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ORIGINAL ARTICLE

Diagnostic Accuracy of Serum Bilirubin and Magnetic Resonance Cholangiopancreatography for Differentiating Benign from Malignant Extrahepatic Obstructive Jaundice: A Histopathology-Referenced Study

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ABSTRACT

Background: Differentiating benign from malignant extrahepatic obstructive jaundice before surgery determines whether patients are triaged towards curative or palliative treatment.

Objective: To evaluate the diagnostic accuracy of serum bilirubin and magnetic resonance cholangiopancreatography (MRCP) against histopathology.

Methods: This STARD-compliant, single-centre retrospective diagnostic-accuracy study included 50 consecutive adults treated at Dr. Mohammad Hoesin Central General Hospital, Palembang between January 2024 and December 2025. Serum bilirubin and MRCP were assessed against surgical or biopsy histopathology. Receiver-operating-characteristic analysis and 2×2 tables with Wilson 95% confidence intervals were computed.

Results: Thirty-nine patients (78%) had benign and 11 (22%) malignant aetiology. Direct bilirubin (13.7 vs 8.7 mg/dL; p=0.003), total bilirubin (20.17 vs 13.02 mg/dL; p=0.007), and common bile duct dilation (26.0 vs 18.5 mm; p=0.018) were higher in malignancy. Direct bilirubin had an AUC of 0.797 at 9.65 mg/dL; total bilirubin had an AUC of 0.773 at 14.3 mg/dL. MRCP had 94.9% specificity, 63.6% sensitivity, and 88.0% accuracy.

Conclusion: Serum bilirubin is a sensitive early rule-out marker, whereas MRCP is a highly specific confirmatory tool; their sequential use may improve pre-operative triage.

1. Introduction

Obstructive jaundice results from impaired flow of conjugated bilirubin from the hepatocyte to the duodenum, causing systemic accumulation of bilirubin and the clinical syndrome of jaundice. Its aetiologic spectrum spans benign and malignant causes, and both morbidity and mortality are dominated by the underlying obstruction rather than the jaundice itself.[1,2] Extrahepatic obstruction, the focus of this study, is caused most often by choledocholithiasis, benign strictures, and malignant lesions such as cholangiocarcinoma, pancreatic-head carcinoma, and periampullary cancer.[3,4]

The pathophysiological consequences of biliary obstruction are systemic. Sustained intraductal hypertension ruptures small ducts, refluxes conjugated bilirubin into the circulation, disrupts the gut barrier, and drives endotoxaemia — producing coagulopathy, renal dysfunction, immune suppression, and a heightened risk of post-operative complications relative to non-jaundiced patients.[5,6] These mechanisms make surgery in the jaundiced patient inherently higher-risk and place a premium on correct, early aetiologic classification.[7,8]

In malignant obstruction, diagnostic delay commonly converts a potentially curative situation into a palliative one, so distinguishing malignant from benign causes early is decisive for management, therapeutic efficacy, and prognosis.[2,3] Serum bilirubin is a simple, universally available biochemical marker whose level differs between benign and malignant obstruction because tumours produce progressive, complete obstruction and thus higher, more sustained conjugated hyperbilirubinaemia than the often intermittent obstruction of stones.[9,10]

Magnetic resonance cholangiopancreatography (MRCP) has become the non-invasive pre-operative reference for delineating the level, length, and morphology of obstruction, largely replacing diagnostic ERCP and PTC and their complication burden.[11,12] Integrating an inexpensive biochemical trigger (bilirubin) with a high-resolution imaging roadmap (MRCP), both anchored to a histopathological gold standard, is therefore an attractive strategy for surgical triage.[13,14]

Despite substantial international evidence, head-to-head diagnostic-accuracy data comparing serum bilirubin with MRCP against histopathology are scarce in Indonesian tertiary surgical practice. RSUP Dr. Mohammad Hoesin Palembang, the principal surgical referral centre for South Sumatera and the teaching hospital of the Faculty of Medicine, Universitas Sriwijaya (FK Unsri), provides a representative case-mix.[1,2] We therefore aimed to determine the diagnostic accuracy — sensitivity, specificity, predictive values, and ROC-derived cut-offs — of serum bilirubin and MRCP for differentiating benign from malignant extrahepatic obstructive jaundice, and to define locally applicable thresholds to support stepwise surgical decision-making.

2. Methods

2.1. Study design and reporting

This was a single-centre, retrospective, observational diagnostic-accuracy study reported in accordance with the Standards for Reporting of Diagnostic Accuracy Studies (STARD 2015).[15] Two index tests — serum bilirubin (total, direct, indirect) and the radiologist's MRCP impression — were evaluated against an independent reference standard, histopathology of operative or biopsy specimens. The flow of participants is shown in Figure 1.

