



CORRELATION OF MAGNETIC RESONANCE CHOLANGIO-PANCREATOGRAPHY AND INTRAOPERATIVE CHOLANGIOGRAPHY IN CHOLECYSTECTOMY

Dr Upasna	Associate Professor, Dept of Anatomy, Government Medical College, Patiala.
Dr Ruchi Jakhar	Junior Resident, Department of General Surgery, Rajindra Hospital, Patiala.
Dr Parth Dhamija*	Senior Resident, Department of General Surgery, Rajindra Hospital, Patiala. *Corresponding Author
Dr Ashwani Kumar	Professor and Head, Dept of General Surgery, Rajindra Hospital, Patiala.
Dr Manoj Mathur	Professor and Head, Department of Radiodiagnosis, Rajindra Hospital, Patiala
Dr Vandna	Junior Resident, Dept of Pharmacology, Shyam Shah Medical College, Rewa.

ABSTRACT **Background:** Laparoscopic Cholecystectomy (LC) is one of the most common procedure performed for symptomatic cholelithiasis. Older age group, male sex, prior upper abdominal surgeries, frozen Calot's triangle, increased duration of surgery (> 60 min) and aberrant extrahepatic biliary anatomy are some of the factors that can make the procedure difficult. Pre-op MRCP and IOC are useful radiological investigations which help in assessing the above mentioned factors in planning safe cholecystectomy. **Material and Method:** A prospective cohort study was conducted in Department of General Surgery, Rajindra Hospital, Patiala. A total of 60 patients who underwent cholecystectomy were included. Pre-op MRCP and IOC were performed in all patients. Cholecystectomy was performed in all patients. CBD exploration and stenting was considered for CBD stone and/or CBD stricture if detected in MRCP or IOC. **Results:** Among 60 studied patients, majority were females (72%) and average age was 47.28 ± 13.74 years. 59 out of 60 patients experienced pain during the course of disease. CBD stones were visualized in 24 patients on MRCP & in 28 patients on IOC but presence of CBD stones was confirmed intra-operatively in only 25 patients. In detecting biliary anatomy variations, both investigations had concordant results. CBD stricture was seen in five & seven patients on IOC & MRCP respectively. No bile duct injury was observed on IOC. Cost for MRCP (3500 INR) was more than that of IOC (2370.00 ± 96.20 INR). The overall diagnostic accuracy and efficacy was higher in case of MRCP than of IOC. **Conclusion:** Our study reached to a conclusion that Pre-op MRCP was more efficacious and more diagnostically accurate in assessing factors which can lead to a difficult cholecystectomy. To improve safety of cholecystectomy, MRCP should be obtained in patients with suspected biliary obstruction or pathology & IOC should be kept for reserved cases.

KEYWORDS : Cholecystectomy; Common bile duct; Intraoperative Cholangiogram; Magnetic Resonance Cholangio-pancreatography

INTRODUCTION

Cholelithiasis is the most prevalent gall bladder pathology affecting 10 to 20% of the world's population making it one of the most common abdominal surgery in the Western population [1]. Ultrasonography (USG) has been considered as the modality of choice for diagnosis of cholelithiasis bearing a higher sensitivity as compared to computed tomography [2]. Development of secondary CBD Stones in the presence of gallstones is a common entity making its accurate preoperative detection imperative for reducing overall morbidity and mortality along with health care costs[3].

Limitations of USG in detection of CBD stones and other pathologies are overcome by the availability of more sensitive investigations such as Magnetic Resonance Cholangio Pancreatography (MRCP) and Intra Operative Cholangiogram (IOC)[4]. MRCP, being a non-invasive radiological investigation is being widely used as a primary imaging modality for delineating biliary anatomy to rule out any obstruction either due to stricture or stones and helping in therapeutic operative planning[5].

IOC enables detection of unsuspected choledocholithiasis and anatomical variation during laparoscopic cholecystectomy and helps in avoiding bile duct injury, incidence of which is more during LC[6]. In recent times, the use of IOC has decreased because of increased operative times, steep learning curve, invasive nature and the availability of improved techniques such as MRCP, EUS and Endoscopic Retrograde CholangioPancreatography(ERCP)[7]. Despite wide variety of investigations, consensus on the diagnostic method ensuring the safety of LC has not been established. Hence, the urge for conducting this study was generated to compare efficacy and diagnostic accuracy of MRCP and IOC after correlating their findings.

