COMPLICATIONS OF HEPATOBILIARY SURGERY: MR COLANGIOGRAPHY ASSESSMENT.

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SUMMARY

INTRODUCTION
Magnetic resonance colangiography (MRC) has emerged as a recent technique in our milieu enabling an adequate anatomical assessment of the biliary tract, of great use when evaluating its disorders.

OBJECTIVE
To determine the usefulness of MRC in patients with suspected post-operative complications of hepatobiliary surgery.

MATERIAL AND METHODS
Twenty-five consecutive MRCs referred to our service performed in 22 patients with suspected post-operative complications following hepatobiliary surgery, were carried out during the June 2008 and July 2009 period. The previous surgical procedures had been: 15 liver transplantations, 5 biliary-anastomoses and 5 cholecystectomies. The MRC findings were correlated with the clinical course, laboratory tests, conventional cholangiogram (in those cases where it had been done) and surgical findings. The study was carried out with General Electric 1.5 Tesla Horizon, Signa LX Echo Speed 4 channel equipment. The examinations were reviewed by the authors at the Advantage Windows 4.3 work station.

RESULTS
An adequate visualization of the biliary tract was obtained in 24 studies (96%). Anatomical variations were identified in 6 out of the total 22 patients studied (27.3%). A good visualization was obtained in 16 (80%) of the total 20 patients with biliary anastomosis. A dilation of the biliary tract was diagnosed in 15 studies: 12 stenoses and 3 lithiasis and/or biliary sludge. Stenosis was diagnosed in 15 cases (12 with biliary dilation and 3 without). The diagnosis was confirmed in the 5 cases with a probable surgical lesion, and the level was determined.

CONCLUSIONS
MRC is a non-invasive method of great value in the study of the biliary tract in patients with suspected complications derived from hepatobiliary surgery.

KEY WORDS: Magnetic resonance cholangiography, hepatobiliary surgery, biliary-digestive surgery, biliary stenosis.

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INTRODUCTION

The development of new surgical techniques in hepatobiliary surgery has been accompanied by a reduction in the incidence of complications, however biliary tract lesions and stenosis in the site of anastomosis are the main cause of morbidity (1, 2). Biliary tract lesions are also the most frequent cause of complications in all patients undergoing hepatobiliary surgery. The early complications are due to cuts in the biliary ducts due to an error originated in anatomical variants; incorrectly positioned clips, fibrosis and ischemia caused by right hepatic artery lesions.

few months later and up to many years following surgery (3, 4). The incidence of biliary duct lesions following open surgery cholecystectomy and the laparoscopic procedure is low but occurs in 0.1 to 1.3% according to the international literature (we have no knowledge of any national figures), and is related with anatomical variants and surgeons’ lack of experience (1). As cholecystectomy is a frequent procedure, complications impact on a considerable number of patients.

Figure 1. Liver transplantation (cadaveric donor): 29 years, F. 3D MRC. Biliary tract mapping. Visualization of the choledoco-choledocian anastomosis, remnant cystic ducts in the donor and native common bile ducts. Anatomical variant consisting in drainage of the posterior branch of the right hepatic duct in the common hepatic duct.

Stenosis complication
complications are the second most frequent cause of liver dysfunction after rejection (5, 6, 7, 8, 9, 10, 11). Between 10 and 33% of patients develop biliary complications following LT, including: obstruction, leaks, strictures and lithiasis. The clinical and laboratory findings are rather non-specific in these patients, and may simulate rejection -this is the reason why they may require imaging assessment (5, 9, 11, 12).

Transparietal hepatic cholangiography (TPHC) and endoscopic retrograde cholangiopancreatography (ERCP) are the most commonly used diagnostic techniques. Both are invasive and show important morbidity-mortality figures. Furthermore, in cases of complete biliary obstruction, TPHC does not show the biliary tract below the lesion and ERCP does not show what is above (13). In patients with bilio-enteric shunts, it is very hard or practically impossible to carry out an ERCP (14).

Magnetic resonance cholangiopancreatography (MRC) has emerged as a recent technique in our milieu enabling an adequate anatomical assessment of the biliary tract (15, 16, 17, 18, 19, 20). The aim of this study is to determine the usefulness of MRC as carried out in our Service in patients where there is a suspicion of early or late postoperative complications of hepatobiliary surgery.