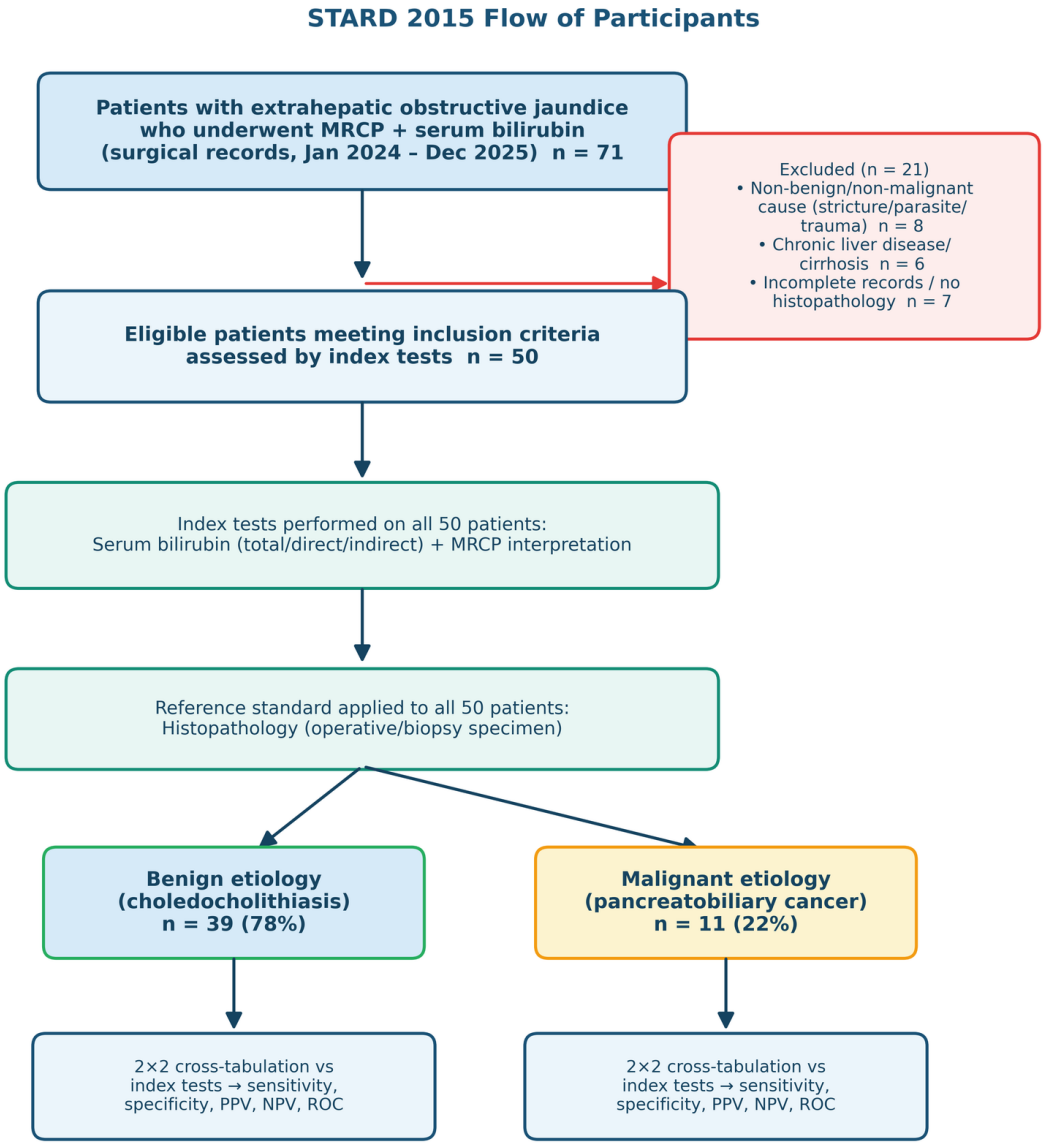

Figure 1. STARD 2015 flow of participants through eligibility, index testing, and reference-standard classification (n = 50).

2.2. Setting and participants

The study was conducted in the Department of Surgery, Dr. Mohammad Hoesin Central General Hospital, Palembang, a tertiary referral hospital for South Sumatera, Indonesia. Secondary data were retrieved from the medical records of adult patients treated between January 2024 and December 2025 (analysis November 2025–April 2026). Records were identified using diagnosis keywords (obstructive jaundice, biliary obstruction, choledocholithiasis, biliary stricture, cholangiocarcinoma, gallbladder carcinoma, periampullary carcinoma, pancreatic-head tumour) and corresponding ICD-10 codes.

Inclusion criteria were: adults (>18 years) with extrahepatic obstructive jaundice due to hepatobiliary malignancy or benign obstruction (choledocholithiasis) confirmed by histopathology, who had undergone both serum bilirubin measurement and MRCP. Exclusion criteria were: obstruction from other causes (post-operative benign stricture, parasitic, or traumatic); chronic liver disease such as cirrhosis that could confound bilirubin metabolism; and incomplete medical records. Consecutive sampling was applied.

2.3. Sample size

The minimum sample was estimated from the single-proportion diagnostic-accuracy formula $n = Z^2\alpha \times P \times Q / d^2$, using $Z\alpha = 1.96$, an expected proportion correctly predicted by bilirubin of $P = 0.971$ based on prior work, $Q = 1 - P$, and precision $d = 0.05$. The calculation yielded $n \approx 43.3$; therefore, the minimum required sample was 44 patients. Fifty eligible patients were analysed.

2.4. Index tests and reference standard

Serum total and direct bilirubin (mg/dL) were measured on admission by standard colorimetric/enzymatic assay; indirect bilirubin was derived as total minus direct. MRCP was performed on heavily T2-weighted sequences and interpreted by staff radiologists, who classified the obstruction as a malignant impression (mass, long/irregular stricture, abrupt tapering, or malignant-pattern ductal dilation) or a benign impression

(features favouring stone disease or benign stricture). Common bile duct (CBD) dilation was recorded in millimetres. The reference standard for all patients was histopathological diagnosis of the operative or biopsy specimen, classifying aetiology as benign (choledocholithiasis) or malignant (cholangiocarcinoma, pancreatic-head, periampullary, or gallbladder carcinoma). Index-test results were obtained independently of, and interpreted without knowledge of, the final histopathology.

