Role of magnetic resonance cholangiography (MRC) in the detection of biliary complications after orthotopic liver transplantation (OLT)

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Purpose

Since its inception in 1963, orthotopic liver transplantation has evolved into the optimum treatment for end-stage liver disease with 1-year survival rates of 90% and 10 years predicted survival of 70%. Improved survival has been achieved by better patient selection and immunosuppression, as well as changes in surgical technique and postoperative care. Despite these improvements in patient survival, morbidity after liver transplantation remains a significant problem and biliary complications after OLT still constitute one of the leading causes of morbidity and graft dysfunction in recipients.

Biliary reconstruction is the final step of OLT which is done after all the vascular anastomoses have been completed. An end-to-end duct-to-duct anastomosis is the procedure of choice in most institutions following wholeorgan OLT in patients with healthy native bile ducts of suitable caliber. This technique yields a physiological bilioenteric continuity and allows biliary complications to be treated endoscopically.

Roux-en-Y hepaticojejunostomy is utilized in cases of preexisting biliary tract disease (sclerosing cholangitis, biliary atresia), large disparity in size or small calibre ducts, and may be preferred in case of retransplantations because of inadequate recipient duct length.

Biliary complications, once considered as the technical "Achilles heel" of orthotopic liver transplantation still occur in 10-30% following whole-organ OLT resulting in mortality rates up to 10% of cases.

Biliary complications are classified in literature as early, when occur within 3 months after OLT, and late when occur from a few months to several years after OLT. Biliary leaks and strictures are the most common biliary complications, but sphincter of Oddi dysfunction, hemobilia, and biliary obstruction from cystic duct mucocele, stones, sludge or casts have also been observed.

Biliary complications are due to various factors, including hepatic artery thrombosis or stenosis, surgical techniques, as well as ischemia-reperfusion injury and immunological injury, which may lead to the ischemic-type biliary lesions.

Technical reasons for biliary complications include imperfect anastomosis leading to a leak and/or stricture and T-tube-related.

Ischemic-type biliary lesions appear to be a broad pathological entity characterized by intrahepatic strictures and dilatations seen on cholangiogram. The pathogenesis of ischemic-type biliary lesions remains unclear; however, an increased frequency of such lesions is reported in patients with prolonged cold ischemia time or delayed rearterialization of the graft or stenosis - thrombosis of hepatic artery.
Immunologically related ischemic-type biliary lesions comprise injury to the biliary epithelium and/or vascular endothelium in the course of chronic rejection, cytomegaloviral infection, recurrent sclerosing cholangitis and ABO incompatible transplantation.

Cholestasis in a liver transplant patient may also be caused or aggravated by biliary sludge formation. Biliary sludge consists of thickened bile and/or connective tissue originating from destroyed bile duct walls. It may lead to a serious biliary obstruction due to a cast formation and life-threatening cholangitis. Biliary casts are more likely to develop in the setting of liver graft ischemia, biliary strictures, ischemic-type biliary lesions, and when stationary bile in the donor biliary tree had not been flushed out prior to cold storage.

The early detection of biliary complications and adequate management is crucial for graft and patient survival. Clinical features are often nonspecific and may be masked by steroid and immunosuppressive therapy. They may include abdominal discomfort or the absence of peritoneal signs even in the case of diffuse biliary peritonitis due to a biliary leak in the immediate postoperative period. For this reason, any clinical deterioration of the patient in the early postoperative period including pain, fever, prolonged ileus or ascites and/or liver allograft dysfunction needs algorithmic use of diagnostic modalities in order to make a proper diagnosis and start treatment promptly. The main imaging examinations used for this purpose are ultrasound and T-tube cholangiography. Doppler ultrasonography is the first-line investigation because of the frequent association of biliary complications with the presence of hepatic artery thrombosis or stenosis. However, ultrasound evaluation of the biliary tree is of limited value because bile duct dilatation may be absent in the presence of biliary obstruction in liver transplant patients. After the removal of a T-tube (if used), invasive procedures such as endoscopic retrograde cholangiography (ERC) or percutaneous transhepatic cholangiography (PTC), were the only means of directly visualizing the biliary system in the past was to use.

ERCP and PTC can lead to a relatively high rate of procedure-related complications. ERCP with sphincterotomy has a 9.8% reported morbidity rate and a 2.3% mortality rate; therefore it should not be considered a diagnostic tool but rather a therapeutic technique. On the other hand, reported complications of PTC include perihepatic hematoma, hemobilia, infection, and pancreatitis.

Recently, the advent of MR cholangiography (MRC) has significantly changed the approach to diagnosis and management of biliary complications after OLT because it allows non-invasive visualization of the biliary tree with precise anatomic detail and without the administration of contrast material.

The aim of this study was to evaluate the role of MRC in the detection of biliary complications in patients undergone OLT.
Methods and Materials

Between August 2004 and August 2008, 78/201 patients undergone OLT, with clinical suspected biliary complications, were evaluated by MRC.

Biliary complications were suspected in transplanted recipients in case of fever, abdominal pain and jaundice or in asymptomatic patients in case of elevations of serum transaminases, serum bilirubin, alkaline phosphatase and/or #-glutamyl transferase levels. They all underwent hepatic needle biopsy to exclude rejection and viral reinfection, then MRC were performed.

MR imaging was performed by using 1,5-T system (Achieva, Philips medical System, The Netherlands) with surface body coil.

