



## THE RADIOLOGIST'S ROLE IN THE MINIMALLY INVASIVE THERAPY OF RESIDUAL COMMON BILE DUCT LITHIASIS

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**Abstract.** Residual lithiasis found in the main bile duct entails the presence, at the site, of one or more calculi, consequent to a surgical procedure for gallbladder or common bile duct lithiasis. Currently, the surgical community is trying to treat this condition via a minimally invasive procedure: endoscopic retrograde cholangiopancreatography. A bile duct obstacle can be diagnosed based on several imagistic methods, the most important ones being: the ultrasound, computed tomography or the cholangio- MRI. These methods aim to detect an obstacle, to establish its nature, location and size. The decision to apply these imagistic diagnostics techniques or different ones, depending on their indications, contraindications or their succession belongs, entirely, to the radiologist. In this sense, we compared the results we have obtained so far to specialised studies and research, in an attempt to establish the highest reliability level in the diagnostic imaging investigation of the common bile duct lithiasis whose absence would make impossible an endoscopic retrograde colangiopancreatography.

**Keywords:** choledocholithiasis; ultrasonography; computed tomography; magnetic resonance cholangiopancreatography; endoscopic retrograde colangiopancreatography

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### Introduction

The restant choledocolithiasis represents the residual calculi in the main bile duct, following a procedure at the level of the biliary tract, in history up to a maximum of two years. The approach of a patient that presents restant calculi in the common bile duct relies significantly on the radiologist, who will give a precise diagnosis and localization of the lithiasis as well as provide guidance to the surgeon in view of applying a minimally invasive therapy - ERCP.

Finding an obstacle in the common bile duct requires an immediate and precise location, the establishment of the structure, the assessment of the obstruction degree as well as possible proximal modifications, either pre-existent ones or caused by the calculus itself. Hence, having a clear-cut image of these details depends on imaging methods. In this sense, the most essential data are provided by the following exploration techniques: ultrasound, computed tomography (CT) or cholangio-MRI(MRCP).

Our study aimed to compare current literature with results from our clinical experience regarding the most

effective imaging means to diagnose a restant common bile duct lithiasis that grounds a minimally invasive therapy, as well as their selective use based on benefits and disadvantages.

### Imaging methods

In order to visualise the bile duct, an ultrasound is the first step taken following the clinical examination. In a limited number of cases an abdominal ultrasound shows the bile duct calculi. In most situations, ultrasounds evince only the dilated bile duct. If the images are inconclusive, this technique will guide the radiologist to opt for a different exploration method, which, in fact, constitutes its utility.

A computed tomography (CT) stands for an imagistic exploration method that detects the presence of an obstacle in the bile duct; it provides an estimation of the obstructed segment and sets the cause of the blockage as well as ensures extra data on the simultaneous abdominal pathologies.

The quality of a CT examination increases along with an augmented number of slices that lead to high resolution sections and numerous post processing possibilities.

A cholangio-MRI (Magnetic resonance cholangiopancreatography MRCP) is the most sensitive method that permits an in-depth analysis of the bile duct without contrast agent, identifying with 90-95% sensitivity, the presence of an obstacle in

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the bile duct. The technique doesn't rely on exposure to X-rays but, unlike the CT, it cannot highlight the nature of the obstruction. However one of the most essential traits is its effectiveness in tracing even the smallest calculi that usually do not appear during a CT examination.

## Results

We focused and studied the cases of all patients in Coltea Clinical Hospital, Bucharest who underwent ERCP for restant bile duct lithiasis.

The patients with excision of the gallbladder that presented to our clinic for jaundice, subsequently to the clinical exam were submitted to an abdominal ultrasonography.

Our experience with ultrasound in patients with mechanical jaundice and prior ablation of the gallbladder emphasized the dilation of the biliary tract in 98% of cases. A precise individualization through ultrasound of the bile duct lithiasis was achieved for 72% of the overall analysed cases.

Compared to our results, literature expands and describes the experience of various specialists in the field.

Terhaar demonstrated an 86,4% negative predictive value of the ultrasound coming to the conclusion that if an ultrasound detects a main bile duct calculus with a dimension larger than 10mm without an obvious cause, the following step will most likely be an MRCP [1].

