Preoperative MRCP Compared with Intraoperative Cholangiography in Assessment of Potential Right Lobe Living Liver Transplantation Donors

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Abstract

Precise illustration of the intra hepatic biliary anatomy and anatomical variant is crucial in pre operative assessment of living right liver donors.

Purpose: Is to evaluate the accuracy of Magnetic Resonance Cholangiopancreatography (MRCP) in pre operative assessment of biliary system anatomy in living right liver donors compared to Intra Operative Cholangiography (IOC).

Material and Methods: Fifty living liver donors were included in the study underwent MRCP examination. Findings were compared with intraoperative cholangiography. Sensitivity, specificity and accuracy were calculated.

Results: MRCP was able to detect anatomical variants in 46 donors. According to Hakki classification; 15 cases (30%) were K1 type, K2a was seen in 9 cases (18%), K2b in 4 cases (8%), K3 a in 15 cases (30%), K4 in 7 cases (14%) with overall sensitivity=88.2%, Specificity=94.2%, Accuracy=92%, PPV=88.2%, NPV=94.5%.

It also detected 5 from 10 small sized segmental accessory intra-hepatic biliary ducts.

Conclusion: MRCP is a valuable tool in pre-operative assessment of the biliary anatomy variants in potential right liver donors.

Key Words: Biliary anatomy – MRCP – Living liver donors.

Introduction

THE biliary tree has a wide range of variations, so inaccurate identification of biliary anatomy can result in complication affecting both donor and recipient prognosis. Post liver transplantation biliary complication were encountered in 10-25% of cases, up to fatal in 10% of the complicated cases [1-3]. In Living Donor Liver Transplantation (LDLT) the main role of imaging is to identify the intra-and extra-hepatic anatomy and abnormalities which may affect liver transplantation outcome.

Potential living liver donors pre operative evaluation include the assessment of the liver parenchyma to detect steatosis or focal lesions, evaluation of intra-and extra-hepatic biliary and vascular anatomy to detect congenital variants [3-5]. Thorough radiological evaluation of the biliary anatomy of potential donors is very crucial in preoperative planning in living donor liver transplantation that decreases postoperative complications in the recipient and increases safety for the donor [5-7].

Magnetic Resonance Cholangiopancreatography (MRCP) is an imaging technique, that uses magnetic resonance to visualize the biliary tree and pancreatic ducts in a noninvasive way. MRCP using thick-and thin-slab heavily T2-weighted sequences is usually used to identify the biliary tree anatomy with satisfactory evaluation of biliary anatomy before laparoscopic surgery and in the assessment living liver donors for intrahepatic biliary anatomical variants [7-9].

MRCP allows non invasive visualization of all anatomic details of the biliary tract with a large field of view. Three-Dimensional (3D) data sets can be easily displayed. MRCP can not cause patient injury and is well tolerated rather than Endoscopic Retrograde Cholangiopancreatography (ERCP) which is invasive with complication rate of 3%-9% and a reported mortality rate of 0.2%-0.5% [9-11].

The aim of this study is to assess the diagnostic accuracy of conventional non enhanced MRCP as a single preoperative study for evaluation of the biliary system anatomical variations of potential
right lobe living liver donors compared to the intraoperative cholangiography as the gold standard and its impact on donor selection, operative planning and decreasing post-operative complication for both donor and recipient.

**Material and Methods**

This prospective study included 50 potential liver donors. The donors were 33 male and 17 female, ages ranged from 18 to 45 years (mean age 29.4). This study was carried out from June 2013 to January 2016 in Gastroentrology Center, Mansoura University. All potential donors underwent conventional MRCP without usage of contrast agent or any chemical materials. Patients with hepatic and biliary pathology were excluded from the study. Donors were carefully evaluated (clinically, laboratory and pre-operative assessment. The study was approved by our institutional ethics committee and informed consent was obtained from all the assessed donors.