In all patients the following sequences were performed:

- Axial sDUAL FFE T1-w (TR 241,58; TE 2,30 e 4,60; FOV 38 x 38 cm, slice thickness 5 mm; FA 80).
- Axial SS T2-w (TR 429, TE 80; FOV 38 x 38 cm; slice thickness 5 mm; FA 90).
- Coronal SS T2-w (TR 756; TE 80; FOV 37,5 x 37,5 cm; slice thickness 5 mm; FA 90).
- Axial SE T2-w (TR 432; TE 80; FOV 38 x 38 cm; slice thickness 5 mm; FA 90) with fat-sat
- Cholangiography radial 2D-SE, breath hold, (TR: 8000 ms, TE: 800 ms, FA: 90°, voxel size: 0.59x0.59x20 mm, slice thickness: 20 mm, RA: 12°), with fat sat (SPIR)
- Cholangiography coronal 3D-SE TSE SS, with respiratory trigger (TR: 1800, TE: 650, FA: 90, voxel: 0.59x0.59x0.8, thickness: 1-2 mm), fat sat (SPIR).

When MRC was negative the patients undergone to clinical-ultrasound follow-up.

When biliary complications were found by MRC, diagnostic confirmation was obtained by endoscopic retrograde cholangiography (ERCP) (13), percutaneous transhepatic cholangiography (PTC) (20), ultrasonography (10), CT (2), 11 patients had also surgical confirmation.

Sensitivity, specificity, positive and negative predictive values and accuracy of MRC in detecting biliary complications were calculated.

Results
In all cases MRC enabled the visualization of site and type of biliary anastomosis.

In 44/78 patients MRC detected biliary complications: 42 strictures (37 anastomotic, 5 intrahepatic), 4 sludge, 5 bilomas and 3 stones. In 25/37 cases of anastomotic strictures pre-anastomotic dilatation of biliary tract was also shown.

In 4 cases PTC showed intrahepatic (1), bilo-enteric (1) strictures, sludge (1) and biloma (1) not detected with MRC.

In 2 cases MRC showed intrahepatic and bilio-enteric anastomotic strictures not confirmed by other modalities.

The sensitivity, specificity, positive and negative predictive values and accuracy of MRC in detecting biliary strictures were respectively 93%, 94%, 97%, 89% and 94%.

Images for this section:

**Fig. 1:** Fig. 1( a-b). MRCP enables the correct identification of the biliary anastomotic site after liver transplantation (red arrows): the biliary anastomosis can be duct-to-duct (fig.1 a) or biloenteric (fig.1b) as shown in 3d cholangiographic sequences with MIP reconstruction.
Fig. 2: Fig. 2 (a-b). Coronal single-shot SS T2-w (fig.3 a) shows a large fluid collection with high intensity signal. 3D cholangiographic sequences demonstrates its connection with duct-to-duct anastomotic site: biloma (fig 3b, red arrow).
**Fig. 3:** Fig. 3 (a-c). 3D cholagiography (3a) and MIP reconstruction (3b) of biliary system show mild stricture at choledocho-choledocho anastomotic site (arrows). Not significative dilatation of pre anastomotic biliary tract is associated. The stricture is also visible at Coronal SS T2-w sequences (3c).

![Fig. 3](image1)

**Fig. 4:** Fig 4 (a-c) 3D cholagiography (4a) and MIP reconstruction (4b) of biliary system show severe stricture at the site of choledocho-choledocho anastomosis (red arrow) with associated moderate dilatation of pre anastomotic biliary tract. The stricture is also demonstrated at percutaneous transhepatic cholangiography (PTC, fig.4c black arrow).

![Fig. 4](image2)
Conclusion

The early diagnosis and correct management of biliary complications are important elements for ensuring graft and patient survival after OLT, and the diagnostic work-up has been repeatedly reviewed in an attempt to reach the most accurate strategy. Early diagnosis of biliary complications is also difficult because of the low specificity of the associated clinical and biochemical findings; ultrasound has low diagnostic accuracy especially in early phase of biliary obstruction and doesn't provide direct evaluation of the anastomosis.

CT shows low sensitivity and specificity in particular in detecting biliary strictures (62% e 64%), it can be used to screen for biliary obstruction or leak, but its final role still needs to be established.

Direct cholangiography procedures are the gold standard in diagnosis and offer potential therapeutic options; nevertheless they are affected by major drawbacks.

The established advances in MRC suggest a key role for such technique in evaluating biliary complications after OLT as reported in recent literature.

Our results are in good agreement with other reports in literature [1-4], and confirmed that MRC is a reliable technique to visualization biliary anastomosis and to depict biliary complications after OLT. In particular in our work MRC imaging enables the classification of all biliary strictures as obstructive and non obstructive on the basis of pre-anastomotic dilatation of biliary tree. It can accurately show the site and degree of strictures, one of its advantages being the visualization of the bile ducts above and below the stricture or obstruction, which is also very important when planning possible interventional treatment.

The false positive and negative in MRC are connected with bilio-enteric anastomosis and intrahepatic biliary system, but all complications of termino-terminal anastomosis were correctly evaluated. The evaluation of bilio-enteric anastomosis at MRC, as reported in literature, is difficult, because the surgical conformation of the anastomosis. The natural motility of loop causes temporary folding of anastomosis site and consequently dilatation of biliary pre-anastomotic tree.

Limitations of MRC, as reported in literature, are its low spatial resolution, which can lead to missing mild strictures or overestimating possible strictures, especially when in patients in whom bilomas and abdominal fluid are present at peri-anastomosis site. In our study the evaluation of pre-cholangiographic images contributes to reduce overestimation of strictures detected in MIP reconstruction and allows a better evaluation of site anastomosis.
The MRC accuracy makes mandatory the routinely employ of this exam in all patients undergone OLT with clinical suspected biliary complications.

References


Personal Information

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