A smaller calculus, if positioned in the distal common bile duct will be missed by the ultrasound examination. In this context, Maurea proved that if a calculus has been localised in the distal common bile duct this happened through magnetic resonance cholangiopancreatography (MRCP) and not through an ultrasound [2].

According to Ferrari, if there is any clinical and laboratory suspicion of common bile duct lithiasis, with no confirmation from the abdominal ultrasound, the patient has to undergo an MRCP. On the other hand, if the clinical and lab data raised the main bile duct calculus suspicion and the ultrasound confirmed the lithiasis then the patient will either suffer an endoscopic retrograde cholangiopancreatography (ERCP) or will undergo surgery [3].

However, among the community many support the ultrasound as the first imagistic choice in the assessment of patients with suspicion of biliary obstruction, like Ghimire [4] or others who will opt for subsequent investigation techniques- Blackbourne [5] and Pickuth [6,7].

Kristiansen sustains that patients with cholangitis, jaundice and choledocholithiasis detected via ultrasound will benefit directly from ERCP [8].

In what concerns the computed tomography (CT), our experience proved a 95% accuracy of the method that detects a calculus and over 95% rate of success in terms of precise localization. Once detected, the biliary obstruction must be etiologically differentiated: benign-malignant.

Rosch found 77% sensitivity and 63% specificity of the CT during the process of diagnosing the biliary strictures [9].

In order to obtain a comprehensive image of non

lithiasic lesions possibly responsible for the dilatation of the biliary tract, a CT examination with intravenously administered contrast agent is mandatory. A tumoral lesion will grow in density by contrast overflow, while a calculus will keep the same density [10].

In 87% of biliary lithiasis cases, Maurea has found a correspondence between the data obtained from multislice computed tomography (MSCT) and MRCP [2].

Anderson has found moderate sensitivity and specificity degrees of the native CT followed by intravenous contrast administration, by using axial sections when detecting choledocholithiasis [10]. Tseng revealed that CT diagnosis has been significantly lower in patients with common bile duct calculi smaller than 5 mm (56.5%) compared to patients that presented choledocholithiasis larger than 5 mm (81.2%), the coronal plane reconstructions exerting no modification in the CT's efficacy of diagnosing the common bile duct lithiasis [11].

In terms of evincing choledocholithiasis Pickuth discovered 86% sensitivity and 98% specificity of the native CT, this procedure being useful especially for the cases of calculi at the level of the ampulla [6].

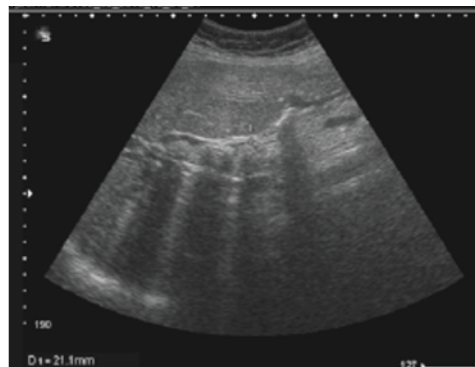


Figure 1a. Ultrasound -lithiasis CBD

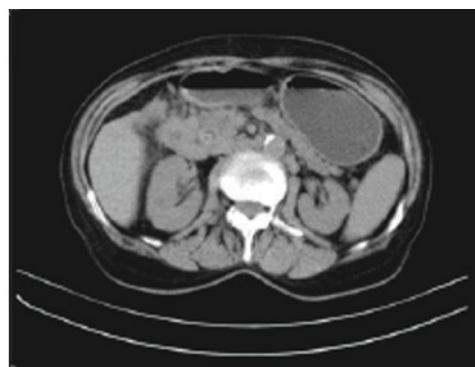


Figure 1b. CT- biliary ducts lithiasis

Our own experience revealed values of MRCP sensitivity and specificity above 95% in the procedure of choledocholithiasis diagnosis. All patients diagnosed with this condition were further exposed to ERCP, as a minimally invasive therapy thus obtaining a 100% rate of lithiasic jaundice cure. Kalra reconfirms that magnetic resonance cholangiopancreatography (MRCP) is the only non-invasive diagnostic method for biliary obstruction, with a high potential to replace endoscopic retrograde colangiopancreatography

(ERCP) - as the first assessment technique of the bile duct obstruction [12]. Hou sustains that CT and MRI explorations of the biliary tract are less invasive diagnostic methods that need to be cautiously applied prior to the interventional endoscopy [13].

