Magnetic Resonance Cholecystopancreatography (MRCP) With Negative Peroral Experimental SPIO Solution in Liver Cirrhosis - Yes or Not?

Poster No.: C-0805
Congress: ECR 2013
Type: Scientific Exhibit
Authors: I. Mocikova; Prostejov/CZ
Keywords: Abdomen, MR, Contrast agent-oral, Cholangiography, Diagnostic procedure, Cirrhosis, Image verification, Transplantation
DOI: 10.1594/ecr2013/C-0805

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Purpose

There are available various imaging modalities for imaging of biliary tree and pancreatic ducts such as ultrasound (US), endoscopic retrograde cholangiopancreatography (ERCP), multislice computer tomography (MSCT) or magnetic resonance cholangiopancreatography (MRCP). MRCP is a totally noninvasive, safe and patient’s well tolerated investigation, regularly needed for accurate biliary tree analysis of intrahepatic and extrahepatic parts and without previous patient’s preparation. However, liver cirrhosis with portal hypertension and ascites (various amount of free intraabdominal fluid and one of the sign of portal hypertension decompenzation) causes small bowel wall edema and worsened differentiation between bowel wall, bowel content and extrahepatic biliary tree for imaging of extraluminal pathology and biliary ducts. Biliary tree analysis is needed for scoring of liver fibrosis, for surgery analysis before orthotopic liver transplantation (OLT), for planning interventional procedures due to liver cirrhosis complications (hepatocellular carcinoma and transarterial chemoembolization [TACE], transjugular portosystemic shunt [TIPS], stenting of biliary ducts). Bowel preparation before MRCP with positive contrast agent is expensive and useless, because ascites and positive contrast agent are hyperintensive in T2 weighted images (T2WI), and heavily T2 weighted images used in MRCP, neutral/biphasic contrast agent is not appropriate also (signal intensity [SI] is the same as ascites in T2WI and heavily T2 WI). Superparamagnetic iron oxide nanoparticles (SPIO) are generally more suitable for luminal SI suppression (dark in T2WI and heavily T2 WI and T1WI). Moreover, appropriate suppression of bowel content can reveal extraluminal bowel and biliary tree pathology. We show that the using of peroral contrast agent based on SPIO nanoparticles is highly recommended for better visualization of biliary tree in patients suffering from liver cirrhosis and ascites, some of those waiting for OLT.

Methods and Materials

A total of 40 patients (15 women and 25 men), age range 20-88 years, were included in the study. The inclusion criteria were the presence and the confirmation of the liver cirrhosis of various degree and signed informed consent before examination. This study was approved by institutional ethic review board. MRCP was indicated because of the standard examination in liver cirrhosis of any degree and before planned OLT in majority of patients. Liver cirrhosis in patients with planned OLT was scored with model for end-stage liver disease (MELD) score by clinicians and this fact was known to radiologists
before MRCP investigation, some patients had not the MELD score. All patients were divided into 2 groups (A and B) according to bowel preparation before MRCP.

In the group A 20 patients (10 women and 10 men) with liver cirrhosis were examined by MRCP immediately after bowel preparation with per-oral negative SPIO contrast solution. Among this group of patients, 12 of them were tested just before OLT, 10 patients suffered of ascites.

In the group B 20 patients (5 women and 15 men) with liver cirrhosis were examined by MRCP without bowel preparation, 14 patients waited for OLT, 13 patients had ascites.

There was no significant difference in gender between groups (p=0.974). The first 20 patients (group A) were investigated within March 2008 - February 2010, next 20 patients (group B) were investigated within March 2010 - December 2011.

*Imaging protocol*

Patients in the group A drank sequentially 500 ml of per-oral negative SPIO contrast solution 30 minutes before MRCP. All examinations were realized on a 1.5 T MRI unit (Signa Horizon Lx, GE, Milwaukee, Wisconsin, USA), with body phased array, in prone position. Protocol of MRCP : localizer, axial and coronal planes 2D T2 SSFSE TE 500, TR6000, bandwith 31.25, matrix 384 x 320, FOV 36, coronal plane 3D FIESTA, 2D MRCP- slice thickness 20 mm, spacing 0, number of slices 14 and more, without intravenous contrast agent and spasmolytics.

All image analyses were performed on the workstation ADW 4.5 (GE, Milwaukee, Wisconsin, USA).