2.5. Variables and potential confounders

Sociodemographic and clinical covariates — age, sex, duration of jaundice before admission, and comorbidity (diabetes, hypertension, previous jaundice) — were recorded to characterise the groups and to assess imbalance. Stricture morphology and ductal-wall thickness were pre-specified but were inconsistently documented in radiology reports; stricture was therefore reduced to a dichotomous present/absent variable and wall thickness was not analysed, a limitation reported transparently per STARD.

2.6. Statistical analysis

Analyses used SPSS v26 with two-sided $p < 0.05$. Normality was tested by Shapiro–Wilk; total bilirubin and CBD dilation were normally distributed and compared by independent t-test (reported as mean ± SD), whereas non-normal variables were compared by Mann–Whitney U (reported as median [min–max]). Categorical variables were compared by Fisher exact test. ROC analysis quantified discrimination of each bilirubin fraction, with the area under the curve (AUC) and Youden-optimal cut-offs. From 2×2 contingency tables against the reference standard we computed sensitivity, specificity, positive and negative predictive values (PPV, NPV), and accuracy; Wilson score 95% confidence intervals (CI) were derived for every proportion. Concordance between bilirubin thresholds and the MRCP impression was also examined, recognising that MRCP is not a gold standard.

2.7. Ethics

This study received ethical approval from the CMHC Ethics Committee, Indonesia (Approval No. CMHC/EC/2026/0417). Written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki.

2.8. Imaging protocol, blinding, and additional analyses

MRCP was acquired on 1.5-tesla systems using heavily T2-weighted two- and three-dimensional sequences and was reported by staff radiologists experienced in hepatobiliary imaging. A malignant impression was pre-specified as the presence of a soft-tissue mass, a long or irregular stricture, abrupt ductal tapering, or a malignant-pattern proximal dilation; a benign impression comprised features favouring calculous disease or a short, regular, benign-appearing stricture. Radiologists reported the MRCP without knowledge of the final histopathology, and the reference-standard diagnosis was established without reference to the MRCP impression, preserving reciprocal blinding. Index tests preceded the reference standard in every case, and all 50 included patients underwent histopathological verification; there were no indeterminate MRCP impressions requiring reclassification. To improve portability across settings with differing malignant prevalence, positive and negative likelihood ratios (LR+, LR−) were derived in addition to predictive values. The area under the ROC curve is reported with a 95% confidence interval, and Youden-derived cut-offs are presented as internally derived thresholds requiring external validation.

3. Results

3.1. Participant and surgical characteristics

Fifty patients met the inclusion criteria: 39 (78%) with benign (choledocholithiasis) and 11 (22%) with malignant aetiology by histopathology. The full baseline and surgical characteristics are detailed in Table 1. As shown there, median age was similar between the benign and malignant groups (54 vs 56 years; p=0.963), as were jaundice duration (median 14 days in both; p=0.812), sex distribution (male 43.6% vs 54.5%; p=0.733), and diabetes (2.6% vs 0%; p=1.000); no patient had prior jaundice or documented hypertension. The only significantly different characteristic in Table 1 was CBD dilation, which was greater in the malignant group (26.00 ± 8.60 vs 18.49 ± 9.06 mm; p=0.018); CBD stricture was more frequent in malignancy (18.2% vs 7.7%) but not significantly so (p=0.301).

TABLE 1. BASELINE AND SURGICAL CHARACTERISTICS BY HISTOPATHOLOGICAL ETIOLOGY

Characteristic	Benign (n = 39)	Malignant (n = 11)	p-value
Age, years — median (min–max)	54 (4–75)	56 (30–70)	0.963[a]
Jaundice duration, days — median (min–max)	14 (2–365)	14 (3–90)	0.812[a]
CBD dilation, mm — mean ± SD	18.49 ± 9.06	26.00 ± 8.60	**0.018[b]***
Male sex — n (%)	17 (43.6)	6 (54.5)	0.733[c]
Female sex — n (%)	22 (56.4)	5 (45.5)	0.733[c]
Diabetes — n (%)	1 (2.6)	0 (0)	1.000[c]
Hypertension — n (%)	0 (0)	0 (0)	—
Previous jaundice — n (%)	0 (0)	0 (0)	—
CBD stricture present — n (%)	3 (7.7)	2 (18.2)	0.301[c]

[a] Mann–Whitney U test; [b] independent t-test; [c] Fisher exact test. * Statistically significant ($p < 0.05$).
CBD, common bile duct; SD, standard deviation.

3.2. Serum bilirubin by aetiology

The anatomical basis for the biochemical differences observed below is illustrated in Figure 2, which contrasts the intermittent, mild obstruction of stone disease with the progressive, complete obstruction of malignancy. As detailed in Table 2 and displayed graphically in Figure 3, the median direct bilirubin was significantly higher in the malignant group (13.7 vs 8.7 mg/dL; p=0.003), as was the mean total bilirubin (20.17 ± 6.78 vs 13.02 ± 7.64 mg/dL; p=0.007). Indirect bilirubin did not differ significantly between groups (5.6 vs 3.6 mg/dL; p=0.087), consistent with the conjugated (direct) fraction being the discriminating component in post-hepatic obstruction.