MATERIAL AND METHODS

Twenty-five consecutive MRCs referred to our service were evaluated; they were carried out in 22 patients with suspected postoperative complications following hepatobiliary surgery during the June 2008 and July 2009 period. The surgical history was: 15 liver transplantations, 5 cholecystectomies with a probable surgical lesion of the main biliary tract and 5 bilio-digestive anastomoses due to different causes.

The conditions leading to LT were: alcohol-induced cirrhosis 1, Primary sclerosing cholangitis 1, biliary tract atresia 5, cryptogenetic cirrhosis 3, auto-immune hepatitis 2, fulminating viral hepatitis 1, biliary cirrhosis 1, without a known diagnosis 1.
The 5 MRCs in patients with complications suspected to be related with the bilio-digestive anastomosis corresponded to: 1 patient operated for a common bile duct cyst, 1 patient with a hepatic-jejunostomy due to a prior surgical lesion of the biliary tract, 3 with bilio-digestive shunt due to common bile duct and intra-hepatic lithiasis.

Two of the 5 studies carried out in the cholecystectomized patients were executed with conventional laparotomy, and the remaining 3 through laparoscopy.

Anatomical and pathological elements were identified in all of the studies.

Anatomical:
1 Visualization of the intra-hepatic (first and second order branches) and extra-hepatic biliary system.
2 Anatomical variants.
3 Visualization of the site of anastomosis.

Pathological:
1 Stenosis and its characteristics (level, morphology).
2 Dilation of the biliary tract.
3 Other complications (lithiasis, tumors, etc.).

We included any decrease in caliber of the biliary tract in relation with the sector immediately distal, or a greater than expected caliber reduction according to the level of the biliary system analyzed, with or without dilation above, as stenosis. The absence of visualization of a sector of the biliary system was likewise considered as an indication of stenosis.

When the intra-hepatic ducts measured 3mm or more immediately proximal to their entry into the common hepatic duct, and when the common bile duct measured 8mm or more we spoke of dilation.
Ages ranged from 4 to 69 years, with a median of 31 years.

The MRC findings were correlated with the clinical course, laboratory tests, conventional cholangiography (in the cases in which it had been carried out) and the surgical findings. The work was done with a General Electric 1.5 Tesla Horizon, Signa LX Echo Speed de 4-channel apparatus.

Five sequences were carried out, all non-breath hold using 3 plane localizer (scout view), ASSET calibration, Axial T2 fat saturation, coronal single shot and 3D MRC. The MRC was carried out with a FRFSE-XL sequence in the 3D mode with a 32 mm FOV, TE:800; TR:3300ms (approx. according to the patients’ respiratory rate); Matrix=256 (freq.) x 256 (phase); NEX: optimized; Thickness: 1mm; localization through slabs: tailored for each patient. Approx. time required for each study: 10 to 14 minutes.

In patients with difficulty in collaborating, radial sequences of the main biliary tract were acquired in suspended respiration.

The studies were reviewed by the authors at the Advantage Windows 4.3 working station.

RESULTS
Adequate visualization of the biliary system was possible in 24 studies (96%). One of the studies lacked diagnostic value due to the presence of ascitis, distended loops with fluid and poor patient collaboration. This was a severely ill male 8 year old patient who had undergone his second liver transplantation, and died a few days following the study.

Figure 5. Liver transplantation (live donor): 12 years, F. radial MRC. Sagital plane, hepatic duct in the antero-posterior direction, with hepato-jejuno anastomosis.
Anatomical variants were identified in 6 out of the 22 patients studied (27.3%). Twenty studies were carried out in patients with biliary anastomosis (the 15 LT and the 5 with bilio-digestive anastomosis due to different causes); adequate visualization of the anastomosis was obtained in 16 (80%). In the latter, good visualization of the anastomosis was obtained in the 5 patients with liver transplantation with choledoco-choledocian anastomosis and in 11 of the 15 case with bilio-digestive anastomosis.

The 4 cases with poor visualization had received transplantation. One was an 11 year old boy with a LT due to biliary atresia. Neither biliary dilation nor other disorders were observed. Poor visualization was attributed to the posterior localization of the anastomosis, and to the fact that the intestinal loop did not contain any fluid. He has shown a good course after one year follow-up, and not required further MR assessment. The other was a 4 year old boy with LT due to neonatal hepatitis that presented an obstructive pattern in the liver enzyme tests. The MRC showed mild dilation in the intra and extra-hepatic biliary tracts, with a possible diagnosis of obstruction in the site of the anastomosis, in spite of its poor visualization, related with the lack of filling of the loop. He has presented difficulties in the realization of the daily clinical evolutive monitoring, and was treated as acute rejection although it was not possible to carry out the liver fine needle aspiration biopsy. The third was a 16 year old adolescent with a prior LT due to biliary tract atresia 13 years before, that presented repeated episodes of cholangitis and biliary tract stenosis and required the placement of external biliary tract drainages on several occasions; he likewise presented moderate to severe rejection. This patient showed an obstructive pattern in the liver enzyme tests, and was placed an external biliary shunt catheter. The anastomosis could not be observed.

