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ORIGINAL ARTICLE

# A survey of the accuracy of interpretation of intraoperative cholangiograms

Pandanaboyana Sanjay[1,2], Sherry Tagolao[1], Ilse Dirkzwager[3] & Adam Bartlett[1,4]

[1]Hepatopancreaticobiliary Unit, Department of General Surgery and [2]Department of Hepatopancreatobiliary Surgery, Ninewells Hospital and Medical School, University of Dundee, Dundee, UK, [3]Department of Radiology, Auckland City Hospital, Auckland, New Zealand and [4]Department of Surgery, Faculty of Medicine and Health Sciences, University of Auckland, Auckland, New Zealand

## Abstract

**Objectives:** There are few data in the literature regarding the ability of surgical trainees and surgeons to correctly interpret intraoperative cholangiograms (IOCs) during laparoscopic cholecystectomy (LC). The aim of this study was to determine the accuracy of surgeons' interpretations of IOCs.

**Methods:** Fifteen IOCs, depicting normal, variants of normal and abnormal anatomy, were sent electronically in random sequence to 20 surgical trainees and 20 consultant general surgeons. Information was also sought on the routine or selective use of IOC by respondents.

**Results:** The accuracy of IOC interpretation was poor. Only nine surgeons and nine trainees correctly interpreted the cholangiograms showing normal anatomy. Six consultant surgeons and five trainees correctly identified variants of normal anatomy on cholangiograms. Abnormal anatomy on cholangiograms was identified correctly by 18 consultant surgeons and 19 trainees. Routine IOC was practised by seven consultants and six trainees. There was no significant difference between those who performed routine and selective IOC with respect to correct identification of normal, variant and abnormal anatomy.

**Conclusions:** The present study shows that the accuracy of detection of both normal and variants of normal anatomy was poor in all grades of surgeon irrespective of a policy of routine or selective IOC. Improving operators' understanding of biliary anatomy may help to increase the diagnostic accuracy of IOC interpretation.

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## Correspondence

Pandanaboyana Sanjay, Department of General Surgery, Auckland City Hospital, Park Road, Grafton, Auckland 1010, New Zealand. Tel: + 64 9 307 4949. Fax: + 64 9 375 4345. E-mail: sanjay.pandanaboyana@nhs.net

## Introduction

Laparoscopic cholecystectomy (LC) is one of the most commonly performed procedures worldwide; over 750 000 such procedures are performed every year in the USA.[1] One of the most feared complications of LC is bile duct injury (BDI), the incidence of which ranges from 0.4% to 1%.[2,3] The impact of BDI is significant; it affects longterm quality of life[4] and mortality rates,[5,6] in addition to placing a financial burden on the health care system.[7] Over the years, several strategies have been employed to minimize the incidence of BDI, including use of intraoperative cholangiography (IOC), laparoscopic ultrasound, cholecystocholangiography and the critical view of safety.[8] However, the success of any of these techniques depends on the accurate interpretation of normal biliary anatomy, anatomical variations and abnormal findings. A recent meta-analysis looking at variations in bile duct anatomy showed that aberrant anatomy is seen in 35% of patients and has a slightly higher incidence in females.[9] A further study noted that 85% of aberrant ducts appear to be within Calot's triangle,[10] which emphasizes the need for accurate interpretation of IOCs. The role of routine IOC in minimizing BDI is subject to debate with evidence for[11] and against[3] it. However, in the absence of accurate interpretation, a policy of routine IOC may have minimal impact on the prevention of BDI during LC. An electronic survey of surgical consultants and trainees was performed to identify current practice with regard to policy for routine or selective IOC and to assess the accuracy of interpretation of

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IOCs showing, respectively, normal, variants of normal and abnormal anatomy during LC.