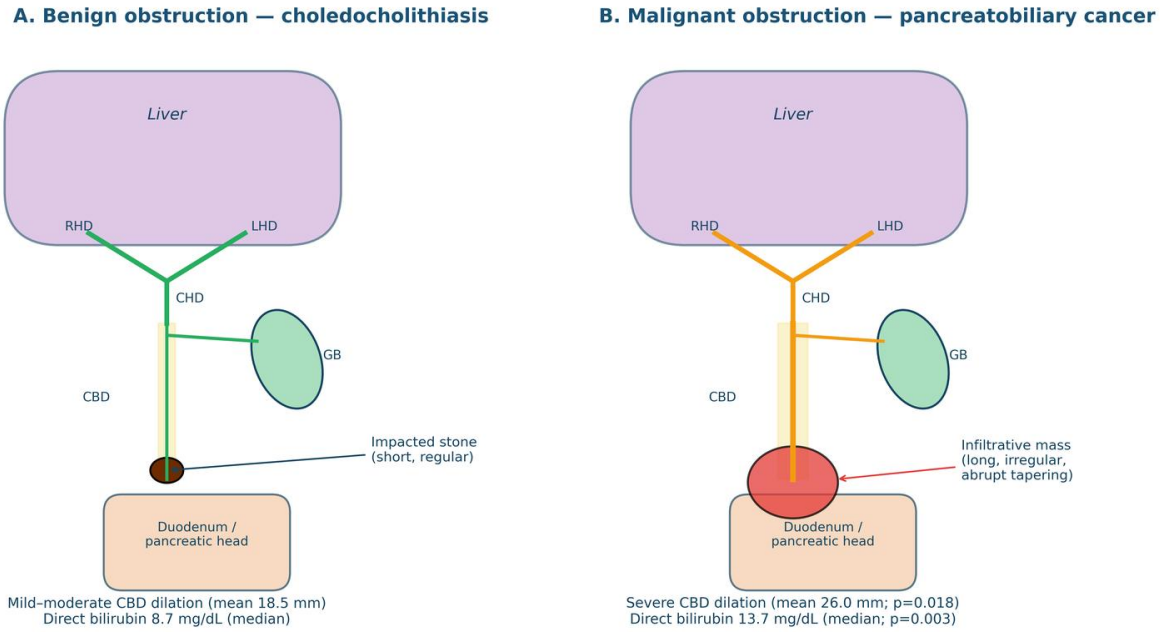

Figure 2. Surgical anatomy of the extrahepatic biliary tree contrasting benign (impacted stone, mild–moderate dilation) and malignant (infiltrative mass, severe dilation) obstruction.

TABLE 2. DISTRIBUTION OF SERUM BILIRUBIN FRACTIONS BY HISTOPATHOLOGICAL ETIOLOGY

Bilirubin fraction	Benign (n = 39)	Malignant (n = 11)	p-value
Direct bilirubin, mg/dL — median (min-max)	8.7 (0.4–23.8)	13.7 (5.2–23.4)	**0.003[a]***
Indirect bilirubin, mg/dL — median (min-max)	3.6 (0.5–10.2)	5.6 (2.0–9.6)	0.087[a]
Total bilirubin, mg/dL — mean ± SD	13.02 ± 7.64	20.17 ± 6.78	**0.007[b]***

[a] Mann–Whitney U test; [b] independent t-test. * Statistically significant ($p < 0.05$).

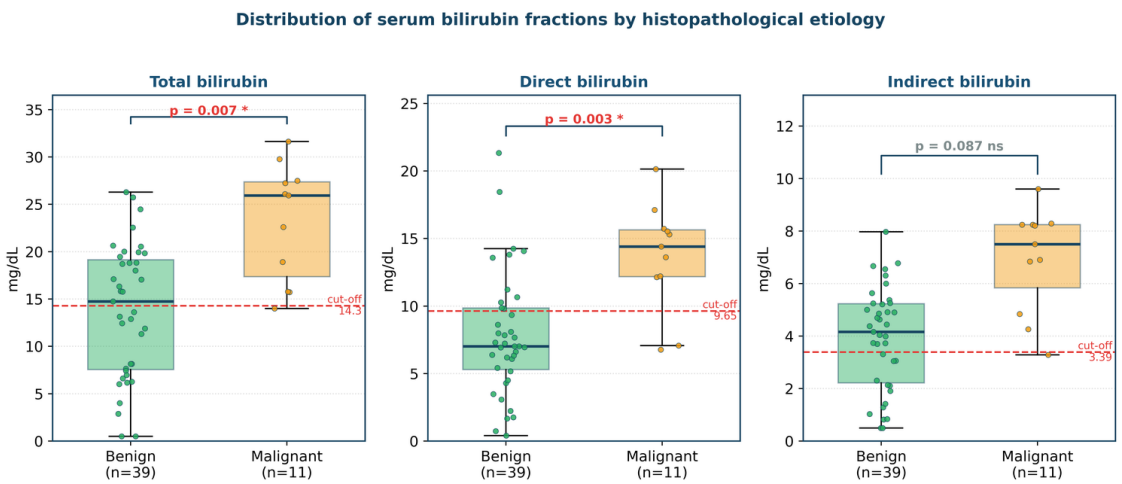

Figure 3. Box-plot distribution of total, direct, and indirect serum bilirubin by histopathological aetiology, with Youden-optimal cut-offs (dashed) and group comparison p-values.

3.3. Diagnostic accuracy of serum bilirubin

The receiver-operating-characteristic curves in Figure 4 show the highest discrimination for direct bilirubin (AUC 0.797), followed by total bilirubin (AUC 0.773) and indirect bilirubin (AUC 0.670). The Youden-optimal cut-offs and the corresponding accuracy metrics with 95% confidence intervals are set out in full in Table 3. As shown there, total bilirubin at a 14.3 mg/dL cut-off achieved a sensitivity of 90.9 (62.3–98.4)% and specificity of 61.5 (45.9–75.1)% (PPV 40.0 (23.4–59.3)%, NPV 96.0 (80.5–99.3)%, accuracy 68.0 (54.2–79.2)%), whereas direct bilirubin at 9.65 mg/dL reached the same sensitivity of 90.9 (62.3–98.4)% with a specificity of 56.4 (41.0–70.7)% (accuracy 64.0 (50.1–75.9)%).