MATERIAL AND METHODS

This was a prospective cohort study conducted in Department of General Surgery, Rajindra Hospital, Patiala where a total of 60 patients undergoing cholecystectomy (open/laparoscopic) from November

2021 to November 2022 were included. Pre-operative assessment including detailed history and examination, routine lab investigations and anaesthetic check up was conducted. All patients underwent pre-operative MRCP followed by cholecystectomy and simultaneous IOC for CBD delineation. MRCP was done using 1.5 Tesla superconducting unit without the use of any contrast media. IOC was done using an infant feeding tube (5 Fr) inserted into the cystic duct, followed by injection of 20 ml diluted iodinated contrast (diatrizoate meglumine in 1:1 dilution with normal saline). Fluoroscopic images were taken and interpreted intra-operatively. Choledochoscopy was performed to correlate the findings of both IOC and MRCP.

The results of our study were described as continuous variables and expressed in terms of mean and standard deviations. Further analysis of the data was done by using chi-square and student t-tests. P-value of <0.005 was considered statistically significant.

RESULTS

In our study, average age of patient was 47.28 ± 13.74 years with majority being females (72%). 37 (61.66%) patients experienced only pain, one had only jaundice and rest all had other associated features (vomiting, dyspepsia, jaundice) along with pain during their course of disease. On biochemical testing, out of a total of 60 patients, 21 (39%) had raised serum bilirubin (>1mg/dl) & 53 (88.33%) patients had raised serum alkaline phosphatase (>128 IU/L).(Table 1)

Table 1 : Biochemical Results

S. Bilirubin				S. Alkaline Phosphatase (ALP)			
Normal (0.1-1.0 mg/dL)		Raised (>1 mg/dL)		Normal (53-128 IU/L)		Raised (>128 IU/L)	
Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
39	65	21	35	7	11.67	53	88.33

The following results were obtained with MRCP and IOC in terms of CBD stones, Stricture and variations in biliary anatomy :

Table 2: Detection Of CBD Stones

CBD Stones	USG (%)	Pre-Op MRCP (%)	IOC (%)	Intra Operative (%)	X2	p value
Stone	10(16.67%)	24(40%)	28(46.67%)	25(41.67%)	0.54	0.461
No Stone	50(83.33%)	36(60%)	32(53.33%)	35(58.33%)		
Total	60(100%)	60(100%)	60(100%)	60(100%)		

Table 3: Detection Of CBD Stricture

CBD Stricture	Pre-Op MRCP		IOC		X ² value	p value
	Patients	Percentage	Patients	Percentage		
Stricture	7	11.67%	5	8.33%	0.37	0.543
No Stricture	53	88.33%	55	91.67%		
Total	60	100%	60	100%		

Table 4: Detection Of Variations In Bile Duct Anatomy

Bile Duct Anatomical Variations	Pre-Op MRCP		IOC		X ² value	P - value
	No. of patients	%	No. of patients	%		
Dilated and Tortuous Cystic Duct	2	3.33%	2	3.33%	0.42	0.519
Low & Medial Insertion of Cystic Duct	4	6.67%	4	6.67%	0.20	0.657
Long Tortuous with Low & Medial Insertion of Cystic Duct	1	1.67%	1	1.67%	0.75	0.386
Type 3A Bile duct variation	1	1.67%	1	1.67%	0.75	0.386
No	52	86.67%	52	86.67%	0.02	0.901
Total	60	100%	60	100%		

DISCUSSION

Laparoscopic cholecystectomy (LC) is the most commonly performed surgery for cholelithiasis[1]. Multiple radiological investigations such as ultrasound, MRCP and IOC are available for diagnosis of cholelithiasis and other disorders of hepatobiliary system. Incidence of cholelithiasis increases dramatically after the age of 40 especially in females due to presence of increased levels of estrogen[8,9]. Out of 60 diagnosed cases of cholelithiasis, majority were females (43, 72%) with similar findings observed by Samanta PK et al (2020)[10].

Migration of gallstones into the CBD is a common phenomenon where pre-operative detection is important to reduce morbidity in patients undergoing treatment for cholelithiasis. MRCP and IOC are the two widely accepted investigations for delineating the biliary tree and therefore diagnosing CBD stones and other pathologies.