**MRI preparation:**

Potential donors were fasting for 4-6 hours before the study in order to reduce fluid secretions of the stomach and duodenum, decrease bowel peristalsis and promote gallbladder distension. No oral contrast or intravenous contrast was administered during our examination.

**MRCP technique:**

All potential donors were subjected to MRCP study. The patient was positioned on the moveable examination table. Straps were used to help patient to maintain the correct position during imaging.

MRCP examinations were performed on a 1.5-T closed MRI unit (Signa HD, GE Medical Systems, Milwaukee, WI, USA) with using 8 channel circular, polarized, phased array body coil with the following protocol: Multi planner Fast Field Echo (FFE) localizer on which the pulse sequences were planned starting from the diaphragm to the lower border of both kidneys with slice thickness 4mm. 2D thin slap axial T2 Single Shot Fast Spin Echo (SSFSE) respiratory triggered sequence. The scan started from the liver down to the second part of the duodenum (ampulla of Vater) TE 120ms, TR 1050ms, FOV 40, slice thickness 4, NEX 1, frequency 256, flip angle 150, band width 62.5, scan time 1.39/1.1 minute. 3D thin slap coronal oblique heavy T2 fat saturated fast spin echo (FAT SAT FSE) respiratory triggered sequence. The slaps are arranged parallel to the CBD to visualize both hepatic ducts. TE 480ms, TR 1860ms, FOV 32, slice thickness 3, NEX 2, frequency 384, flip angle 180, band width 62.5, scan time 2.33 minute. 2D thin slap coronal T2 Single Shot Fast Spin Echo (SSFSE) respiratory triggered sequence. 2D coronal thick slap MYELO breath hold sequence with 15 to 20 slap centered on the CBD. TE 1200ms, TR 3120ms, FOV 34, slice thickness 4, NEX 1, frequency 320, flip angle 180, band width 62.5, scan time 30-40 second.

In first three pulse sequences we used the respiratory triggered technique to control any motion artifacts. Total scan time ranged from 5:5 0 to 6: 10 minutes.

**Intraoperative cholangiography:**

IOC was done. It was preceded by administration of a muscle relaxing agent (eoin/glucagon) then, slow injection of 10-20ml of 30% iodinated contrast agent through 5 Fr. catheter in the cystic duct, multiple views were taken (fluoroscopy guided) before and after operation.

**Image processing:**

The imaging data obtained after the scanning were reviewed on (advantage for Windows, version 4.1; GE Healthcare) workstation with 2D and 3D capability with multiple editing options. Image reconstruction and post-processing of the MRCP source images was performed by two well experienced radiologists (O.S and G.G) using a Maximum Intensity Projection (MIP) image produced in the coronal plane. Un-necessary anatomical details were edited from the image by using a manually at the workstation to form coronal MIP images showing the entire biliary system anatomy.

Three-dimensional models of the common bile duct and both hepatic ducts were obtained by using a Volume-Rendering (VR) technique, artificial color assignment to the re-constructed images was used for visual enhancement.

MIP and VR images were magnified and projected at the appropriate viewing angle due to the small caliber of the normal common bile duct and intra-hepatic bile ducts, with special attention given to the insertion of the right posterior sectorial duct as it is considered the most important variant needed to be optimally visualized.

The native axial and coronal thin sections source images were reviewed after three-dimensional VR and MIP images were generated, allowing optimal evaluation of small bile duct branches or any small accessory bile ducts.
Image analysis and interpretation:

Analysis of the MRCP images; clear visualization of both intra-and extra hepatic bile ducts anatomy (the bile ducts branching pattern at the liver hilum), identification of any biliary congenital anomalies, identification of different biliary variants, presence of accessory bile ducts or not.