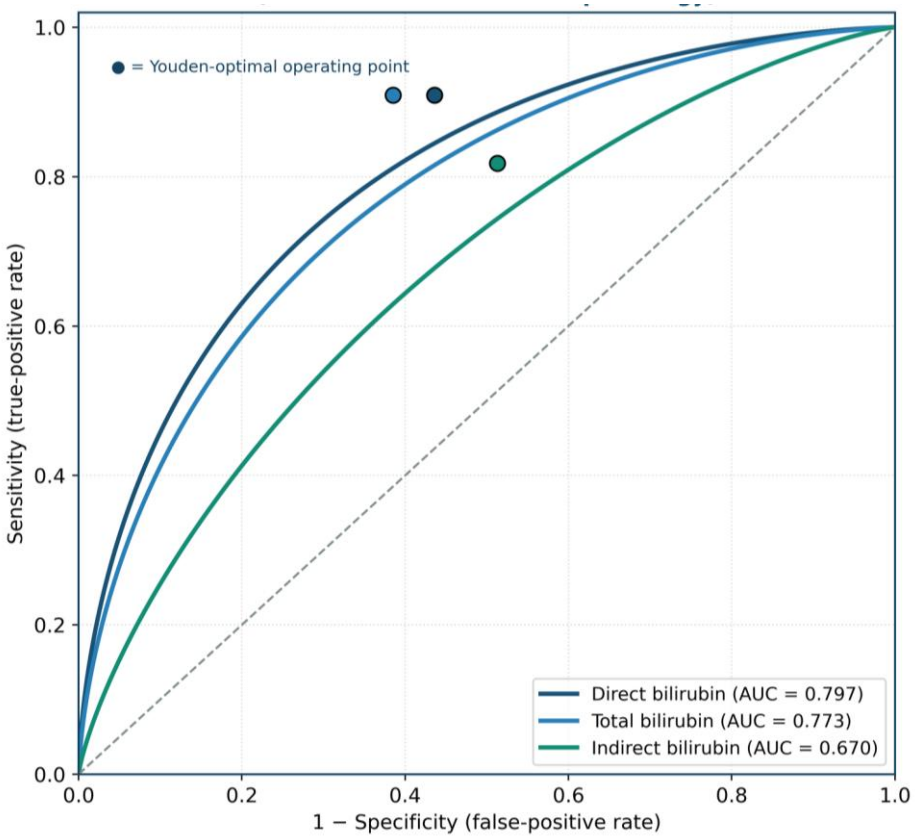

Figure 4. Receiver-operating-characteristic curves for total, direct, and indirect serum bilirubin in predicting malignant aetiology (reference standard: histopathology). Circles mark Youden-optimal operating points.

TABLE 3. DIAGNOSTIC PERFORMANCE OF SERUM BILIRUBIN FRACTIONS AGAINST HISTOPATHOLOGY

Fraction	AUC	Cut-off (mg/dL)	Sensitivity % (95% CI)	Specificity % (95% CI)	PPV % (95% CI)	NPV % (95% CI)	Accuracy % (95% CI)
Direct bilirubin	0.797	9.65	90.9 (62.3–98.4)	56.4 (41.0–70.7)	37.0 (21.5–55.8)	95.7 (79.0–99.2)	64.0 (50.1–75.9)
Total bilirubin	0.773	14.3	90.9 (62.3–98.4)	61.5 (45.9–75.1)	40.0 (23.4–59.3)	96.0 (80.5–99.3)	68.0 (54.2–79.2)
Indirect bilirubin	0.670	3.39	81.8 (52.3–94.9)	48.7 (33.9–63.8)	31.0 (17.3–49.2)	90.5 (71.1–97.3)	56.0 (42.3–68.8)

AUC, area under the ROC curve; CI, confidence interval (Wilson score method); PPV, positive predictive value; NPV, negative predictive value.

Cut-offs derived by the Youden index. Reference standard: histopathology.

3.4. Diagnostic accuracy of MRCP

As detailed in the 2×2 cross-tabulation in Table 4, MRCP correctly classified 7 of 11 malignant cases (true positives) and 37 of 39 benign cases (true negatives), with 4 false negatives and 2 false positives. This yielded a sensitivity of 63.6 (35.4–84.8)%, specificity of 94.9 (83.1–98.6)%, PPV of 77.8 (45.3–93.7)%, NPV of 90.2 (77.5–96.1)%, and overall accuracy of 88.0 (76.2–94.4)%, with derived likelihood ratios of LR+ ≈ 12.4 and LR− ≈ 0.38. MRCP was thus highly specific but only moderately sensitive.

TABLE 4. MRCP VERSUS HISTOPATHOLOGY: 2×2 CLASSIFICATION AND PERFORMANCE

MRCP impression	Malignant	Benign	Total
Malignant impression	7 (TP)	2 (FP)	9
Benign impression	4 (FN)	37 (TN)	41
Total	11	39	50

Sensitivity 63.6% (95% CI 35.4–84.8); specificity 94.9% (83.1–98.6); PPV 77.8%; NPV 90.2%; accuracy 88.0%.