Literature contains numerous studies on MRCP's sensitivity, specificity, positive and negative predictive values in the diagnosis of choledocholithiasis. However these traits vary from study to study as in Griffin's and Norero's: sensitivity- 84% and 97%; specificity- 96% and 74%, negative predictive value- 93% and 90%, positive predictive value- 91% and 91% [14, 15]. In Taylor and Topal's research sensitivity scored 97,9% and 95%, specificity- 89% and 100%, positive predictive value- 83,6% and 100% while negative predictive value scored 98,6% and 98%. [16, 17].

In Pisani's comparative study on ERCP-MRCP, one of the main conclusions was that the two methods have similar sensitivity when distinguishing a biliopancreatic obstruction [18]. In the same context, Sakai obtained data that support MRCP as replacement of ERCP, namely as a more effective method to detect choledocholithiasis [19].

In a different comparative study on magnetic resonance cholangiopancreatography, endoscopic retrograde cholangiopancreatography and ultrasound Maurea concluded that MRCP is superior in detecting the calculi at the level of an intrahepatic bile duct (IHBD) and of an extrahepatic bile duct (EHBD). [2]

Maccioni believes that MRCP can be mainly involved in the diagnosis of biliary obstruction. When necessary, it is doubled by a conventional MRI with enhancing agent in the area of the upper abdomen

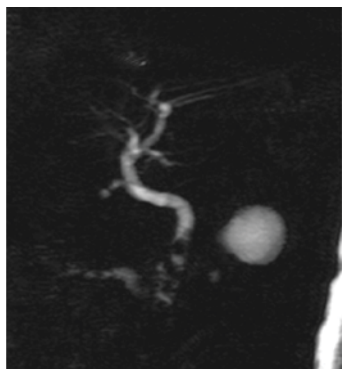


Figure 2a. MRCP choledocholithiasis



Figure 2b. ERCP bile duct stone extractions

and, possibly, by functional studies, thus generating a morphological and functional "all in one" study on the biliopancreatic tree [20].

## Conclusions

1. Despite its numerous deficits in what concerns the diagnosis of the main bile duct lithiasis, the ultrasound remains, for most cases, the first investigation in patients with mechanical jaundice, especially due to its low costs and lack of counter-indications. The most recognised merit is the easy visualisation of the biliary tree dilatation, thus offering a wide perspective of the following diagnostic phases, in view of highlighting the calculi and resolving the case.
2. A CT examination distinguishes with a higher accuracy than an ultrasound the remaining bile duct calculi in patients submitted to cholecystectomy. The biggest advantage of a CT is the precise localization and provider of clear data on the calculus structure. If contrast medium is used intravenously it makes the difference between the nature of the biliary tract obstacle- benign or malignant, with a complete description of the possible associated proximity tumour processes.
3. MRCP is the proper investigation method for the biliary tree, with the highest diagnostic value in the case of a choledocian obstruction. Although it cannot distinguish between benign and malignant features it will provide accurate data to the surgeon who will apply ERCP for biliary stone extraction.
4. The succeeding diagnostic step, after an ultrasound, should depend on the radiation dose the patient is submitted to (children, pregnant women, women in their fertile age), the counter-indication related to the contrast agent and an MRI exam. All these aspects enter and constitute the radiologist's responsibility.
5. ERCP represents the top therapeutic choice for the removal of biliary calculi. It is the least traumatizing method for patients with obstructive jaundice by choledocholithiasis. Also, the method allows the palliative percutaneous drainage in the tumour pathology.
6. ERCP requires a precise imagistic diagnostic that renders the radiologist indispensable for the minimally invasive therapy, needed in the choledocian lithiasis removal procedure.