In our study, when we correlated and compared the findings of pre-op MRCP and IOC regarding CBD stone detection, we considered intraoperative findings for CBD stones as the 'gold standard' method. Intra-op findings were assessed using choledochoscopy before and after CBD stones extraction. MRCP showed presence of stones in 40% (24/60) cases whereas IOC showed it in 46.67% (28/60) cases. Intra-operatively, stones were detected in 25/60 cases (41.67%). Various studies have utilized these investigations for diagnosing CBD stones and their findings have been summarized in Table 5.

Table 5: MRCP And IOC Findings Of Various Studies

Name of the Study	Findings
Zidi SH et al[11]	MRCP + in 28/49 (56%) pts. Confirmed By ERCP
Varghese JC et al[12]	MRCP + in 31/34 (91%) pts. Confirmed by ERCP and IOC
Demartines et al[13]	MRCP + in 21/40 (52%) pts. Confirmed by ERCP in 19 pts. MRCP + in 6/30 (20%) pts. Confirmed by IOC in all 6 pts.
Dalton SJ et al[14]	MRCP + in 16/69 (23%) pts. Confirmed by IOC in 14 pts.
Richard F et al[15]	Out of 70 pts, MRCP alone was + in 9 pts. IOC alone was + in 13 pts. Both MRCP and IOC were + in 6 pts. Confirmed by ERCP

Mandelia A et al[16]	MRCP + in 19/30 (63.3%) pts. Confirmed by CBD exploration
Silva A A et al[17]	Pre op IOC showed CBD stones in 32/143 (22.37%) pts. Intra op IOC showed CBD stones in 33/243 (13.58%) pts.
Tofigh AM et al[18]	MRCP + in 14/59 (23.7%) pts. IOC was + in 8 of these pts.
Zang et al[19]	MRCP + in 192/257 (74.7%) pts. Confirmed by exploration in 180 pts. IOC + in 157/213 (73.7%) pts. Confirmed by exploration in 152 pts.
Virzi V et al[20]	MRCP + in 7/104 (6.7%) pts. Confirmed by ERCP
Thacoor A et al[21]	MRCP + in 12/36 (33.3%) pts. Confirmed by exploration in 1 pt. IOC + in 13/102(12.7%) pts. Confirmed by exploration in 11 pts.
Perales SR et al[22]	MRCP + in 27/72 (37.5%) pts. Confirmed by ERCP in 20 pts.
Samanta PK et al[10]	MRCP + in 112/130 (86.1%) pts. Confirmed by exploration in 108 pts.

Demartines et al[13] found MRCP to be more sensitive (100%) than IOC & also highly specific (95.6%) modality in diagnosing choledocholithiasis. Zidi SH et al[11] similarly showed MRCP as an investigation with 100% specificity in diagnosing choledocholithiasis and favored its use but with improved techniques. Whereas other studies like Richard F et al [15] and Tofigh AM [18] favored use of IOC over MRCP due to high false negative and high false positive results of MRCP respectively. Kumar A et al [23] concluded that information obtained from routine IOC didn't make any difference in managing cholelithiasis and our study supported the same. In our study we saw that MRCP was more diagnostically accurate (98.33%) than IOC (95%) in diagnosing choledocholithiasis.

Considering other pathologies including bile duct stricture and bile duct anatomy, no significant difference was observed among two modalities. Studies done by Bahram M et al[24] and Al-Aubaidi et al[25] agreed on the thought that MRCP provides information regarding silent CBD stones & variations in biliary anatomy which benefited in reducing post cholecystectomy complications.

Rhaiem R et al[26] observed that MRCP was not only a diagnostic tool but can also help in preventing bile duct injuries (BDI). In a study done by Alvarez F et al[27], 20 (0.17%) patients had bile duct injuries during LC but IOC demonstrated the same in 18 patients, thereby suggesting the routine use of IOC in prevention of BDI's. In our study no bile duct injuries were detected in patients who underwent MRCP preoperatively.