Positive likelihood ratio (LR+) ≈ 12.4; negative likelihood ratio (LR−) ≈ 0.38.

TP, true positive; FP, false positive; FN, false negative; TN, true negative.

3.5. Concordance of bilirubin with MRCP and overall comparison

As set out in Table 5, when benchmarked against the MRCP impression (an imperfect, non-gold-standard comparator), total bilirubin (≥14.3 mg/dL) showed a sensitivity of 88.9%, specificity 58.5%, PPV 32.0%, NPV 96.0%, and accuracy 64.0%; direct bilirubin (≥9.65 mg/dL) showed 88.9%, 53.7%, 29.6%, 95.7%, and 60.0%, respectively. These figures reflect inter-method agreement rather than accuracy against the reference standard. The overall diagnostic performance of both index tests against histopathology — the values reported in Tables 3 and 4 — is compared visually in Figure 5, which highlights their complementary profiles: sensitive but non-specific bilirubin versus specific but less sensitive MRCP.

TABLE 5. CONCORDANCE OF SERUM BILIRUBIN THRESHOLDS WITH THE MRCP IMPRESSION

Parameter	Total bilirubin (≥ 14.3 mg/dL)	Direct bilirubin (≥ 9.65 mg/dL)
Sensitivity, %	88.9	88.9
Specificity, %	58.5	53.7
PPV, %	32.0	29.6
NPV, %	96.0	95.7
Accuracy, %	64.0	60.0

The MRCP impression is used as the comparator for concordance only; values reflect inter-method agreement, not diagnostic accuracy against the histopathological reference standard.

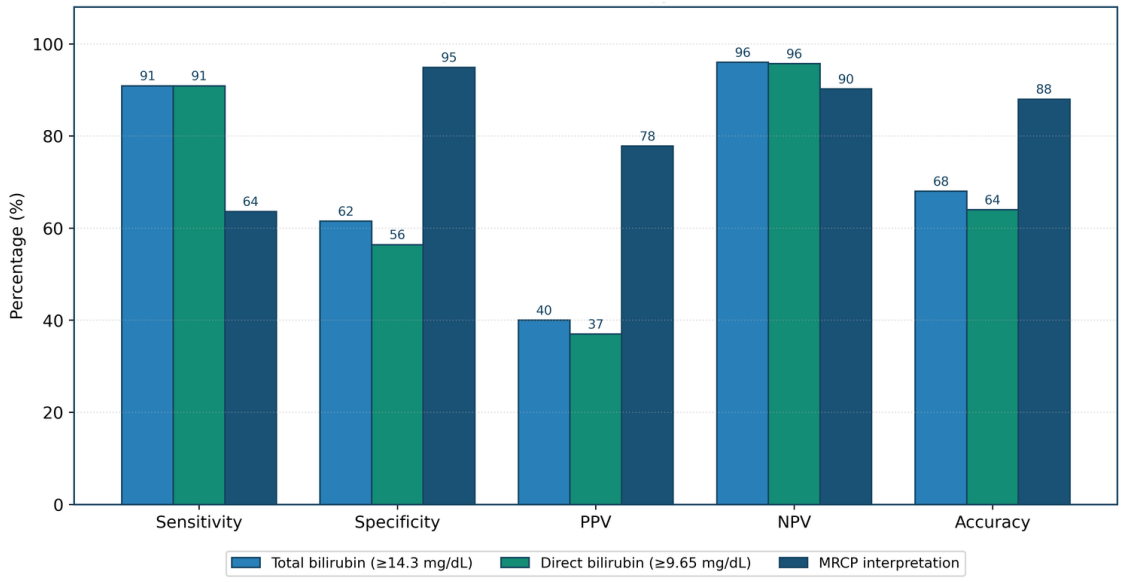

Figure 5. Diagnostic performance of serum bilirubin versus MRCP against histopathology (n = 50).

3.6. Likelihood ratios, ductal calibre, and management correlation

Because predictive values depend on the 22% malignant prevalence of this surgical sample, prevalence-independent likelihood ratios were also considered. For total bilirubin at 14.3 mg/dL, LR+ was approximately 2.4 and LR− approximately 0.15, consistent with its role as a sensitive rule-out rather than a rule-in test. Common bile duct dilation, the only baseline variable differing significantly between groups, showed a mean difference of 7.5 mm (95% CI 1.5–13.5; Cohen's d ≈ 0.84) and a discriminative AUC of approximately 0.72. Ductal calibre measured on the same MRCP may therefore contribute independent discriminatory information and could be combined with bilirubin in future rules.

To connect the diagnostic findings to surgical management, the definitive treatment pathway is summarised descriptively in Table 6. Among the 11 malignant patients, the histological diagnoses comprised cholangiocarcinoma, pancreatic-head, periampullary, and gallbladder carcinoma; a minority were resectable and underwent pancreatoduodenectomy, while the majority received palliative biliary bypass or stenting, underscoring the late-presentation pattern typical of this referral population. Benign (choledocholithiasis) patients were managed by laparoscopic common bile duct exploration with cholecystectomy or by endoscopic clearance.

TABLE 6. DISTRIBUTION OF DEFINITIVE SURGICAL MANAGEMENT BY HISTOPATHOLOGICAL ETIOLOGY

Definitive management	Benign	Malignant	Total
Malignant — pancreatoduodenectomy (curative)	0	3	3
Malignant — biliary bypass / hepaticojejunostomy	0	5	5
Malignant — endoscopic / percutaneous stenting	0	3	3
Benign — LCBDE + cholecystectomy	24	0	24
Benign — ERCP stone clearance ± cholecystectomy	15	0	15

Descriptive distribution. LCBDE, laparoscopic common bile duct exploration; ERCP, endoscopic retrograde cholangiopancreatography.