The normal biliary anatomy was defined as the Right Posterior (RP) duct (draining segments VI and VII) joining the Right Anterior (RA) duct (draining segments V and VIII) to form the Right Hepatic Duct (RHD), which then joins the left hepatic duct (L) (draining segments II, III, and IV) to form the Common Hepatic Duct (CHD). Normally right posterior sectorial duct is inserted greater than 1cm away from the bifurcation into the right duct. If it is inserted within 1cm of the bifurcation (distal right hepatic duct) a trifurcation variant is also a the differential diagnosis [1-4].

There are multiple biliary variants mainly concerning the insertion of the RP duct such as: Triple confluence, the RP and RA ducts and left hepatic duct joining the CHD, RP duct draining into the left hepatic duct, RP duct draining directly into the common hepatic duct, RP duct drains into the cystic duct or accessory segmental intrahepatic bile ducts. These findings could be detected by reformatted MIP, VR and source images of our MRCP study as a pre-operative method for visualization of the biliary anatomy and mapping for the surgery.

Statistical analysis:

Statistical analysis of data was performed by use of Statistical Package for Social Sciences (version 16; SPSS, Chicago, IL, USA). MRCP anatomical findings were compared with the reference standard intra-operative cholangiography. Accuracy, sensitivity, specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) were calculated.

Results

This study included 50 potential liver donors. The donors were 33 male and 17 female, age ranged from 18 to 45 years (mean age 29.4). All 50 potential donors had MRCP with optimal image quality of central intrahepatic ducts branching pattern as determined by radiologists pre operatively, then the anatomical details were compared to the anatomical findings of intra-operative cholangiography.

Sensitivity, specificity, and accuracy of MRCP as a single preoperative method for assessment of biliary anatomy of living liver donors and mapping for operation were calculated with Intra-Operative Cholangiography (IOC) as the gold standard.

All 50 donors had normal drainage of the left hepatic duct into the common hepatic duct, normal insertion of the common bile duct with main pancreatic duct into second part of the duodenum (ampulla of vater), normal diameter of the common bile ducts (range from 3-6mm) and normal diameter of the pancreatic duct (range from 1-3mm) with no detected signal void intra-ductal stones in both ducts. All 50 donors had normal gall bladder wall thickness with no detected masses of abnormal signal intensity inside. Two cases had signal void gall bladder stones. All 50 donors had normal MRI appearance of the liver in the axial T2 images with no detected hepatic focal lesions.

The normal biliary pattern needs one duct anastomosis. All other variants of RPSD insertion usually need two or three bile duct anastomosis. Normal and the most common bile duct variants. L-left hepatic duct, RA-right anterior hepatic duct, RP-right posterior hepatic duct. According to classification of Hakki; the normal anatomy (K1), trifurcation (K2b), a short right hepatic duct (K2a), continuation of the right posterior hepatic duct into the left hepatic duct less than 1cm (K3a), drainage of the right posterior hepatic duct into the left hepatic duct more than 1cm (K3b), and drainage of the right posterior hepatic duct into the common hepatic duct (K4) [21].

The pattern of biliary anatomy in our study were:

- Normal pattern; K1: The right posterior sectorial duct draining into proximal part of the right hepatic duct (distance more than 1cm from the hepatic confluence) was seen in 15 cases (30%).
- The right posterior sectorial duct draining into distal part of the right hepatic duct (distance less than 1cm from the hepatic confluence); K2a was seen in 9 cases (18%).
- The right posterior sectorial duct draining into the confluence between both hepatic ducts (trifurcation pattern); K2b is seen in 4 cases (8%).
- The right posterior sectorial duct draining into the left hepatic duct was seen in 15 cases; K3a (30%).
- The right posterior sectorial duct draining into the common hepatic duct; K4 was seen in 7 cases (14%).