*Negative SPIO per-oral contrast solution*

The experimental per-oral solution (500 ml) was composed from maghemite SPIO nanoparticles (800 mg of gamma-Fe$_2$O$_3$) in bentonite matrix (4 g), fruit juice 500 ml-apple/carrot (HAMI, Nutricia, CZ), water 500 ml, polyethylene glycol 4000 (Macrogol) 76.8 g + 2.82 g sodium sulphate (Na$_2$SO$_4$) + 0.84 g sodium bicarbonate (NaHCO$_3$) + 0.72 g sodium chloride (NaCl) + 0.36 g potassium chloride (KCl).

*Analysis*

Four radiologists (p1=RB,p2=PN,p3=NI,p4=KN) performed a blind review of all MRCP investigations in both groups of patients (A and B). Among them, p1, p3, p4 were trained in gastrointestinal MR imaging in the past. Only p2 was experienced in MR generally, without special workout in gastrointestinal MR imaging.
After MRCP examination of each patient in both groups, all four radiologists fulfilled the given questionnaires containing questions related to the quality of the diagnosed abdominal part:

visualization of intrahepatic biliary tree [1. excellent (80-100%), 2. sufficient (50-80%), 3. insufficient (less than 50%), 4. impossible to evaluate]; (ii) visualization of extrahepatic biliary tree [1. excellent (80-100%), 2. sufficient (50-80%), 3. insufficient (less than 50%), 4. impossible to evaluate]; (iii) absence/presence of bowel wall edema (1. yes, 2. no); (iv) presence of extraluminal bowel pathology (1. ascites, 2. varices, 3. pathologies);

presence of ascites in investigated patients together with description of the state of ascites (1. absent, 2. mild amount, 3. advanced ascites) were described. Advanced ascites was defined as a large amount of free intraabdominal fluid caused pressing and rotating of intraabdominal organs (difficult breath uptake within breathold, great enlargement of the peritoneal cavity). Mild ascites was defined as a presence of free abdominal fluid without pressing and rotating of intraabdominal organs (without difficult breath uptake within breathold, great enlargement of the peritoneal cavity).

Statistics

$\chi^2$ - analysis was performed for patients with and without ascites, separately. $\chi^2$-test analysis was performed for comparison of intrahepatic and extrahepatic bile ducts separately. Next parameter was the distribution of bowel luminal filling of negative SPIO contrast solution in both groups after 30 minutes drinking.

$\chi^2$ - test was used for the evaluation of categorical variables in all 4 radiologists: p1, p2, p3, p4. All tests were made at the level of significance $p \leq 0.05$. The questions from the given questionnaires, answered by radiologists as blind tests were analyzed by program STATISTIKA. The graphical visualization of categorical dates was performed by Mosaic plots.

Results

$\chi^2$ - analysis was performed for patients with and without ascites, separately. The visualization of intrahepatic biliary ducts was independent on the bowel preparation. The $\chi^2$ - analysis confirmed this fact in 3 of 4 radiologists ($p1=0.00276$, $p2=0.0432$, $p3=0.51955$, $p4=0.07524$). The visualization of intrahepatic biliary ducts is strongly dependent on the stage of liver cirrhosis.

Analysis showed in patients without ascites - the visualization of extrahepatic biliary ducts was good, no matter if bowel preparation by negative per-oral SPIO contrast solution
have been done or not (Fig. 1, Fig 2). \(^2\) - test confirmed this hypothesis (4 radiologists: p1=0.102, p2=0.116, p3=0.976, p4=0.413).

\(^2\) -analysis for patients suffering of ascites, after drinking negative per-oral SPIO contrast solution, confirmed the fact, that the extrahepatic biliary duct’s visualization was improved in all 4 radiologists (p1=0.000039, p2=0.00039, p3=0.00279, p4=0.00002). (Fig 3, Fig 4) (Table 1)

We tested also the distribution of the luminal filling in group A for each reader particularly and for patients with ascites (p1= 0.01751, p2= 0.03526, p3= 0.05304,p4= 0.00167). The statistic analysis confirmed that 30 minutes of per-oral drinking of negative SPIO contrast solution is sufficient time for visualization of proximal bowel loops, duodenum and stomach before MRCP with good/ sufficient luminal suppression.

Th visualization of extrahepatic biliary ducts and extraluminal pathologies was observed and improved in patients suffering of ascites after drinking negative per-oral SPIO contrast solution in all 4 radiologists (p1=0.0175, p2=0.03526, p3=0.053, p4=0.00167). In patients without ascites, the visualization of extraluminal pathologies was independent on the bowel preparation.

We observed the presence of bowel wall edema caused decreased homogeneity of luminal content suppression with negative per-oral SPIO contrast solution.

The distribution of the luminal filling in group A for each reader particularly and for patients with ascites (p1= 0.01751, p2= 0.03526, p3= 0.05304,p4= 0.00167). The statistic analysis confirmed that 30 minutes of per-oral drinking of SPIO contrast solution is sufficient time for visualization of proximal bowel loops, duodenum and stomach before MRCP with good/ sufficient luminal suppression.

