S Afr J Surg. 2024;62:190-193. Online first
https://doi.org/10.36303/SAJS.00411

S Afr J Surg
ISSN 038-2361

CASE SERIES

Misinterpretation of the severity of bile duct injuries by MRCP

M Bhana, M Bernon, JC Kloppers, E Jonas

Surgical Gastroenterology Unit, Department of Surgery, Faculty of Health Sciences, Groote Schuur Hospital, University of Cape Town Health, South Africa

Corresponding author, email: *malinibhana@yahoo.com*

Background: Magnetic resonance imaging (MRI) is widely regarded as the gold standard for assessment of the bile ducts in patients with bile duct injuries (BDIs). This case series aims to highlight the shortcomings of this imaging modality and demonstrate how it may overestimate the injury severity.
Methods: Three patients treated at Groote Schuur Hospital and the University of Cape Town in whom MRI/magnetic resonance cholangiopancreatography (MRCP) overestimated the severity of BDI were included in the study. Demographic characteristics, clinical presentation, blood results and imaging findings are presented.
Results: All patients had an MRI/MRCP done which assessed the BDIs as major complete cut-off of the proximal common hepatic duct with substance loss. Subsequent direct cholangiography showed minor injuries and all three patients were successfully managed with endoscopic stenting.
Conclusion: Major BDIs are complex, and assessment of severity is intricate and may be overestimated. These patients are best managed in high-volume multidisciplinary team settings.
Keywords: bile duct injury, magnetic resonance imaging, endoscopic retrograde cholangiography

Introduction

Bile duct injury (BDI) remains a devastating complication of cholecystectomy. In the pre-laparoscopic cholecystectomy (LC) era, the incidence of BDI was reported to be around 0.2%.[1] After the introduction of LC, an increase in incidence to between 0.4 and 0.8% was reported.[2-5] In patients with a suspected bile duct injury, work-up is performed to establish the extent of the injury in terms of anatomical location and substance loss of the bile ducts, and to identify any associated vascular injury and intra-abdominal collections that may require drainage. Work-up includes contrast-enhanced computed tomography (CE-CT) using a liver protocol and magnetic resonance cholangiopancreatography (MRCP) to depict the biliary tree. The non-invasive imaging can be complemented by endoscopic retrograde cholangiography (ERC) and percutaneous transhepatic cholangiography (PTC) for better anatomical delineation of the biliary tree.

Major BDIs are defined as a transection of the common hepatic duct (CHD) or common bile duct (CBD), a partial injury involving > 25% of the circumference of the ducts or a postoperative stricture.[6] Reconstructing biliary continuity with a hepaticojejunostomy (HJ) using a Roux-en-Y configuration is accepted as the treatment of choice for major BDIs and is associated with the best long-term outcomes.[7] The overall morbidity after surgical reconstruction is reported to be as high as 36%, with a mortality rate of approximately 2%. Endoscopic management of major BDIs remains contentious with successful long-term outcomes reported in approximately two-thirds of patients.[8] Endoscopic management is, however, well established in the management of minor BDIs, and in some categories, is the treatment of choice. Overestimation of the severity of BDIs may lead to patients undergoing reconstructive surgery, rather than endoscopic treatment, with unnecessary exposure to the higher morbidity and mortality rates of operative management.

We report on three patients where MRCP overestimated BDI severity that were subsequently successfully treated by endoscopic means.

Patients and methods

We identified three patients from an ethics-approved prospective Groote Schuur Hospital GI Unit ERCP registry (HREC 414/2018) in whom MRCP overestimated the severity of BDI. Demographic characteristics, clinical presentation, blood results and imaging findings were reported and the injury classified at each stage by the ATOM classification.[9] The ATOM classification has distinct advantages over the commonly used Bismuth Strasberg classification which only describes the anatomical level of the biliary injury. The ATOM classification includes the anatomical level of injury (A) as well as time of detection (TO) and mechanism of injury (Me).[10]

Results

Demographic and clinical information is summarised in Table I. Cross-sectional imaging, ERC and PTC findings are shown in Table II.