*Author's contribution: All authors contributed equally to the manuscript.*

## References

1. Terhaar OA, Abbas S, Thornton FJ, Duke D, O'Kelly P, Abdullah K, Varghese JC, Lee MJ.- Imaging patients with "post-cholecystectomy syndrome": an algorithmic approach. *Clin Radiol.* 2005 Jan;60(1):78-84.
2. Maurea S, Caleo O, Mollica C, Imbriaco M, Mainenti PP, Palumbo C, Mancini M, Camera L, Salvatore M. - Comparative diagnostic evaluation with MR cholangiopancreatography, ultrasonography and CT in patients with pancreatobiliary disease. *Radiol*

*Med.* 2009 Apr;114(3):390-402. doi: 10.1007/s11547-009-0374-x.

3. Ferrari FS, Fantozzi F, Tasciotti L, Vigni F, Scotto F, Frasci P. -US, MRCP, CCT and ERCP: a comparative study in 131 patients with suspected biliary obstruction. *Med Sci Monit.* 2005 Mar;11(3):MT8-18.

4. Ghimire R, Lohani B, Pradhan S- Accuracy of ultrasonography in evaluation of level and cause of biliary obstruction: a prospective study. *Kathmandu Univ Med J (KUMJ).* 2005 Jan-Mar;3(1):17-21.

5. Blackburne LH, Earnhardt RC, Siström CL, Abbitt P, Jones RS.- The sensitivity and role of ultrasound in the evaluation of biliary obstruction. *Am Surg.* 1994 Sep;60(9):683-90.

6. Pickuth D, Spielmann RP- Detection of choledocholithiasis: comparison of unenhanced spiral CT, US, and ERCP. *Hepatogastroenterology.* 2000 Nov-Dec;47(36):1514-7.

7. Pickuth D.- Radiologic diagnosis of common bile duct stones. *Abdom Imaging.* 2000 Nov-Dec;25(6):618-21.

8. Kristiansen VB, Rosenberg J, Kehlet H.- Diagnosis of common bile duct stones in symptomatic gallstone disease. *Ugeskr Laeger.* 2000 Jul 31;162(31):4134-9.

9. Rösch T, Meining A, Frühmorgen S, Zillinger C, Schudziarra V, Hellerhoff K, Classen M, Helmberger H.- A prospective comparison of the diagnostic accuracy of ERCP, MRCP, CT, and EUS in biliary strictures. *Gastrointest Endosc.* 2002 Jun;55(7):870-6.

10. Anderson SW, Lucey BC, Varghese JC, Soto JA.- Accuracy of MDCT in the diagnosis of choledocholithiasis. *AJR Am J Roentgenol.* 2006 Jul;187(1):174-80.

11. Tseng CW, Chen CC, Chen TS, Chang FY, Lin HC, Lee SD.- Can computed tomography with coronal reconstruction improve the diagnosis of choledocholithiasis? *J Gastroenterol Hepatol.* 2008 Oct;23(10):1586-9. doi: 10.1111/j.1440-1746.2008.05547.x.

12. Kalra M, Sahani D, Ahmad A, Saini S. -The role of magnetic resonance cholangiopancreatography in patients with suspected biliary obstruction. *Curr Gastroenterol Rep.* 2002 Apr;4(2):160-6.

13. Hou LA, Van Dam J.- Pre-ERCP imaging of the bile duct and gallbladder. *Gastrointest Endosc Clin N Am.* 2013 Apr;23(2):185-97. doi: 10.1016/j.giec.2012.12.011.

14. Griffin N, Wastle ML, Dunn WK, Ryder SD, Beckingham IJ.- Magnetic resonance cholangiopancreatography versus endoscopic retrograde cholangiopancreatography in the diagnosis of choledocholithiasis. *Eur J Gastroenterol Hepatol.* 2003 Jul;15(7):809-13.

15. Norero E, Norero B, Huete A, Pimentel F, Cruz F, Ibáñez L, Martínez J, Jarufe N. -Accuracy of magnetic resonance cholangiopancreatography for the diagnosis of common bile duct stones. *Rev Med Chil.* 2008 May;136(5):600-5. doi: /S0034-98872008000500008.