Table 1 Mosaic plots-statistic evaluation of extrahepatic biliary duct in patients with ascites in 4 radiologists separately ( KN, NI,PN,RB)

Footnotes: No means no contrast agent was used; Yes means negative per-oral SPIO based contrast solution was used before MRCP investigation; numbers 1, 2, 3 and 4 means excellent, sufficient, insufficient and impossible to evaluate and the portions of the grey areas means what is the % of the answers related to the given number (1-4)

Images for this section:
**Fig. 1:** MRCP without bowel preparation in advanced liver cirrhosis without ascites, sufficient delineation of extrahepatic and intrahepatic biliary ducts anatomy
**Fig. 2:** MRCP with bowel preparation in advanced liver cirrhosis, without ascites, good delineation of the extrahepatic biliary duct and bowel loops
**Fig. 3:** MRCP without bowel preparation, before OLT, advanced hepatosplenomegaly and liver cirrhosis with ascites, small bowel wall edema, difficult differentiation between extrahepatic biliary duct and bowel loops
Fig. 4: Fig.4 MRCP with bowel preparation in advanced liver cirrhosis and advanced ascites before OLT, better depiction of extrahepatic biliary duct anatomy before surgery. Evidence of perihepatic varices.
Table 1 Mosaic plots-statistic evaluation of extrahepatic biliary duct in patients with ascites in 4 radiologists separately (KN, NI, PN, RB)

<table>
<thead>
<tr>
<th>Mosaic plot doctor KN</th>
<th>Mosaic plot doctor NI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mosaic plot doctor PN</th>
<th>Mosaic plot doctor RB</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Footnotes: No means no contrast agent was used; Yes means negative per-oral SPIO based contrast solution was used before MRCP investigation; numbers 1, 2, 3 and 4 means excellent, sufficient, insufficient and impossible to evaluate and the portions of the grey areas means what is the % of the answers related to the given number (1-4)

**Fig. 5:** Table 1 Mosaic plots-statistic evaluation of extrahepatic biliary duct in patients with ascites in 4 radiologists separately (KN, NI, PN, RB) Description of the Table 1: Mosaic plots as a statistic evaluation of the answers of 4 radiologists on the given question from the blind questionnaire: “How is the visualization of extrahepatic biliary duct in patients suffering of ascites?” [1.excellent (80-100%), 2. sufficient (50-80%), 3. insufficient (less than 50%), 4. impossible to evaluate] Footnotes: No means no contrast agent was used; Yes means negative per-oral SPIO based contrast solution was used before MRCP investigation; numbers 1, 2, 3 and 4 means excellent, sufficient, insufficient and impossible to evaluate and the portions of the grey areas means what is the % of the answers related to the given number (1-4)
Conclusion

Although there was relatively small number of patients in this study, the results of the study in patient suffering from ascites in liver cirrhosis and MRCP with previous bowel preparation with negative per-oral SPIO contrast solution seemed to be contributional. Negative per-oral SPIO contrast solution is more appropriate for bowel preparation in comparison of per-oral positive or biphasic contrast solution. MRCP without per-oral bowel preparation is reliable for patients with liver cirrhosis and without ascites. Imaging of the intrahepatic biliary ducts is independent on the previous bowel preparation before MRCP. More investigation need to be realized in patients with ascites of any causes.

References

17: 669-674. DOI 10.1007/s00330-006-0414-z

Personal Information

Ingrid Mocikova¹,⁴, Katerina Polakova², Dana Mlcuchova³, Pavel Tucek³, Pavel Novak¹,
Katerina Novotna⁴, Izak Niko⁴, Radoslav Bielik⁴, Radek Zboril², Miroslav Herman⁵

(1) Medihope s.r.o., Mathonova 291/1, 796 04 Prostejov, Czech Republic

(2) Regional Centre of Advanced Technologies and Materials, Departments of Physical
Chemistry and Experimental Physics, Faculty of Nature Sciences, Palacký University,
Šlechtitel# 11, 783 71 Olomouc, Czech Republic

(3) Department of Geoinformatics, Faculty of Nature Sciences, Palacký University,
Šlechtitel# 11, 783 71 Olomouc, Czech Republic

(4) Department of Radiology, F.D.Roosevelt Faculty Hospital, nam. gen. Svobody 1, 975
17, Banska Bystrica, Slovak Republic

(5) Department of Radiology, Faculty of Medicine and Dentistry, Palacky University
Olomouc, Czech Republic