Patient 1

A 30-year-old female represented to our unit with signs and symptoms of obstructive jaundice after an elective LC for biliary colic seven days earlier. An MRCP showed an

Table I: Patient demographics, presentation and blood results

	Patient		
	1	2	3
Demographics			
Age (years)	30	63	47
Gender	F	F	F
Clinical information			
Time of re-presentation	Day 7	Day 9	Day 5
Symptoms	Abdominal pain	Asymptomatic	Febrile
Clinical signs	Jaundice	Jaundice	Peritonitis
BMI	35	33	38
Blood tests			
White cell count (X 10^9/l) {RR 4.0–11.0}	16	16.6	5.25
Haemoglobin (g/dl) {RR 11.7–15.3}	12.2	12.1	13.7
Total bilirubin (umol/l) {RR 0–21}	161	186	143
Conjugated bilirubin (umol/l) {RR 0– 5}	144	131	130
AST (U/l) {RR < 32}	139	202	109
ALT (U/l) {RR < 35}	245	300	127
GGT (U/l) {RR < 40}	824	967	699
ALP (U/l) {RR 35–105}	221	491	252

abrupt cut-off of the proximal CHD 8 mm from the biliary confluence with substance loss of 9 mm (Figure 1a). The injury was classified as MBD2 Dc LS 8.9 VBI- L Me according to the ATOM classification. A CE-CT showed intact vascularity and no fluid collections. A right-sided PTC showed a narrowed portion of the CHD (ATOM MBD2 Op LS 8.9 VBI- L Me) which was traversed with a guidewire and an 8F internal/external catheter was placed (Figure1b, 1c). No leak could be demonstrated. During a subsequent ERC a fully covered self-expanding metal stent (SEMS) was placed covering the stricture with the distal end in the duodenum (Figure 1d). The PTC drain was removed one week later. At two months she was asymptomatic with a normal total bilirubin. The SEMS will be changed every three months for a total stent period of one year.

Patient 2

A 63-year-old female was referred to our hospital with obstructive jaundice 13 days after a LC at a peripheral hospital. An MRCP showed a cut-off of the proximal CHD 11 mm from the biliary confluence with substance loss of 11 mm (Figure 2a) (ATOM MBD2 Dc LS 11 VBI- L Me). A CE-CT showed no collections and an intact vascular supply. An ERC showed seven Liga clips around the cystic duct junction and a cut-off of the CBD (Figure 2b). A 0.25 mm guidewire was advanced beyond the stricture and the clip dislodged after inflation of a 6 mm dilatation balloon (Figure 2c) (ATOM MBD2 Oc LS 11 VBI- L Me). A fully covered SEMS was placed through the stricture (Figure 2d). The stent was changed every three months for one year. She made an uneventful recovery and 15 months after the first stent placement has normal LFTs.

Patient 3

A 47-year-old female was referred from a neighbouring country. She represented five days after a LC with pain and peritonitis at the referring hospital, where a laparotomy and washout were performed and a 6F feeding tube was placed through an opening in the bile duct into the CHD. An MRCP

Table II: Imaging findings of the three patients included

Imaging Modality	**Patient**		
CE-CT	**1**	**2**	**3**
Biliary dilatation	Yes	Yes	Yes
Vascular injury	No	No	No
Intra-abdominal collections	No	No	Yes
MRI/MRCP			
Biliary dilatation	Yes	Yes	Yes
Classification of injury*	MBD2 Dc LS 8.9 VBI- L Me	MBD2 Dc LS 11 VBI- L Me	MBD2 Dc LS 13 VBI- L Me
Distance from confluence	8 mm	11 mm	7 mm
Substance loss	9 mm	11 mm	13 mm
PTC			
Findings	Stricture below confluence no contrast flow below this. Traversed with guidewire 8F internal external catheter placed	Cut-off level at the metal clip on the CHD	Stricture below biliary confluence. Contrast flowinto the distal CBD and duodenum
Classification of injury*	MBD2 Op LS 8.9 VBI- L Me	MBD2 Oc LS 11 VBI- L Me	MBD2 Dp LS 13 VBI- L Me
ERCP			
Findings	FC SEMS (8 x 10 mm) placed PTC removed	Cut-off at level of the metal clip. Clip dislodged with guidewire with balloon dilation of CHD FC SEMS (8 x 10 mm) placed	Stricture just below biliary confluence. Bridged with guidewire. FC SEMS (8 x 60 mm) placed.
Classification of injury*	MBD2 Op LS 8.9 VBI- L Me	MBD2 Oc LS 11 VBI- L Me	MBD2 Dp LS 13 VBI- L Me