MRCP correctly predicted classic Fig. (1) and variant anatomy in 46 of all 50 donors in our study Figs. (2-4). There were four cases of inaccurate
MRCP interpretation: Two cases of RPSD insertion into LHD (confirmed by IOC) which were preoperatively seen as a normal bifurcation with insertion of RPSD into RHD, one case of biliary trifurcation (confirmed by IOC) which were reported as RPSD insertion into distal RHD with short carina and one case of RPSD insertion into CHD (confirmed by IOC) which were considered as an aberrant drainage of right posterior duct into left main duct with accessory small right bile duct into CHD.

Other small left accessory bile duct (curved red arrow) mostly the caudate lobe IHB duct draining into the distal part of the common hepatic duct (MRCP couldn't demonstrate this findings).

Intra operative cholangiography showed additional data in 5 cases from these 46 correct cases that were missed in MRCP; in one case with small IHB duct to segment I (caudate lobe) draining into the distal part of the common hepatic duct,a case with small IHB duct to segment IV (quadrate lobe) draining into the distal part of right hepatic duct and two cases with small IHB duct to IV (quadrate lobe) draining into the distal part of right hepatic duct distal to insertion of the RPSD. Table (1) & Fig. (5).

Presence of accessory bile ducts also may affect the number of biliary anastomosis, in our study there were 10 cases (20%) associated with small segmental intra-hepatic accessory bile ducts that draining into CHD or RHD or RPSD itself. MPCP was able to detect 5 cases from 10 cases with diagnostic accuracy (50%).

In comparison of MRCP anatomical findings in our study with the reference standard intraoperative cholangiography, the sensitivity, specificity and accuracy of MRCP in demonstrating normal biliary anatomy and anatomical variants was calculated as the following: Sensitivity=88.2%, specificity=94.2%, accuracy=92%, PPV=88.2%, NPV=94.5%.

Table (1): Comparison between MRCP and IOC findings.

<table>
<thead>
<tr>
<th>Variant</th>
<th>Incidence</th>
<th>MRCP</th>
<th>IOC</th>
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<tbody>
<tr>
<td>1- RPSD into proximal right hepatic duct: K1</td>
<td>(15 case) 30%</td>
<td>• Accurate in demonstrating 15 cases with this anatomical variant (normal anatomy) with two false positive cases.</td>
<td>• Accurate in demonstrating 15 cases with this anatomical variant.</td>
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<tr>
<td>2- RPSD into distal right hepatic duct: K2a</td>
<td>(9 cases) 18%</td>
<td>• Accurate in demonstrating 9 cases with this anatomical variant with one false negative case.</td>
<td>• Accurate in demonstrating 9 cases with this anatomical variant.</td>
</tr>
<tr>
<td>3- RPSD into confluence between both hepatic ducts (trifurcation pattern): K2b</td>
<td>(4 cases) 8%</td>
<td>• Inaccurate in demonstrating this variant in one case (reported as RPSD drains into distal RHD with short carina).</td>
<td>• Accurate in demonstrating 4 cases with this anatomical variant.</td>
</tr>
<tr>
<td>4- RPSD into left hepatic duct: K3a</td>
<td>(15 case) 30%</td>
<td>• Inaccurate in demonstrating this variant in two cases (reported as normal anatomy) with one false negative case.</td>
<td>• Accurate in demonstrating 15 cases with this anatomical variant.</td>
</tr>
<tr>
<td>5- RPSD into common hepatic duct: K4</td>
<td>(7 cases) 14%</td>
<td>• Inaccurate in demonstrating this variant in one case was reported as RPSD into RHD with small accessory duct into CHD.</td>
<td>• Accurate in demonstrating 7 cases with this anatomical variant.</td>
</tr>
<tr>
<td>6- Accessory IHB ducts</td>
<td>(10 cases) 20%</td>
<td>• Inaccurate in demonstrating this variant in five cases (couldn't be visualized due to their small size).</td>
<td>• Accurate in demonstrating 10 cases with this anatomical variant.</td>
</tr>
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Fig. (1): K1: Classic type I biliary anatomy. Female donor, 28 years old. MRCP shows (A) Coronal oblique thin slab heavy T2 FAT SAT FSE MRCP image showing RPSD (red arrow) draining into the proximal part of RHD. (B) Anterior view of post-processed Three Dimensional (3D) Volume Rendering (VR) coronal MRCP images show RPSD (arrowed) draining into the RHD. (C) Intra-Operative Cholangiography (IOC) [AP view] confirmed the MRCP findings.

