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ROLE OF PRE-OPERATIVE MAGNETIC RESONANCE CHOLANGIOPANCREATOGRAPHY (MRCP) IN PATIENTS OF GALL STONE DISEASE

Radiodiagnosis

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ABSTRACT

Gall stone disease is a common problem which is diagnosed mainly by clinical symptoms and signs and investigations like Ultrasound, Computerized Tomography (CT), Magnetic Resonance Cholangiopancreatography (MRCP) and Endoscopic Retrograde Cholangiopancreatography (ERCP). The definitive treatment for gall stone disease is surgery. MRCP provide excellent images of the biliary tree demonstrating ductal obstruction, strictures or other intraductal abnormalities. A normal biliary anatomy is present in only about 60% of the population. There are many cystic duct variants which can be recognised on MRCP, as it may be ligated or cut at the time of cholecystectomy. In this study we have taken 80 patients of gall stone disease undergoing laparoscopic cholecystectomy over a period of 15 months from February 2019 – April 2020, compared MRCP and laparoscopic findings. We also studied anatomy of intrahepatic and extrahepatic biliary radicals with their anatomical variations and assessed whether routine MRCP before laparoscopic cholecystectomy can reduce the risk of per-operative biliary tree injury.

KEYWORDS

Gall Stone, Common bile duct, Cystic Duct, Magnetic Resonance Cholangiopancreatography, Laparoscopic Cholecystectomy

INTRODUCTION

Gall stone disease is one of the commonest abdominal reasons for hospital admissions in developed countries and the situation in India is not much different.

MRCP has an established role in the investigation of many biliary disorders, serving as a non- invasive alternative to ERCP(1). MRCP uses specialized MRI sequences (i.e. heavily T2-weighted) to make the fluid in the ducts appear bright while the surrounding organs and tissues are suppressed and appear dark. MRCP is able to demonstrate the ducts beyond an obstructing lesion whereas this may be difficult with ERCP (2).

The right hepatic duct drains the segments of the right liver lobe (V-VIII). The right hepatic duct has two major branches: The right posterior duct draining the posterior segments VI and VII and the right anterior duct draining the anterior segments V and VIII. The left hepatic duct is formed by segmental tributaries draining segments II-IV(3). Swain B et al studied total of 1,038 cases of MRCP of population of Odisha. The typical and most common pattern of right hepatic duct (RHD) branching was seen in 72.8% cases. The most common variant of RHD was trifurcation pattern of insertion of right anterior sectoral duct (RASD), right posterior sectoral duct and left hepatic duct (LHD) forming common hepatic duct (CHD) in 11.3% of cases. The common trunk of segment II and III ducts joining the segment IV duct was the most common LHD branching pattern in 90.3% of cases(4).

The cystic duct attaches the gall bladder to the extrahepatic bile duct; its point of insertion into the extrahepatic bile duct marks the division between the common hepatic duct and the common bile duct. Variation of cystic duct described in table(5).

Table 1: Variation in cystic duct insertion

Layout (type)	Interpretation	Percentage
Type A	Long cystic duct with low insertion into the distal third of CBD	9
Type B	Medial cystic duct insertion	10-17
Type C	Parallel course of cystic duct with common hepatic duct	1.5-25
Type D	Abnormally high fusion of cystic duct with common hepatic duct	2.1
Type E	Cystic duct entering the right hepatic duct	0.7
Type F	Cholecystohepatic duct or subvesical duct	0.7
Type G	Cystic malformation of cystic duct	-
Type H	Others and unclassified variations	-

Laparoscopic cholecystectomy in now treatment of choice for cholethiasis. Laparoscopic cholecystectomy was completely incorporated into general surgery in an astonishing 2 years to 3 years, and reports of the successful use of laparoscopy in larger clinical studies led to the rapid development of minimally invasive surgery(6).