*ATOM Classification: MBD – for main bile duct; 1 to 6 – corresponding to the anatomic level on the bile duct (similar to the Strasberg-Bismuth classification 10); Oc – occlusion; D – division; P – partial; C – complete; LS – loss of substance, VBI – vasculo-biliary injury; Ei – early intraoperative detection; Ep – early postoperative detection; L – late detection; Me – mechanical mechanism of injury; ED – energy-driven mechanism of injury

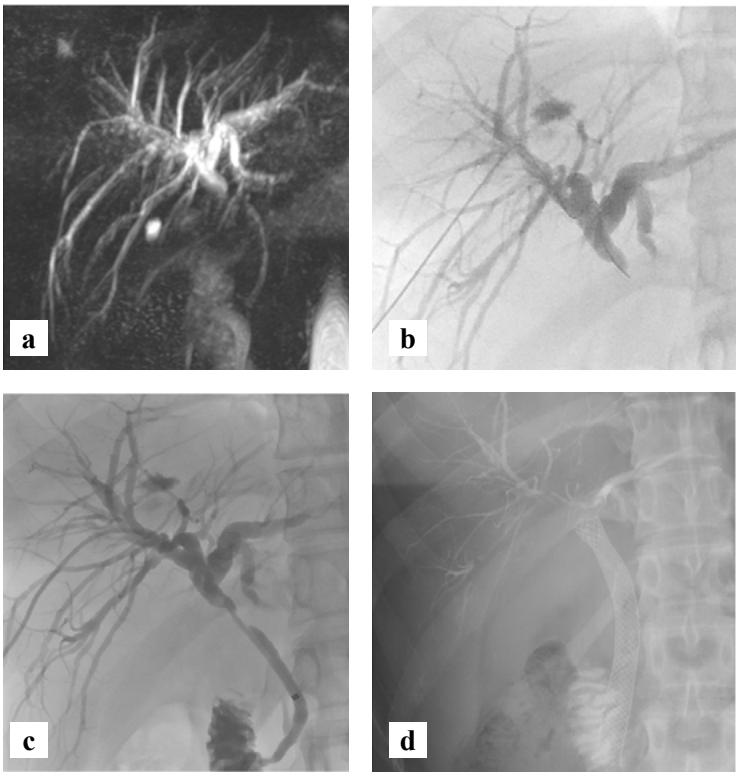

Figure 1: Patient 1, a) MRCP showing an abrupt cut-off of the proximal CHD 8 mm from the biliary confluence with substance loss of 9 mm, b) right-sided PTC showing a narrowed portion of the CHD, c) guidewire traversing the stricture, d) deployed SEMS across the stricture

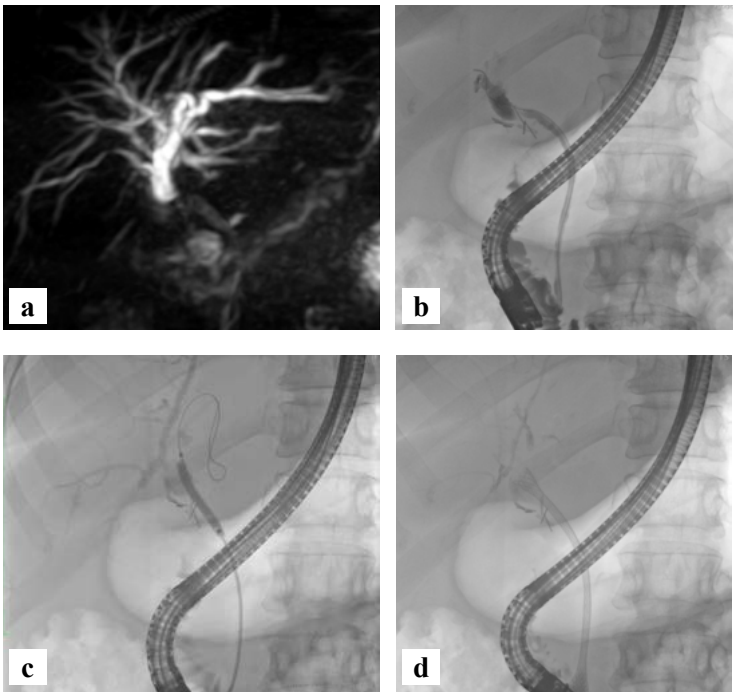

Figure 2: Patient 2, a) MRCP showing a cut-off of the proximal CHD 11 mm from the biliary confluence with substance loss of 11 mm, b) ERC showing a cut-off at the level of a clip across the CHD, c) balloon dilatation of the stricture with dislodgement of the metal clip, d) deployed SEMS across the stricture