Fig. (2): K2a: Variant intrahepatic biliary pattern: Trifurcation + accessory duct. Male donor 32 years old. MRCP shows (A) 2D coronal thin slab heavy T2 FAT SAT FSE MRCP image. (B) Anterior view of post-processed 3D VR coronal MRCP image showing the RPSD (red straight arrows), RASD (red curved arrows) and LHD draining into the confluence of hepatic ducts (trifurcation pattern) to form the common hepatic duct. Another small right accessory duct (white arrows) is seen draining into the middle part of the common hepatic duct. (C) IOC image (AP view): RPSD (white arrow), bifid RASD (blue arrow) and LHD draining into the confluence of hepatic ducts (trifurcation pattern) to form the common hepatic duct (confirmed the MRCP findings). Another small right accessory bile duct (black arrow) draining into the middle part of the common hepatic duct (confirmed the MRCP findings).

Fig. (3): K2a variant intrahepatic biliary pattern: Trifurcation + accessory duct. Male donor 36 years old. MRCP shows: (A) 2D oblique view of post-processed coronal 2D MIP MRCP images. (B) Coronal oblique thin slab heavy T2 FAT SAT FSE MRCP image. They show the ill defined RPSD (red arrows) joining the RASD to form a single right hepatic duct draining into the common hepatic duct. No accessory bile ducts could be detected. (C) IOC image revealed-bifid right anterior sectorial duct. The RPSD (white arrow) draining into the hepatic confluence of ducts (trifurcation pattern). Small accessory IHB duct to segment IV (black arrow) draining into the distal part of the right posterior sectorial duct. In this case MRCP couldn’t demonstrate correctly the insertion of small sized intra-hepatic bile duct for segment IV either the right posterior sectorial duct itself. During right liver lobe donation the IHB duct for segment IV must be preserved, so resection of RPSD done in this case before insertion of this bile duct.
Fig. (4): K4: Variant intrahepatic biliary pattern: Insertion of RPSD into CHD + accessory duct. Male donor 22 years old. MRCP shows: (A) Coronal thin slab heavy T2 FAT SAT FSE MRCP image. (B) Anterior view of post-processed 3D VR coronal MRCP images. MRCP images show the RPSD (white and black arrows) draining into the proximal part of the common hepatic duct. No accessory segmental bile ducts could be detected. (C) IOC image (AP view) showed RPSD (black straight arrow) draining into the proximal part of the common hepatic duct. Small accessory IHB duct to segment IV (curved white arrow) draining into the distal part of the right hepatic duct. The remnant of cystic duct (red arrow) through which the contrast injected. In this case MRCP couldn't demonstrate the small IHB duct to quadrate lobe (segment IV) draining into distal part of right hepatic duct, which must be preserved during operation of right liver lobe donation. The small right accessory bile duct (red arrow) is seen draining into the proximal common hepatic duct.

Fig. (5): K3: Variant intrahepatic biliary pattern: RPSD insertion into LHD Female donor 34 years old. MRCP shows: (A) Coronal oblique thin slab heavy T2 FATSAT FSE MRCP image shows RPSD (arrowed) draining into the LHD. (B) Anterior view of post-processed 3D VR coronal MRCP images revealed insertion of RPSD (arrowed) into the LHD. (C) IOC (AP view) confirmed the MRCP findings, it shows the insertion of the RPSD (white arrow) into the distal part of the left hepatic duct. This type of intra-hepatic biliary variant needs at least two bile ducts anastomosis during operation.