Radunovic M et al retrospectively studied medical records of 740 patients who had laparoscopic cholecystectomy. Among the postoperative complications, the most common ones were bleeding from abdominal cavity 27 (3.64%), biliary duct leaks 14 (1.89%), infection of the surgical wound 7 patients (0.94%) and 29 conversions (3.91%) (30). So, Bile duct injury, bile spill, stone spill, bleeding and conversion to open surgery were taken criteria for difficult surgery in our study.

Tariq Al-Aubaidi et al carried out randomized study on 100 patients aged 16-65 years between 2013 and 2015. Laparoscopic cholecystectomy was performed for them. The study showed that MRCP was a good non-invasive diagnostic imaging modality for the diagnosis of choledocholithiasis and biliary anomalies prior to laparoscopic cholecystectomy. Preoperative MRCP can reduce the incidence of laparoscopic cholecystectomy complications as it decreases the incidence of residual stone in the biliary ducts. However, using MRCP routinely is questionable, therefore, a criteria for the indications of MRCP is needed.(7)

MATERIALS AND METHODS

A Prospective comparative study was done in Ramkrishna care hospital, Raipur over a period of 15 months from February 2019 – April 2020. A total of 80 cases of gall stone disease undergoing laparoscopic cholecystectomy were included in the study.

INCLUSION CRITERIA

All patients of gall stone disease who are posted for laparoscopic cholecystectomy and underwent the same (irrespective of forced conversion to open surgery due to difficult surgery and/or complications).

EXCLUSION CRITERIA

1) Patients who are on medical treatment and who are planned for conventional cholecystectomy
2) Patient in whom MRI is contraindicated
3) Patient who are claustrophobic and are afraid to undergo MRI

RESULTS

In our study the age of the patients ranged between 19 and 83 years, majority of patients were in 4th and 5th decade of life with males being affected a decade later and female: male ratio of 1.16: 1.

On MRCP 28.75% patients have single calculus, 66.25% patients have multiple calculi and 5% have gall bladder sludge. while per operative finding during laparoscopic cholecystectomy showed single GB calculus in 26.25% of cases, multiple GB calculi in 70% of cases, GB sludge in 2.5% of cases and no calculi in 1.25% of case.

Table 2: Correlation of MRCP and Per-op findings of calculi - An Observation

MRI against Per-op Findings	True Positive	False Positive	False Negative	True Negative	Total
Single calculus	21	2	0	57	80
Multiple calculi	52	1	4	23	80
GB sludge	2	2	0	76	80
CBD calculus	7	0	0	73	80

Figure 1: Coronal thick section showing multiple calculi in GB and single calculus in mid CBD.

During correlating MRCP findings with per-operative findings, there were 2 false positive cases of single calculus, 1 false positive case and 4 false negative cases of multiple calculi, 2 false positive cases of GB sludge. A false positive case of multiple calculi was seen as after surgery no calculus was seen in GB and air was present in gall bladder instead of calculi which was confirmed with patients previous history.

8.75% of patient had CBD calculus on MRCP which was confirmed per operatively. MRCP showing sensitivity and specificity of 100% each for delineation of CBD calculi. 75% were having CBD diameter <7.0 mm and 25% were having CBD diameter ≥7.0 mm on MRCP. Mean diameter of CBD was 6 mm with a SD of 2.73 mm.

During study of cystic duct anatomy, right lateral insertion was found in 68.75% of cases, anterior spiral insertion into CHD in 7.5% of cases, posterior spiral insertion into CHD in 11.25% of cases, low lateral insertion of cystic duct was found in 3.75% of cases, high insertion of cystic duct was found in 2.5% of cases and low medial insertion of cystic duct was found in 3.75% of cases on MRCP which later on confirmed per operatively.

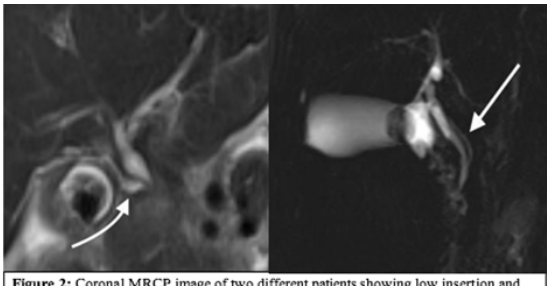

Figure 2: Coronal MRCP image of two different patients showing low insertion and low posterior insertion of cystic duct.