was done two weeks after the initial injury which showed a cut-off of the bile duct 7 mm below the confluence with substance loss of 13 mm (Figure 3a) (MBD2 Dc LS 13 VBI- L Me). She was referred to our unit eight weeks after the LC for a bile duct repair. A cholangiogram via the percutaneous drain showed a stricture below the confluence, with distal CBD continuity (MBD2 Dp LS 13 VBI- L Me). At ERC a SEMS was deployed through the stricture covering the defect in the CBD (Figure 3b, 3c). The patient was discharged with normal bilirubin levels, with stent exchanges planned every three months for a total stent period of one year.

Discussion

In this report we demonstrate overestimation of BDI severity by MRCP in three patients. Initially, the MRCP images were reported as major BDIs, but subsequent PTC and/or ERC showed minor injuries, which were treated successfully by endoscopic stent placement.

MRCP relies on the high signal intensity of static bile in the ducts on T2-weighted imaging to depict the biliary tree which is reconstructed as three-dimensional images using maximum intensity projections of tomographic images. MRCP is limited by its qualitative nature, and requires operator interpretation, which may result in high rates of variability. Recent studies have demonstrated significantly different interpretation of high quality MRCP images by highly experienced radiologists and clinicians, with difficulty in distinguishing biliary strictures from transections.[11] The presence of large volumes of periductal fluid may obscure or compress intact bile ducts. Local swelling due to postoperative changes, not generating high T2 intensity signals, may also compress bile ducts, resulting in non-visualisation which may be misinterpreted as BDIs. Gadoxetic acid-enhanced MRI may facilitate distinguishing stenoses from transection and may show bile leaks.[12]

Complete transection on MRCP should be questioned in patients with moderately raised liver function tests (LFTs) with minimally dilated bile ducts in the absence of intra-abdominal collections or free fluid, in particular in patients presenting late. This would indicate that some level of drainage is preserved and further mapping of the bile ducts with ERC and/or PTC should be considered.

Inaccurate preoperative assessment of the extent of major BDIs in patients undergoing surgical repair may confound intraoperative interpretation of findings and decision-making. Overestimation of minor BDIs as major injuries may result in patients undergoing reconstructive surgery, rather than endoscopic treatment, with longer hospitalisation and unnecessary exposure to higher morbidity and mortality rates.

Conclusion

In patients with suspected major BDIs where clinical, biochemical and imaging findings are discrepant, additional imaging should be considered to prevent overestimation of the injury. These patients are best managed in multidisciplinary teams with input from hepato-pancreato-biliary surgeons, diagnostic and interventional radiologists and endoscopists.