## Materials and methods

Fifteen cholangiograms performed at the time of LC were identified by a consultant surgeon (AB) and independently verified by a consultant radiologist (ID). The cholangiograms were classified as showing normal ($n = 5$), variations of normal ($n = 5$) and abnormal ($n = 5$) anatomy. Normal cholangiograms were defined as those showing standard intra- and extrahepatic biliary anatomy with no anatomical variations or biliary dilation, and no filling defects, and demonstrating both the third-order intrahepatic ducts and contrast flow into the duodenum. The cholangiograms showing anatomical variants included images showing drainage of the right posterior duct (RPD) into the left hepatic duct (LHD) ($n = 1$), drainage of the RPD into the common hepatic duct (CHD) ($n = 1$), trifurcation of the right anterior duct (RAD), RPD and LHD ($n = 1$), insertion of the cystic duct into the LHD ($n = 1$) and low insertion of the cystic duct ($n = 1$). The abnormal cholangiograms included images of the cannulation of the cystic artery ($n = 1$), division of the CHD with cannulation of the common bile duct (CBD) ($n = 1$), division of the RHD ($n = 1$), and choledocholithiasis ($n = 2$). The images were digitalized, de-identified and electronically sent to 20 consultant general surgeons and 20 general surgical trainees throughout New Zealand. The participants were asked to classify each cholangiogram as showing normal, a variant of normal or abnormal anatomy. The operator's current practice regarding routine or selective use of IOC was also sought.

### Statistical analysis

Statistical analysis was performed using SPSS Version 17.0 (SPSS, Inc., Chicago, IL, USA). Fisher's exact *t*-test was used to compare outcomes between various groups. A *P*-value of <0.05 was considered to indicate statistical significance. The kappa coefficient was used to measure interobserver agreement between trainees and consultants, and for the total group.

## Results

All of the general surgical consultants and trainees who received the electronic survey responded. Five of the 20 surgical consultants stated they had a subspecialty interest in upper gastrointestinal or hepatopancreaticobiliary surgery. All of the trainees had completed at least 2 years of the Royal Australasian College of Surgeons (RACS) Surgical Education and Training (SET) programme. Only seven consultants and six surgical trainees stated that they performed cholangiography routinely in all patients undergoing cholecystectomy.

The cholangiograms showing normal anatomy were correctly identified by nine consultants and nine trainees. Three consultants and three trainees marked cholangiograms showing normal anatomy as showing variants of normal anatomy, and an equal number of consultants and trainees marked them as showing abnormal anatomy. Six out of 20 consultants and five out of 20 trainees correctly identified the presence of a variant of normal anatomy on the cholangiograms (Table 1). Seven consultants and six trainees marked cholangiograms showing variants of normal anatomy as normal, and seven consultants and nine trainees marked them as showing abnormal anatomy. A similar pattern was seen in both consultants and trainees.

**Table 1** Accurate identification of variants of normal anatomy on intraoperative cholangiograms by consultants and trainees

| Variant of normal anatomy | Consultants ($n = 20$) | Trainees ($n = 20$) | *P*-value |
|---|---|---|---|
| Low insertion of cystic duct | 16 | 13 | 0.480 |
| Insertion of RPD into LHD | 1 | 1 | 1.000 |
| Trifurcation of RPD, RAD and LHD | 9 | 7 | 0.747 |
| Insertion of cystic duct into LHD | 4 | 7 | 0.480 |
| Drainage of RPD into CHD | 1 | 0 | 1.000 |

RPD, right posterior duct; LHD, left hepatic duct; RAD, right anterior duct; CHD, common hepatic duct.

**Table 2** Accurate identification of abnormal anatomy on intraoperative cholangiograms by consultants and trainees

| Abnormal anatomy | Consultants ($n = 20$) | Trainees ($n = 20$) | *P*-value |
|---|---|---|---|
| Cannulation of cystic artery | 19 | 20 | 1.000 |
| Division of CHD | 19 | 20 | 1.000 |
| Choledocholithiasis | 18 | 20 | 0.487 |
| Choledocholithiasis | 19 | 20 | 1.000 |
| Division of RHD | 17 | 19 | 0.605 |

CHD, common hepatic duct; RHD, right hepatic duct.

The variations in the drainage of the RPD were less likely to be identified. Only two participants identified drainage of the RPD into the LHD. Only one consultant and none of the trainees correctly identified the low insertion of the RPD into the CHD. Anatomical variations in the drainage of the cystic duct were more likely to be identified, with 29 respondents correctly identifying a low insertion of the cystic duct into the CHD.

In 37 of 40 (92.5%) instances, the cholangiograms showing abnormal anatomy were correctly interpreted (Table 2). These cholangiograms were correctly interpreted by 19 of the 20 trainees and 17 of the 20 consultants; this difference was not statistically significant ($P = 1.000$). One trainee identified an abnormal cholangiogram as showing normal anatomy, and two consultants marked abnormal cholangiograms as showing a variant of normal and normal anatomy, respectively.

There was no statistically significant difference between respondents according to whether they routinely or selectively performed IOC in their ability to correctly interpret cholangiograms showing normal (four vs. 13), variants of normal (three vs. eight)