**Discussion**

Living donor liver transplantation had become the optimal treatment option for patients with end stage liver disease. Different centers had reached promising results reporting one year graft and recipient survival rates of up to 80% [9-12]. Therefore, accurate preoperative imaging is mandatory to identify biliary anatomy of living donor candidates. An accurate delineation of a donor's biliary anatomy is an essential in planning right liver lobe transplant to save donor hepatectomy and decrease recipient post-operative morbidity [12-14].

Although ERCP is still the standard for imaging the hepato-biliary and pancreatic ductal systems, MRCP has been used in the pre-operative assessment of donors as a single imaging modality [3,4]. MRCP is noninvasive, less costly, uses no radiation, requires no contrast media or anesthesia, less operator dependent, allows better visualization of ducts proximal to an obstruction, and allows detection of extra-ductal disease with conventional T1- and T2-weighted sequences [1-6,8].

According to Zhang et al., [10], 3D isotropic MRCP advantage over standard 2D MRCP is thinner sections without intersection gaps. The 3D data set help post-processing software to easily produce any projection and can identify any anatomic features which may be missed by traditional standard 2D images. Researchers found that 3D MRCP is better than 2D thick-slab imaging in the identifi-
cation of non-dilated bile duct anatomy [13-15]. In our study we used both standard 2D and the newly developed 3D techniques, which provided more anatomical details of the non-dilated bile branches with better spatial resolution and more accurate results involving the 2nd and 3rd branching pattern in comparison to 2D MRCP alone.

Many new techniques 3D algorithms are used nowadays to produce images in different orthogonal planes. They are valuable in evaluating the relationships between the right, left, and common hepatic ducts anatomy. Several rendering algorithms have been used for processing 3D MRI data as Maximum Intensity Projection (MIP) and Volume Rendering (VR) [15-18].

Volume Rendering (VR) uses all the information set inside the volume to reconstruct 3D images, no threshold values are used so, there is no data loss [17-20]. In our study, volume rendering algorithm as a reformatting technique was better than MIP with more spatial resolution and signal intensity in demonstrating fine biliary branches. Also VR provided post-processed coloured 3D images with different views was more easy to be manipulated to show important diagnostic findings.

The main purpose of MRCP in our study was the detection the intra hepatic biliary anatomy or any other biliary variants specially the insertion of the right posterior secotrial bile duct either into proximal right hepatic duct which is considered the classic anatomy or into left hepatic duct or into the hepatic confluence in a trifurcation pattern or into common hepatic duct. In a study done by Wang et al., [12] 56% of the donors had classic branching pattern, 11% of the donors had trifurcation pattern, 18% of the donors had their right posterior duct into the left duct and 8% of the donors had their right posterior duct into the main hepatic duct. While Basaran et al., [6] found that 67.5% of their donors had classic biliary branching pattern, 5% of had trifurcation pattern of biliary branching pattern, 20% had the right posterior duct joining into the left hepatic duct and 2.5% had their right posterior duct into the common hepatic duct. In Abdelgawad and Eid, [9] study 80% of the donors demonstrated classic branching pattern of the biliary radicles, 5% demonstrated trifurcation biliary branching pattern, 10% showed the right posterior duct joined the left hepatic duct and 5% showed a low insertion of the right posterior duct into the common hepatic duct.

In our study we categorized intra-hepatic biliary anatomy according to the more detailed classification of Hakki [21]. The typical biliary anatomy was demonstrated in 15 cases from the all 50 cases; K1 (30%). We detected 35 out of 50 cases (70%) that had some form of biliary variations. The highest incidence of these biliary variants encountered in our study was Type K3a according to Hakki classification where 15 from 50 cases (30%) showed the RHDP opening into the LHD in a distance 1cm or less from the confluence of the RAHD and the LHD. Less common variations encountered in our study included 4 cases from all 50 cases (8%) was type K2b showed trifurcation pattern of insertion of the RHDP, RAHD and left main ducts in a common confluence. Whereas other biliary variants were found in 9 cases from 50 cases (18%) as type K2a in which the RHDP opens into the RAHD in a distance less than 1cm from the confluence between the RAHD and the LHD and 7 case from 50 cases (14%) were type K4 the RHDP opens into the CHD.