Table 3: Correlation of MRCP and Per-op findings - Cystic duct insertion

Cystic duct insertion	MRI		Per-op	
	No	%	No	%
A. Right lateral insertion	55	68.75	55	68.75
B. Anterior spiral insertion	6	7.5	6	7.5
C. Posterior spiral insertion	9	11.25	9	11.25
D. Low lateral insertion	3	3.75	3	3.75
E. High insertion	2	2.5	2	2.5
F. Low medial insertion	2	2.5	2	2.5
G. Others (long cystic duct, insertion into RHD)	3	3.75	3	3.75

The findings of Cystic duct insertion patterns are statistically correlated between MRI and Pre-op with sensitivity of 100.0%, specificity of 100.0%, PPV100%, NPV100%

In our study normal biliary tree anatomy was seen in 42.5 %, trifurcation of biliary duct in 25%, right dorsocaudal branch draining into LHD in 22.5%, aberrant RHD emptying into CHD in 5%(n=4) and aberrant RHD draining into cystic duct in 2.5% on MRCP. Per operative finding shows aberrant IHBR pattern in 7.5% of cases, among them 5% showing aberrant RHD emptying into CHD and 2.5% showing aberrant RHD draining into cystic duct. In 90% cases IHBR pattern was not assessed per-operatively.

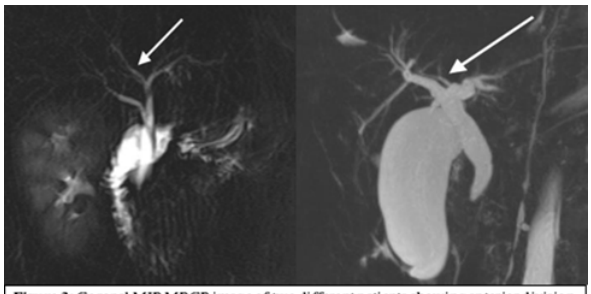

Figure 3: Coronal MIP MRCP image of two different patients showing anterior division of right hepatic duct draining into left hepatic duct and posterior division of right hepatic duct draining into left hepatic duct.

73.75% patient had operation time < 60 minutes and 26.25% patient had ≥60 minute. Mean operation time was 45.98±21.91 min.

Criteria included for difficult surgery in concordance with other studies were Laparoscopic surgery time > 60 minutes, bile spill, stone spill, bleeding, biliary tree injury, conversion to open surgery. There were 19 cases with surgery duration > 60 minutes, among these 1 case was associated with stone spill and bleeding another case was associated with bile spill and stone spill. Hence, there are 19 cases of difficult surgery.

Table 4: Univariate analysis to predict the difficulty of surgery

Variables	Outcome		Univariate		
	Difficult surgery (n=19)	Easy surgery (n=61)	P value	OR	95%CI
Age >65 years	0(0%)	12(19.67%)	0.15	0.10	0.006-1.80
Male	11(57.89%)	26(42.62%)	0.25	1.85	0.65-5.25
MRI-CBD stone	2(10.5%)	5(8.2%)	0.75	1.32	0.23-7.41
IHBR pattern (Aberrant)	2(10.5%)	6(9.84%)	0.93	1.08	0.20-5.84
Cystic duct insertion pattern (D+E+F+G)	5(26.31%)	5(8.2%)	0.037*	4.0	1.01-15.06
CBD ≥ 7.0 mm	8(42.11%)	12(19.67%)	0.04*	2.96	0.98-8.99

Cystic duct patterns(D+E+F+G) are significantly associated with difficult surgery with P value 0.037* and CBD diameter ≥7.0 mm was also significantly associated with difficult surgery with P value 0.04*. Age more than 65 years, male sex, CBD stone and IHBR pattern are not associated with difficult surgery.