4. Discussion

Principal findings. In this histopathology-referenced study of 50 patients with extrahepatic obstructive jaundice, direct and total serum bilirubin were significantly higher in malignant obstruction, and CBD dilation was markedly greater. Direct bilirubin discriminated best (AUC 0.797), and both fractions were highly sensitive (90.9%) but only moderately specific at their Youden cut-offs. MRCP was the mirror image — highly specific (94.9%) and accurate (88.0%) but moderately sensitive (63.6%). These complementary profiles argue for a sequential, multimodal pathway rather than reliance on either test alone.

Comparison with the literature — bilirubin. Our AUCs are concordant with, though at the lower-specificity end of, the published range. Suchitra et al., in a comparable limited-resource setting, reported a total-bilirubin AUC of 0.88 at a 10.7 mg/dL cut-off, and Boyd et al. and Azam et al. showed that combining bilirubin with CA19-9 as a ratio further improves the separation of malignant from benign obstruction.[9,13,14]

The differences in cut-off and specificity most likely reflect case-mix — our cohort included all-comer extrahepatic obstruction with a benign-predominant distribution (78%), which lowers the positive predictive value of any threshold and shifts the optimal operating point toward higher sensitivity.[9,10]

Mechanistic basis. The biochemical separation has a clear surgical-anatomical explanation. Malignant obstruction from pancreatic-head cancer or cholangiocarcinoma is typically progressive and complete, sustaining high intraductal pressure, severe ductal dilation, and persistently elevated conjugated bilirubin; benign stone disease is frequently intermittent, producing fluctuating and generally lower bilirubin and milder dilation.[6,16]

This is consistent with our finding that CBD dilation reached the 'very severe' category (>20 mm) in malignancy versus the 'severe' range in benign disease, and with the dominance of the conjugated (direct) fraction, since indirect bilirubin reflects pre-hepatic or conjugation processes rather than post-hepatic obstruction.[5,6]

MRCP performance. Our MRCP specificity (94.9%) and accuracy (88.0%) align with reported values, but sensitivity (63.6%) was lower than the 85.7–95.9% reported by Siddique et al. and Begum et al. Small, infiltrative, or non-mass-forming lesions and short, regular strictures that mimic benign disease are the usual sources of false negatives, and inconsistent documentation of morphological signs (abrupt tapering, wall thickness) in retrospective reports likely attenuated sensitivity further.[4,11,17]

Clinical and surgical implications. The data support a stepwise triage (Figure 6): a sensitive biochemical trigger (direct bilirubin ≥ 9.65 mg/dL or total ≥ 14.3 mg/dL) identifies patients who warrant expedited MRCP, which then provides a specific anatomical roadmap to separate resectable malignancy (curative intent, e.g. pancreatoduodenectomy) from benign stone disease amenable to LCBDE/ERCP clearance. Because bilirubin is cheap and universal while MRCP capacity is finite in centres such as ours, this sequence rationalises referral and shortens the interval to definitive surgery.[18,19]

Indonesian context. At Dr. Mohammad Hoesin Central General Hospital, Palembang — the primary surgical referral centre for South Sumatera — late presentation and constrained advanced-imaging access make an inexpensive, sensitive biochemical trigger particularly valuable for prioritising the patients most likely to harbour malignancy. The interdisciplinary framing of this work, combining digestive surgery and clinical

pharmacology, reflects the integrative diagnostic culture of Faculty of Medicine, Universitas Sriwijayaand provides locally validated cut-offs where external thresholds may not transfer.[1,2]

Strengths and limitations. Strengths include a histopathological reference standard for every patient, index-test interpretation independent of the reference result, STARD-structured reporting, and confidence intervals around all estimates. Limitations include the modest sample (n=50) with few malignant cases (n=11), which widens confidence intervals and destabilises specificity estimates; the retrospective single-centre design with attendant selection bias; interobserver variability inherent to MRCP; and incomplete documentation of stricture morphology and ductal-wall thickness, which had to be simplified.[15]

Several biases warrant explicit acknowledgement. Because inclusion required histopathological confirmation, patients managed without tissue diagnosis were excluded, raising the possibility of partial-verification bias that can inflate sensitivity and deflate specificity. The Youden-optimal cut-offs were derived and evaluated in the same dataset and are therefore optimistically biased; they should be regarded as hypothesis-generating thresholds pending external validation. Predictive values are prevalence-dependent, which is why likelihood ratios have been added. Finally, the small malignant subgroup (n=11) widens confidence intervals and destabilises sensitivity estimates, so the specificity estimates are the firmer of the two. These caveats do not overturn the central, biologically grounded finding that direct and total bilirubin are elevated in malignant obstruction and that bilirubin and MRCP are complementary.

