resonance imaging with magnetic resonance cholangiopancreatography (MRI/MRCP) in evaluating common bile duct stones. Cureus. 2025;17:e94572.

12. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet. 1986;1:307-10.

13. de Lédinghen V, Lecesne R, Raymond JM, et al. Diagnosis of choledocholithiasis: EUS or magnetic resonance cholangiography? A prospective controlled study. Gastrointest Endosc. 1999;49:26-31.

14. Tenner S, Baillie J, DeWitt J, Vege SS; American College of Gastroenterology. American College of Gastroenterology guideline: management of acute pancreatitis. Am J Gastroenterol. 2013;108:1400-15. Erratum in: Am J Gastroenterol. 2014;109:302.

15. Macari M, Megibow AJ, Balthazar EJ. A pattern approach to the abnormal small bowel: observations at MDCT and CT enterography. AJR Am J Roentgenol. 2007;188:1344-55.

16. Nino-Murcia M, Jeffrey RB Jr, Beaulieu CF, Li KC, Rubin GD. Multidetector CT of the pancreas and bile duct system: value of curved planar reformations. AJR Am J Roentgenol. 2001;176:689-93.

17. Giljaca V, Gurusamy KS, Takwoingi Y, et al. Endoscopic ultrasound versus magnetic resonance cholangiopancreatography for common bile duct stones. Cochrane Database Syst Rev. 2015;2015:CD011549.

18. Kondo S, Isayama H, Akahane M, et al. Detection of common bile duct stones: comparison between endoscopic ultrasonography, magnetic resonance cholangiography, and helical-computed-tomographic cholangiography. Eur J Radiol. 2005;54:271-5.

19. Catalano OA, Sahani DV, Forcione DG, et al. Biliary infections: spectrum of imaging findings and management. Radiographics. 2009;29:2059-80.

20. Brady A, Laoide RÓ, McCarthy P, McDermott R. Discrepancy and error in radiology: concepts, causes and consequences. Ulster Med J. 2012;81:3-9.

21. Mahgerefteh S, Kruskal JB, Yam CS, Blachar A, Sosna J. Peer review in diagnostic radiology: current state and a vision for the future. Radiographics. 2009;29:1221-31.