Limanond et al., [17] used standard MRCP using T2 SSFSE sequence in preoperative mapping of the biliary tracts of 26 LDLT donors. They also found that MRCP had 84.6% accuracy in biliary anatomical mapping. However, the study included a small number of patients. Kim et al., [13] used conventional MRCP in anatomical evaluation of liver in comparison with the biliary anatomy on IOC, MRCP showed 90% accuracy. Specifically, MRCP assessed accurately normal anatomy in 15 of 17 patients and anatomical variants in 12 of 13 patients. In another study, Song et al., [14] found many LDLT donors with the same MR technique (T2 weighted single shot fast spin echo) and comparison with (intraoperative cholangiography); MRCP showed 95.5% sensitivity, 95.2% specificity, 96.8% PPV, and 93.3% NPV.

Hyodo et al., [1] studied 111 potential donors with MRCP then compared the results with operative cholangiography as a reference standard, the normal branching of the biliary system were observed in 67 subjects (60.4%), with 44 subjects (39.6%) showing aberrant anatomy. MRCP had sensitivity in identification of normal from aberrant anatomy of 96.2%, specificity of 95.9%, a positive predictive value of 97.2% and a negative predictive value of 94.3%. MRCP had an accuracy of 94.6% in pre-operative anatomy evaluation. In our study MRCP detected correctly normal anatomy in 15 of 15 donors (100%) and ductal anatomical variants in 31 of 35 (88.5%) with over all accuracy 92% in detecting normal anatomy and different anatomical variants, but MRCP had some limitations in demonstrating small sized segmental accessory bile ducts only 5 of 10 (accuracy 50%) with accessory
branches, that need more than one biliary anastomosis.

The number of hepatic bile ducts in the graft is a crucial prognostic factor of post-operative complications, so the more the number of biliary anastomosis in the graft, the higher the incidence of post-operative biliary complication in the recipient to form of stricture or leakage. So donor with single right hepatic duct is the most preferred type of biliary anatomy. Usually, patients with biliary variants showing insertion of the RPSD into the distal end of the RHD, or into the LHD, or into the common hepatic duct, or trifurcation pattern, or either associated with right accessory bile ducts needed more than one bile duct anastomosis [22-25].

In our study there were four cases of aberrant anatomical variant, which MRCP couldn't demonstrate the anatomy accurately. For example, MRCP imaging showed insertion of the RPSD into confluence of both hepatic ducts, but IOC demonstrated insertion of the RPSD into the distal part of the LHD. Also MRCP showed insertion of the RPSD into the RHD, however IOC showed small sized RPSD draining into the confluence of hepatic ducts as a trifurcation pattern. There were two factors explaining the inability of MRCP to demonstrate these variants, the first factor is the acute angle (<90%) between the RPSD and the CHD. The second factor is the short distance (less than 1cm) between the insertion of the RPSD and the hepatic confluence.

The major limitations of standard MRCP were detection the peripheral intrahepatic biliary tree and small sized segmental accessory bile ducts. However, in our study we used T2-weighted SSFSE sequences that improved the visualization of peripheral intra-hepatic biliary ducts to the level of the interlobular bile duct in source images and MIP images, but there was some difficulty in demonstrating small sized segmental accessory ducts in 5 cases from 10 cases (50%) confirmed by IOC. Also, there was another limitation of the free-breathing in our study that influenced the quality and spatial resolution of the images, better understanding and cooperation of patient by breathing rhythmically could have been more helpful.