CONCLUSION

MRCP and IOC are two important radiological investigations available for delineating the biliary tree for diagnosis numerous pathologies. MRCP is a non-invasive procedure with an additional benefit of no radiation exposure in contrast to IOC. Although MRCP is an expensive investigation, it provides detailed information concerning gall bladder and hepatopancreaticobiliary system which helps in deciding the best possible outcomes for patients with gallstones and CBD stones. Use of IOC increases the overall operative time along with increased chances of complications such as contrast allergy, steep learning curve, radiation exposure and limited information. In our study MRCP was found to be overall more diagnostically accurate and efficacious than IOC. The misdiagnosed cases were also higher with IOC (false positive results in three patients) than with MRCP (one missed case of choledocholithiasis). Hence MRCP should be performed preferably and IOC being kept for highly selective cases, in performing cholecystectomy safely.

REFERENCES

- Tandon, B. N., & Nundy, S. (1988). Textbook of tropical gastroenterology. Vol. I. Hepatobiliary diseases. Textbook of tropical gastroenterology. Vol. I. Hepatobiliary diseases.
- Ahmed, M., & Diggory, R. (2011). The correlation between ultrasonography and histology in the search for gallstones. The Annals of The Royal College of Surgeons of England, 93(1), 81-83.
- O'Neill, C. J., Gillies, D. M., & Gani, J. S. (2008). Choledocholithiasis: overdiagnosed endoscopically and undertreated laparoscopically. ANZ Journal of Surgery, 78(6), 487-491.
- Kiryama, S., Kozaka, K., Takada, T., Strasberg, S. M., Pitt, H. A., Gabata, T., ... & Yamamoto, M. (2018). Tokyo Guidelines 2018: diagnostic criteria and severity grading of acute cholangitis (with videos). Journal of Hepato-Biliary-Pancreatic Sciences, 25(1), 17-30.
- Maccioni, F., Martinelli, M., Ansari, N., Kagarmanova, A., De Marco, V., Zippi, M., &