Figure 6. Liver transplantation (cadaveric donor). 44 years, F. 3D MRC. Stenosis in choledoco-choledocian anastomosis producing mild dilation of the biliary tract. Donor and native remnant cystic ducts, the latter with a low implantation in the medial side.
due to the lack of filling of the intestinal loop. A sectorial dilation of the biliary tract due to a partially drained intra-hepatic stenosis was diagnosed, these finding were in agreement with the clinical course and with the previous findings. The last was the patient initially mentioned in the first part of the results for whom it was not possible to obtain a diagnostic examination.

Of these total 15 studies, 9 were fully confirmed, 7 of which required treatment: stent placement in 2, a bilio-digestive shunt in 2, balloon dilation in 2, and external shunt in 1. 5 cases were not treated and we do not have a confirmation; they all corresponded to patients with LT: one with stenosis caused by extrinsic compression of the common bile duct,

![Image](image.jpg)

Figure 7. Liver transplantation (live donor): 6 years, M. 3D MRC. Sagital (7 a) and coronal (7 b) planes. Stricture in the bilio-digestive anastomosis with a posterior topography and mild biliary distension. Percutaneous dilation was carried out and was followed by a good clinical course.

Stenosis was diagnosed in 15 cases (60%): 3 at the level of the choledoco-choledocian anastomosis, 5 in the bilio-digestive anastomosis, 1 due to extrinsic compression of the hepatic duct in a transplanted patient, 5 due to surgical biliary tract lesions, and 1 in a patient with a probable biliary tract ischemia complication following liver transplantation.

with a probable diagnosis of cystic duct stump mucocele; it could not be confirmed because it did not require treatment.

The remaining 4 patients with LT diagnosed with stenosis in the bilio-digestive anastomosis did not require treatment because they were asymptomatic and did not show
significant alterations in the liver enzyme tests. And 1 case corresponds to a follow-up in a patient with a surgical lesion of the biliary tract. Biliary tract dilation was diagnosed in 15 studies: 12 due to stenosis and 3 due to lithiasis and/or biliary sludge.

DISCUSSION

The advent of new techniques such as laparoscopic cholecystectomy, LT and partial hepatectomies due to different conditions during the clinical course of hepato-biliary surgery has determined an increase in the number of complications derived from biliary tract lesions and the complex patient management (21, 22).

Although ERCP and TPHC have been the conventional diagnostic assessment tools used for these complications, they are invasive procedures with a non-negligible global morbidity-mortality that has increased because many of these patients present immune depression or coagulation disorders. Ultrasound is an excellent non-invasive assessment instrument for patients with suspected complications of liver transplantation or other hepato-biliary surgeries, but it is not an appropriate method for the detection of early biliary complications (10).

CT-scan also presents some important shortcomings in the assessment of biliary complications in these patients. MRC is a method that has only been recently applied in our milieu (15). There are numerous international publications that mention its usefulness and its role in the diagnosis of biliary diseases (4, 17, 18). It is a rapid and non-invasive method, with no risks. Due to its multiplanar capacity is very useful to assess the biliary tract in patients with anatomical modifications of the biliary system related to surgical procedures. It also enables an adequate selection of the therapeutic procedure: surgical intervention, laparoscopy, ERCP or TPHC for dilation or placement of a stent, or observation.

The main limitations of MRC are fundamentally determined by its current scarce availability in our milieu, high cost and the need for
patient collaboration; the contra-indications are those proper to the method.
In our series it was possible to adequately assess the whole biliary system in 96% of cases. We highlight the importance of analyzing all the “raw” images of the volumetric study and not only the post-processed ones, examining all sectors of the biliary tree. The extra-hepatic biliary system is frequently tortuous, and this may hinder its assessment. We likewise stress the importance of carrying out radial, non-volumetric acquisitions, which are especially useful in patients in whom the volumetric (longer duration) acquisition has been of poor quality.
More than one quarter of the patients studied presented anatomical variations such as a long cystic duct with a low implantation, trifurcation of the biliary tract, ending of the right duct in the left hepatic duct, etc (a percentage similar to that reported in the literature). (Fig.1) We underline the high frequency of these variants and their potential impact on surgical complications (23).
Biliary stenosis is the most frequent long-term complication in biliary tract surgery patients. In patients with biliary anastomosis this is the most frequent site of stricture, thus the importance of its adequate visualization (22).
We highlight the fact that adequate visualization was obtained in all patients with a choledoco-choledocian or hepatic-choledocian anastomosis (Fig. 1).