16. Taylor AC, Little AF, Hennessy OF, Banting SW, Smith PJ, Desmond PV. -Prospective assessment of magnetic resonance cholangiopancreatography for noninvasive imaging of the biliary tree. *Gastrointest Endosc.* 2002 Jan;55(1):17-22.

17. Topal B, Van de Moortel M, Fieuw S, Vanbeckevoort D, Van Steenberg W, Aerts R, Penninckx F. - The value of magnetic resonance cholangiopancreatography in predicting common bile duct stones in patients with gallstone disease. *Br J Surg.* 2003 Jan;90(1):42-7.

18. Pisani JC, Bacelar A, Malafaia O, Ribas-Filho JM, Czezcko NG, Nassif PA.- Comparative study between magnetic resonance cholangiopancreatography and endoscopic retrograde cholangiopancreatography in the diagnosis of the pancreatic and biliary obstruction. *Arq Gastroenterol.* 2001 Jul-Sep;38(3):149-57.

19. Sakai Y, Tsuyuguchi T, Tsuchiya S, Sugiyama H, Miyakawa K, Ebara M, Saisho H, Yokosuka O.- Diagnostic value of MRCP and indications for ERCP. *Hepatogastroenterology.* 2007 Dec;54(80):2212-5.

20. Maccioni F, Martinelli M, Al Ansari N, Kagarmanova A, De Marco V, Zippi M, Marini M.- Magnetic resonance cholangiography: past, present and future: a review. *Eur Rev Med Pharmacol Sci.* 2010 Aug;14(8):721-5.

21. Stroszczyński C, Hunerbein M.- Malignant biliary obstruction: value of imaging findings. *Abdom Imaging.* 2005 May-Jun;30(3):314-23.

22. Soto JA, Castrillón GA. Clinical applications of magnetic resonance cholangiopancreatography. *Radiologia.* 2007 Nov-Dec;49(6):389-96.

23. Chu YL, Wang XF, Gao XZ, Qiao XL, Liu F, Yu SY, Zhang J.- Endoscopic ultrasonography in tandem with endoscopic retrograde cholangiopancreatography in the management of suspected distal obstructive jaundice. *Eur J Gastroenterol Hepatol.* 2013 Apr;25(4):455-9. doi: 10.1097/MEG.0b013e32835ca1d7.

24. Ascunze G, Ribeiro A, Rocha-Lima C, Larsen M, Sleeman D, Merchan J, Szabo D, Levi JU- Single-session endoscopic ultrasonography and endoscopic retrograde cholangiopancreatography for evaluation of pancreaticobiliary disorders. *Surg Endosc.* 2010 Jun;24(6):1447-50. doi: 10.1007/s00464-009-0798-3.

25. Kaltenthaler EC, Walters SJ, Chilcott J, Blakeborough A, Vergel YB, Thomas S - MRCP compared to diagnostic ERCP for diagnosis when biliary obstruction is suspected: a systematic review. *BMC Med Imaging.* 2006 Aug 14;6:9.

26. Al-Mofleh IA, Al-Rashed RS, Al-Amri SM, Al-Ghamdi AS, Al-Faleh FZ, Al-Freihy HM, Isnani AC.- Malignant biliary strictures. Diagnosis and management. *Saudi Med J.* 2003 Dec;24(12):1360-3.

27. Di Cesare E, Puglielli E, Michelini O, Pistoia MA, Lombardi L, Rossi M, Barile A, Masciocchi C- Malignant obstructive jaundice: comparison of MRCP and ERCP in the evaluation of distal lesions. *Radiol Med.* 2003 May-Jun;105(5-6):445-53.

28. Sharma SK, Larson KA, Adler Z, Goldfarb MA.- Role of endoscopic retrograde cholangiopancreatography in the management of suspected choledocholithiasis. *Surg Endosc.* 2003 Jun;17(6):868-71.

29. Caddy GR, Tham TC.- Gallstone disease: Symptoms, diagnosis and endoscopic management of common bile duct stones. *Best Pract Res Clin Gastroenterol.* 2006;20(6):1085-101.