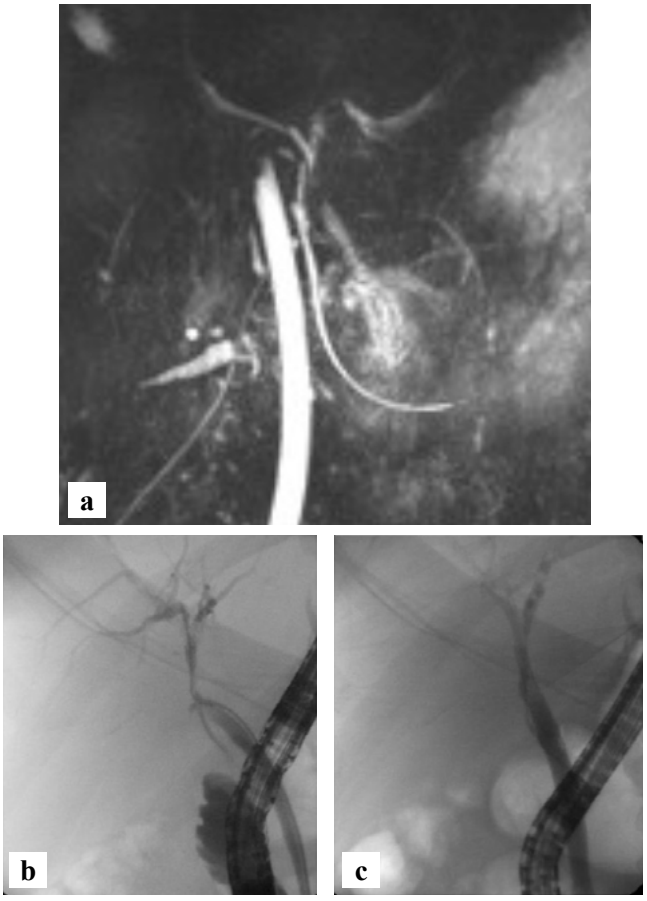

Figure 3: Patient 3, a) MRCP showing a cut-off of the bile duct 7 mm below the confluence with substance loss of 13 mm, b) ERC image with a guidewire placed across the stricture, c) deployed SEMS across the stricture and defect in the CBD

Conflict of interest

The authors declare no conflict of interest.

Funding sources

No funding was obtained for this study.

Ethical approval

Ethical approval was obtained from the University of Cape Town Health Human Research Ethics Committee (HREC 414/2018).

ORCID

M Bhana https://orcid.org/0000-0001-6301-2234
M Bernon https://orcid.org/0000-0002-7967-8548
JC Kloppers https://orcid.org/0000-0003-2438-6879
E Jonas https://orcid.org/0000-0003-0123-256X

REFERENCES

1. Roslyn JJ, Binns GS, Hughes EF, et al. Open cholecystectomy: a contemporary analysis of 42 474 patients. Ann Surg. 1993;218(2):129-37. https://doi.org/10.1097/00000658-199308000-00003.
2. Barone JE, Lincer RM. Correction: a prospective analysis of 1518 laparoscopic cholecystectomies. N Engl J Med. 1991;325(21):1517-8. https://doi.org/10.1056/NEJM199111213252117.
3. Deziel DJ, Millikan KW, Economou SG, et al. Complications of laparoscopic cholecystectomy: a national survey of 4292 hospitals and an analysis of 77 604 cases. Am J Surg. 1993;165(1):9-14. https://doi.org/10.1016/S0002-9610(05)80397-6.
4. Schirmer BD, Edge SB, Dix J, et al. Laparoscopic cholecystectomy. Treatment of choice for symptomatic cholelithiasis. Ann Surg. 1991;213(6):665-76; discussion 77. https://doi.org/10.1097/00000658-199106000-00018.
5. The Southern Surgeons Club. A prospective analysis of 1518 laparoscopic cholecystectomies. N Engl J Med. 1991;324(16):1073-8. https://doi.org/10.1056/NEJM199104183241601.
6. McMahon AJ, Fullarton G, Baxter JN, O'Dwyer PJ. Bile duct injury and bile leakage in laparoscopic cholecystectomy. Br J Surg. 1995;82(3):307-13. https://doi.org/10.1002/bjs.1800820308.
7. De'Angelis N, Catena F, Memeo R, et al. 2020 WSES guidelines for the detection and management of bile duct injury during cholecystectomy. World J Emerg Surg. 2021;16(1):30. https://doi.org/10.1186/s13017-021-00369-w.
8. Donatelli G, Cereatti F, Dhumane P, et al. Long-term outcomes of combined endoscopic-radiological approach for the management of complete transection of the biliary tract. J Gastrointest Surg. 2022;26(9):1873-80. https://doi.org/10.1007/s11605-022-05365-2.
9. Fingerhut A, Dziri C, Garden OJ, et al. ATOM, the all-inclusive, nominal EAES classification of bile duct injuries during cholecystectomy. Surg Endosc. 2013;27(12):4608-19. https://doi.org/10.1007/s00464-013-3081-6.
10. Strasberg SM, Hertl M, Soper NJ. An analysis of the problem of biliary injury during laparoscopic cholecystectomy. J Am Coll Surg. 1995;180(1):101-25.
11. Khalid TR, Casillas VJ, Montalvo BM, Centeno R, Levi JU. Using MR cholangiopancreatography to evaluate iatrogenic bile duct injury. AJR Am J Roentgenol. 2001;177(6):1347-52. https://doi.org/10.2214/ajr.177.6.1771347.
12. Ribeiro BJ, Alves AMA, de Oliveira RS, Velloni F, D'Ippolito G. The role of gadoxetic acid-enhanced magnetic resonance cholangiography in the evaluation of postoperative bile duct injury: pictorial essay. Radiol Bras. 2019;52(6):403-7. https://doi.org/10.1590/0100-3984.2018.0089.