In patients with a bilio-digestive anastomosis (Fig.2) visualization was satisfactory in 73 %. In two of the cases in which the anastomosis was not visualized the loop had very little fluid content, hindering the accurate visualization of the anastomotic site (Fig. 3).

Figure 9. Lesion of the right hepatic duct: 56 years, F. 3D NRC. Lesion of the right hepatic duct.
The lack of filling of the intestinal loop is the the main cause of poor visualization of the anastomosis (22). In another case, the patient showed multiple perihilar biliary strictures, with an important distortion of the biliary system architecture - consequently the anastomosis was not a relevant element either.
Figure 4 shows an example of a bilio-digestive anastomosis in a patient with choledoco-duodenostomy due to common bile duct lithiasis. A sump syndrome was diagnosed, consisting in an accumulation of food remains, biliary sludge and lithiasis in the common bile duct distal to the
duodenostomy. This may give rise to cholangitis and biliary obstruction (20).

In patients with bilio-intestinal shunt some authors recommend the administration of anti-spasmodic medication, but we do not include it in our everyday practice; intestinal motility has not generated artifacts spoiling the quality of the studies.

Patients with liver transplantation tend to show anatomical modifications and it is of utmost importance to be familiar with them (10, 12). In cases of live donor LT, the donor organ hepatic duct presents a rather antero-posterior horizontal position and the bili-digestive anastomosis is in a very posterior topography, while the loop is often collapsed between the liver and the posterior abdominal wall (Fig. 5).

Choledoco-choledocian anastomoses are easier to identify. On occasions it is possible to observe the cystic duct stump above and below the anastomosis (Fig. 6).

Strictures in patients with LT may occur in the site of the anastomosis (more frequently) or at a distance (5, 9, 10, 11, 12). Figures 6 and 7 show two cases of stenosis in the site of anastomosis.

Dilation above the site of the anastomosis may suggest a stricture at that level.

In any case, there may be an anatomical inconsistency between the donor and receptor biliary ducts without this necessarily entailing a biliary obstruction (11).

Sometimes there is bending at the anastomotic site, without a real stricture; the images are hard to interpret in these cases.

Stenoses far from the anastomosis are generally due to ischemia caused by the obstruction of the hepatic artery or to fibrosis following cholangitis (11).

Post-cholecystectomy biliary tract lesions may be of acute or differed onset (Figures 8, 9 and 10) (21, 24).

It is important to confirm the diagnosis, the site of the lesion and distance to the bifurcation (Bismuth classification) (20). It is also possible to observe peri-hepatic collections, probably bilomas. In certain disorders it may be useful to use contrast that is eliminated through the biliary system. The leak of contrast beyond the main biliary tree could serve to confirm the lesion (3, 24). In our
milieu we do not count with these contrast media and therefore consider CT-scan as a more rapid and easily available tool to assess the presence of these collections.

Figure 10 shows an example of a known common bile duct lesion. The patient was regularly monitored with liver enzyme tests and ultrasound. An ECRP was carried out one year later when these tests showed an alteration, and it served to confirm the diagnosis, the site of the stricture and its repercussion on the biliary system, thus allowing to plan the treatment (the placement of a biliary stent).

Most cases in our series do not include the surgical notes; the surgeries have frequently been carried out many years before, and this greatly hinders the planning of the studies and their later interpretation.

We have had a high diagnostic precision in post-cholecystectomy lesions and in the assessment of choledoco-choledocian anastomoses; we had more difficulties in patients with LT and bilio-digestive anastomosis. In all cases, but more especially in this group of patients, it is necessary to be extremely careful and correlate the MRC findings with the clinical course and liver enzymes before asserting the presence of a true stricture with biliary obstruction.

CONCLUSIONS

MRC is a non-invasive method of great value in the study of the biliary tract in patients with suspected complications derived from hepatobiliary surgery. The adequate interpretation of the imaging studies requires that they always be correlated with the patient’s clinical condition, surgical protocols and the laboratory tests.

Bibliography