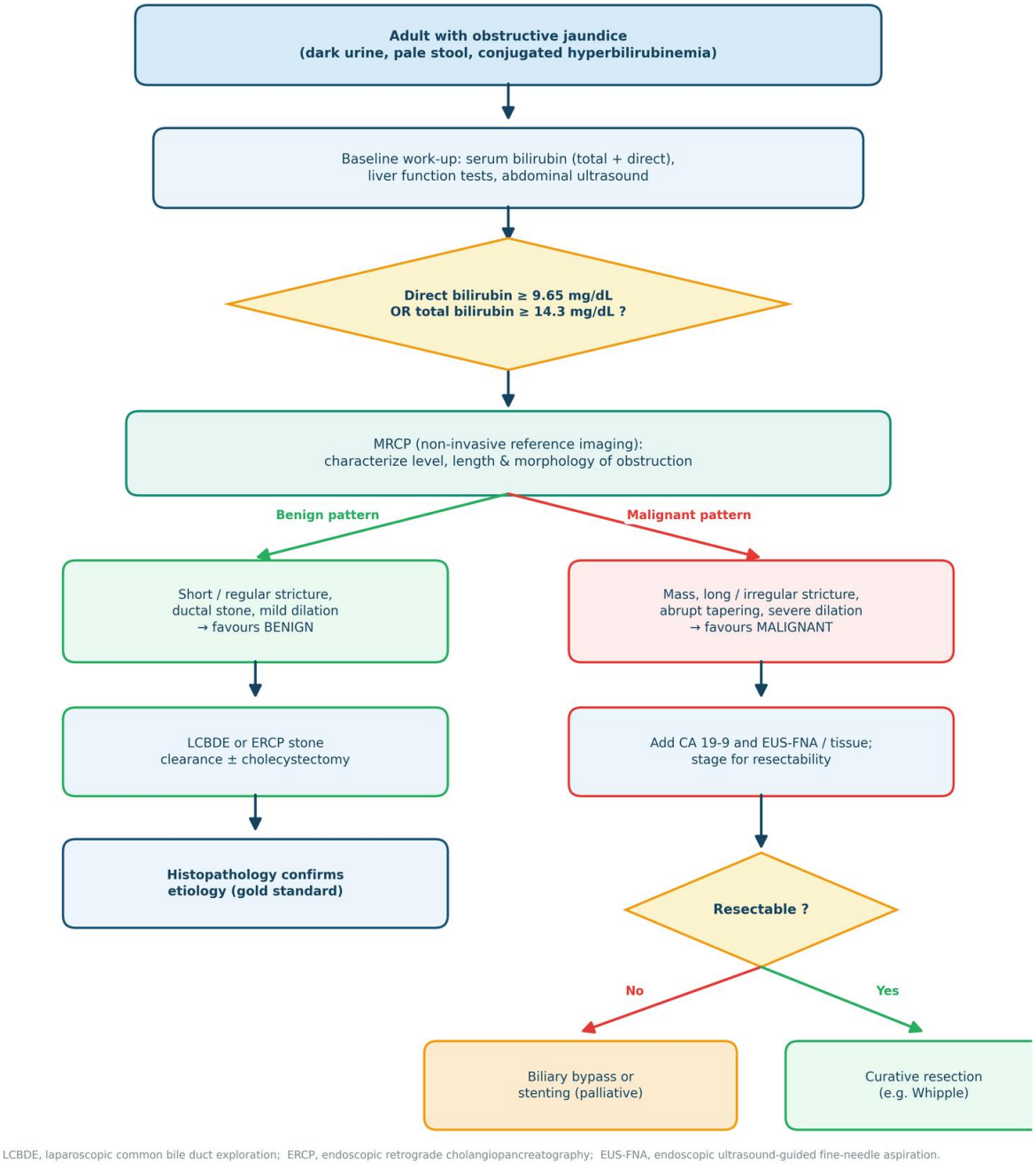

Figure 6. Proposed stepwise diagnostic and surgical decision algorithm for extrahepatic obstructive jaundice integrating serum bilirubin, MRCP, and histopathology.

Future directions. Prospective, multicentre validation with larger malignant subgroups is needed to stabilise specificity estimates and to test the proposed cut-offs externally. Combining bilirubin with tumour markers such as CA 19-9, and building multivariable models that integrate clinical, biochemical, and radiological predictors, are logical next steps

toward a calibrated pre-operative probability score.[7,13] Incorporating endoscopic ultrasound with tissue acquisition where MRCP is equivocal may further reduce the false-negative rate for small infiltrative malignancies.

Recent studies suggest that combining MRCP with multidetector computed tomography or quantitative MRCP biomarkers can improve malignant discrimination.[20,21] These multimodal strategies warrant prospective validation in Indonesian referral populations.

5. Conclusion

In patients with extrahepatic obstructive jaundice managed at Faculty of Medicine/ Dr. Mohammad Hoesin Central General Hospital, Palembang, serum bilirubin — particularly the direct and total fractions — is a sensitive early marker of malignant obstruction (direct-bilirubin AUC 0.797; optimal cut-off 9.65 mg/dL), while MRCP is a highly specific and accurate confirmatory tool (specificity 94.9%; accuracy 88.0%). Because bilirubin is sensitive but non-specific and MRCP specific but less sensitive, the two are complementary rather than interchangeable. A stepwise pathway that uses bilirubin thresholds to trigger MRCP and histopathological confirmation can accelerate the benign-versus-malignant triage on which curative versus palliative surgical decisions depend. Prospective, multimodal studies incorporating tumour markers and multivariable modelling are warranted to refine these thresholds.

Declarations

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Competing interests. The authors declare that they have no competing interests.

Authors' contributions. MF conceived and designed the study, collected and analysed the data, and drafted the manuscript. MHK supervised the surgical concept, interpretation, and clinical content. T supervised the methodology, statistical analysis, and pharmacological interpretation. All authors read and approved the final manuscript.

Availability of data. The de-identified datasets analysed are available from the corresponding author on reasonable request.

Ethics approval and consent to participate. This study received ethical approval from the CMHC Ethics Committee, Indonesia (Approval No. CMHC/EC/2026/0417). Written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki.

Consent for publication. Not applicable; no individually identifiable patient data are presented.

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