- Marini, M. (2010). Magnetic resonance cholangiography: past, present and future: a review. *European Review for Medical & Pharmacological Sciences*, 14(10).
6. Edey, M., Dalvi, A., Canin-Endres, J., Baskin-Bey, E., & Salky, B. (2002). Intraoperative cholangiography is still indicated after preoperative endoscopic cholangiography for gallstone disease. *Surgical Endoscopy and Other Interventional Techniques*, 16, 799-802.
 7. Lehrs-kov, L. L., Westen, M., Larsen, S. S., Jensen, A. B., Kristensen, B. B., & Bisgaard, T. (2020). Fluorescence or X-ray cholangiography in elective laparoscopic cholecystectomy: a randomized clinical trial. *Journal of British Surgery*, 107(6), 655-661.
 8. Maringhini, A., Ciambra, M., Baccelliere, P., Raimondo, M., Orlando, A., Tine, F., ... & Pagliaro, L. (1993). Biliary sludge and gallstones in pregnancy: incidence, risk factors, and natural history. *Annals of Internal Medicine*, 119(2), 116-120.
 9. Etmnan, M., Delaney, J. A., Bressler, B., & Brophy, J. M. (2011). Oral contraceptives and the risk of gallbladder disease: a comparative safety study. *CMAJ*, 183(8), 899-904.
 10. Samanta, P. K., Sarkar, R., & Bakshi, S. (2020). Comparison of pre-operative ultrasonography and magnetic resonance cholangiopancreatography with intra-operative surgical findings among patients suspicious to choledocholithiasis. *International Surgery Journal*, 7(6), 1977-1984.
 11. Zidi, S. H., Prat, F., Le Guen, O., Rondeau, Y., Rocher, L., Fritsch, J., ... & Pelletier, G. (1999). Use of magnetic resonance cholangiography in the diagnosis of choledocholithiasis: prospective comparison with a reference imaging method. *Gut*, 44(1), 118-122.
 12. Varghese, J. C., Liddell, R. P., Farrell, M. A., Murray, F. E., Osborne, D. H., & Lee, M. J. (2000). Diagnostic accuracy of magnetic resonance cholangiopancreatography and ultrasound compared with direct cholangiography in the detection of choledocholithiasis. *Clinical Radiology*, 55(1), 25-35.
 13. Demartines, N., Eisner, L., Schnabel, K., Fried, R., Zuber, M., & Harder, F. (2000). Evaluation of magnetic resonance cholangiography in the management of bile duct stones. *Archives of Surgery*, 135(2), 148-152.
 14. Dalton, S. J., Balupuri, S., & Guest, J. (2005). Routine magnetic resonance cholangiopancreatography and intra-operative cholangiogram in the evaluation of common bile duct stones. *Annals of the Royal College of Surgeons of England*, 87(6), 469.
 15. Richard, F., Boustany, M., & Britt, L. D. (2013). Accuracy of magnetic resonance cholangiopancreatography for diagnosing stones in the common bile duct in patients with abnormal intraoperative cholangiograms. *The American Journal of Surgery*, 205(4), 371-373.
 16. Mandelia, A., Gupta, A. K., Verma, D. K., & Sharma, S. (2013). The value of magnetic resonance cholangio-pancreatography (MRCP) in the detection of choledocholithiasis. *Journal of clinical and diagnostic research: JCDR*, 7(9), 1941.
 17. Silva, A. A., Camara, C. A. C. R., Martins Júnior, A., Teles, C. J. O., Terra Júnior, J. A., & Crema, E. (2013). Intraoperative cholangiography during elective laparoscopic cholecystectomy: selective or routine use?. *Acta Cirúrgica Brasileira*, 28, 740-743.
 18. Tofigh, A. M., Razmjoe, F., Khabbaz, A., Ayazi, K., Farahmand, S., Honar, B. N., & Nikshoar, M. R. (2013). Comparing the efficacy of preoperative magnetic resonance cholangiopancreatography with intra-operative cholangiography in patients suspicious to biliary stones. *Gastroenterology and hepatology from bed to bench*, 6(2), 80.
 19. Zang, J., Yuan, Y., Zhang, C., & Gao, J. (2016). Elective laparoscopic cholecystectomy without intraoperative cholangiography: role of preoperative magnetic resonance cholangiopancreatography-a retrospective cohort study. *BMC surgery*, 16, 1-6.
 20. Virzi, V., Ognibene, N. M. G., Sciortino, A. S., Culmone, G., & Virzi, G. (2018). Routine MRCP in the management of patients with gallbladder stones awaiting cholecystectomy: a single-centre experience. *Insights into imaging*, 9, 653-659.
 21. Thacoor, A., Pike, T. W., Pathak, S., Dixon, J., Macutkiewicz, C., & Smith, A. M. (2019). The role of intraoperative cholangiography in patients undergoing laparoscopic cholecystectomy for acute gallstone pancreatitis: is magnetic resonance cholangiopancreatography needed?. *The Annals of The Royal College of Surgeons of England*, 101(6), 428-431.
 22. Perales, S. R., Souza, L. R. M. F., & Crema, E. (2019). Comparative evaluation of magnetic resonance cholangiopancreatography and perioperative cholangiography in patients with suspect choledocholithiasis. *ABCD. Arquivos Brasileiros de Cirurgia Digestiva (São Paulo)*, 32.
 23. Kumar, A., Kumar, U., Munghate, A., & Bawa, A. (2015). Role of routine intraoperative cholangiography during laparoscopic cholecystectomy. *Surgical endoscopy*, 29, 2837-2840.
 24. Bahram, M., & Gaballa, G. (2010). The value of pre-operative magnetic resonance cholangiopancreatography (MRCP) in management of patients with gall stones. *International journal of surgery*, 8(5), 342-345.
 25. Al-Aubaidi, T., Ghadhbani, B. R., & Chitheer, S. S. (2018). Does preoperative magnetic resonance cholangiopancreatography (MRCP), improve the safety of laparoscopic cholecystectomy?. *International Journal of Surgery Open*, 15, 7-13.
 26. Rhaieem, R., Piardi, T., Renard, Y., Chetboun, M., Aghaei, A., Hoeffel, C., ... & Kianmanesh, R. (2019). Preoperative magnetic resonance cholangiopancreatography before planned laparoscopic cholecystectomy: is it necessary?. *Journal of Research in Medical Sciences: The Official Journal of Isfahan University of Medical Sciences*, 24.
 27. Alvarez, F. A., De Santibañes, M., Palavecino, M., Sánchez Clariá, R., Mazza, O., Arbues, G., ... & Pekolj, J. (2014). Impact of routine intraoperative cholangiography during laparoscopic cholecystectomy on bile duct injury. *Journal of British Surgery*, 101(6), 677-684.