DISCUSSION

The aim of this study is to predict the role of MRCP in predicting difficulty of laparoscopic cholecystectomy and the possibility of complications and conversion to open cholecystectomy before surgery in pre-operative case of Gall stone disease.

In present study majority of patients with gall stone disease were in 4th and 5th decade of life with males being affected a decade later. The mean age was 49±14 years (age range 19-83) with mean age of 50±16 years for males and 49±13 years for females respectively.

The sensitivity of MRI was 93 -100%, specificity 95 – 100% and accuracy 93 – 98% for detecting gall stones which was comparable to study done by Ajit Kumar Elaprolu et al in which sensitivity of MRI was 95 -100%, specificity 97 – 100% and accuracy 96 - 98% for detecting gall stones(8).

In our study the incidence of CBD calculus was 8.75% while Suraj

sonawane et al stated an incidence of CBD calculus of 10%(9). The sensitivity and specificity for detection of CBD calculus was 100% which was similar to study by Rao GB et al in which the sensitivity and specificity in detection of CBD stone by MRCP was 100%(10).

Our study confirmed that the dilated CBD (≥ 7 mm) could predict difficult surgery with a p value of 0.04 which was similar to study by Saeed A et al in which dilated CBD was described to have an association with difficult surgery and conversion to open surgery(11).

In our study we were able to demonstrate cystic duct anatomy in all the patients with 100% sensitivity and specificity. In present study, 5 out of 10 patients with anomalous cystic duct anatomy had difficult surgery. Our study showed that the anomalous cystic duct anatomy predicts the difficult surgery (p value of 0.037) which was similar to study by Radha sarawagi et al which evaluated that prior knowledge of the cystic duct anatomy and its variants helps in proper interpretation of disease process and avoids iatrogenic injuries(12) and by Nitin Babel et al which shows that biliary injuries occur mostly due to intraoperative anatomical misidentification of the cystic duct variation(13). Thus, Pre-operative MRCP helps in surgeon being well prepared for consequences thus reducing the bile duct injury or forced conversion to open surgery.

The sensitivity and specificity for delineation of biliary tree anatomy was 100% each. The incidence of anomalous IHBR patterns were 7.5% in present study. Anomalous drainage of the RPSD into the common hepatic duct was found in 5% and anomalous drainage of the RPSD into the cystic duct in 2.5%. The patterns of IHBR did not have any impact of difficult surgery. Bile duct injury was criteria for difficult surgery in concordance with study by Ghadhban BR et al in which injury to common bile duct was taken criteria for difficult surgery(14). In our study, there were no bile duct injuries due to improved technique.

Conversion from laparoscopic to open cholecystectomy was criteria for difficult surgey in concordance with study by Ghadhban BR et al in which conversion was taken criteria for difficult surgery(14). In our study, there were no conversions to open surgery.

In our study, the mean operation time was 45.98±21.91 min which is comparable to study by Pramod Singh et al which showed in study of 100 patients average time taken for complete Laparoscopic surgery was 44.7 minutes(15). In present study there are 23.75%(n = 19) of cases with duration of surgery>60 minutes. Duration of surgery>60 was criteria for difficult surgey in concordance with study by Ghadhban BR et al in which surgery was easy, if duration of surgery was ≤60 minutes and difficult, if duration>60minutes(14).

Thus in our study, the aberrant Cystic duct patterns(D+E+F+G) and CBD diameter ≥7.0 mm was significantly associated with difficult surgery which can be easily demonstrated on MRCP.

CONCLUSION

MRCP is non-invasive, radiation free imaging modality with multiplanar capabilities, excellent post processing and delineation of biliary anatomy. It can accurately detect gall stones and delineate biliary tree anatomy. It can detect anomalous biliary tree and can predict difficult surgery thus helping the surgeon to be prepared for the eventualities during surgery and to prevent biliary injury. Overall, there is reduction in patient morbidity.

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