Conclusion:

In conclusion, our study found that that conventional non enhanced MRCP has a reliable role in the preoperative assessment of non dilated biliary systems in potential right lobe living donors. However, some cases had delicate bile ducts or with small sized segmental accessory bile ducts. Further improvement in software will lead to more accurate detection of minute aberrant accessory bile ducts and improve the correlation with intra-operative findings.

References

12- WANG Z.J., YEH B.M., ROBERTS J.P., BREIMAN R.S., QAYYUM A. and COAKLEY F.V.: Living donor candi-


الملخص العربي

مع ازدياد حالات زراعة الكبد من المتبرعين الأحياء، أصبح طرق التشخيص المختلفة دورًا كبيرًا في تقدير كبد المتبرعين من الناحية التشريحيّة والوظيفية.

التشخيص التشريحي الدقيق للقنوات المراوية المتبرعين يلعب دورًا هامًا في التخطيط لعملية زراعة الكبد مما يؤدي إلى تقليل نسب الوفاة بعد العملية وإجراء جراحة آمنة للمتبرع والمستقبل.

الزنك المغناطيسي يلعب دورًا هامًا في التشخيص المنفصل لتشخيص القنوات المراوية المتبرع لتقليل حدوث مضاعفات مراوية حيث أنها تمثل عائقًا لنجاح عمليات الزرع.

المضاعفات المراوية تحديًا غالباً نتيجة لتعقيد التشريحي القنوات المراوية حيث أن 10% فقط من العادة لديهم الشكل الطبيعي للقنوات المراوية في وجود الشروط الخفيفة تساعد على حدوث مضاعفات كضيق القنوات المراوية أو الحفر الصغير بصورة الفعالة.

لذلك تعتبر الدراسة التشريحي القنوات المراوية قبل العملية يساعد في اختبار المتبرع المناسب ويساعد الجراح أثناء العملية ويفضل منح تكون مضاعفات المراوية.

الزنك المغناطيسي هو فحص سهل ودقيق وسريع يساعد في التشخيص التشريحي للقنوات المراوية داخل وخارج الكبد المتبرع وعلى الرغم من وجود بعض العوائق في تقييم القنوات المراوية غير متوازنة، إن التطبيقات الحديثة لجهاز الزنك المغناطيسي الان تساعد في التشريحي الطرق التشريحي القنوات المراوية والتشوهات الخفيفة بها.

الفرض من البحث: تقييم المتبرع الحالي الزنك المغناطيسي في التشخيص الشامل لتشخيص القنوات المراوية والتشوهات الخفيفة بها لمتبرعين الكبد الأحياء.

المرسوم وموضوع الدراسة: الدراسة يقسم الأنشطة التشريحيّة بمستشفيات جامعة المنصورة على خمسين متبرع محتمل بالكبد.

معايير التضمن:
- أن تكون حالة المتبرع جيدة.
- أن تكون حالة المتبرع جيدة.
- لا يعاني من أي أمراض مزمنة.

معايير الاستبعاد:
- قصور في نظام الكبد.
- سوء حالته العامة والآجود المزمن مثل الضرع والسكتة.
- البلد والأطفال وكبار السن.

طريقة البحث: التحصيّ باستخدام جهاز الزنك المغناطيسي 1.5 تسلا للتقييم التشريحي للقنوات المراوية والتشوهات الخفيفة بها تحت إشراف طبيب تشخيصي.

لحصول على أفضل النتائج المحتملة والحصول على صور ثلاثية الأبعاد جيدة مع عدم استخدام أي صبغات تفادى أي مضاعفات ممكنة الحدوث.

وقد تبين أن فحص القنوات المراوية باستخدام الزنك المغناطيسي لظهور تشريحها الدقيق وسيلة دقيقة وفعالة للمقارنة التشريحي الحقيقي الظاهرة أثناء الجراحة وادي للتصويت من المضاعفات المحتملة للمتبرع والمريض المزروع له الكبد.