Diagnostic accuracy of MR imaging to characterize focal liver lesions: comparison between the use of extra-cellular and hepatospecific contrast mediums

Poster No.: C-1305
Congress: ECR 2013
Type: Scientific Exhibit
Authors: S. Maurea¹, A. Tambasco¹, P. P. Mainenti¹, M. Imbriaco¹, C. Mollica¹, E. Laccetti¹, L. Camera¹, R. Liuzzi², M. Salvatore¹; ¹Napoli/IT, ²Naples/IT
Keywords: Abdomen, Liver, MR, Contrast agent-intravenous, Neoplasia
DOI: 10.1594/ecr2013/C-1305

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

The most appropriate tools in diagnostic imaging for the characterization of focal liver lesions (FLL) are ultrasonography (US), computed tomography (CT) and magnetic resonance (MR); in particular, MR imaging is currently the method of choice as it does not expose to ionizing radiation, shows a high intrinsic contrast resolution and the possibility of using various types of sequences and contrast agents for the characterization of the FLL; most commonly used contrast agents in MRI are gadolinium chelates, that show an interstitial extra-cellular non-specific parenchymal distribution and organ-specific contrast agents, including those with hepato-biliary excretion or those concentrating in cells of the reticuloendothelial system (RES).

The aim of this study was to compare the diagnostic value of gadolinium (Gd) and ultrasmall superparamagnetic iron oxide (SPIO) MR imaging for characterization of FFL.
Methods and Materials

We prospectively studied 68 patients (40 M, 28 F, age from 22 to 81 yrs) of which 36 with diagnosis of colo-rectal cancer, 26 with hepatic cirrhosis and 6 with incidental imaging detection of FLL.

All patients underwent both gadolinium (Gd) and ultrasmall superparamagnetic iron oxide (SPIO) MR studies of the upper abdomen. MR (Gyrosan Intera 1.5 T, Philips Medical Systems) study was performed using T1 and T2 fast-field-echo (FFE) and T2 turbo-spin-echo (TSE) sequences in axial and coronal views; dynamic multi-phases gadolinium Gd-enhanced T1-FFE-Bh images were obtained in arterial (25 s), portal (60 s) and equilibrium (180 s) phases, followed by SPIO-enhanced T2-FFE scans; images were obtained 15-20 minutes after SPIO administration.

A qualitative analysis of pre- and post-contrast MR images to classify FLL as benign or malignant was performed using a 3-point scoring system: 0=benign; 1=indeterminate; 2=malignant.

Results were classified as true positive or true negative, false positive or false negative by the reference standards represented by the histological data (n = 18), biopsy (n = 18) or clinical-imaging follow-up (n = 86).

The concordance or discordance between the results of the two series of post-contrast MR images (Gd and SPIO) was evaluated; for each set of post-contrast MR images, the values of diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated.
Results

A total of 118 hepatic lesions was identified in 49 patients; 86 lesions were benign (4 adenomas, 29 cysts, 3 focal steatosis, 25 hemangiomas, 1 focal vascular abnormality, 5 fibrotic lesions, 13 regenerative nodules, 6 dysplastic nodules) while 32 lesions were malignant (14 hepatocellular carcinomas (HCC), 17 metastasis and 1 cholangiocarcinoma).

In the majority 83% (n = 98) of the FLL the result of MR images with Gd was concordant with that of the corresponding MR images after SPIO.

Conversely, in the remaining 17% (n = 20) of the FLL the result of the two series of MR images was discordant (p <0.01). In particular, we observed 13 cases of FLL (8 angiomas, 1 adenoma and 4 dysplastic nodules) in which the result of the MR images after Gd was classified as falsely positive for malignancy (score 2), while that of the MR images after SPIO has been classified as a true negative for malignancy (score 0) (Figures 1-5 and 6-10); in a regenerative nodule, the result of images after Gd was classified as true negative for malignancy (score 0), while that of SPIO images has been classified as a false positive for malignancy (score 2); in four cases of hepatocellular carcinoma, the result of images after Gd was classified as a true positive for malignancy (score 2), whereas that of the images after SPIO was classified as false negative for malignancy (score 0); finally in the last two malignant FLL (hepatocellular carcinoma and metastases), the result of images after Gd was classified as false negative for malignancy (score 0), while that of the images after SPIO was classified as a true positive for malignancy (score 2) (Fig. 11-15).
**Fig. 1:** Small (1 cm) capillary hemangioma located in the VIII hepatic segment; dynamic MR images after gadolinium show focal enhancement by the lesion only in the arterial phase (fig. 1) with no focal abnormality in portal (fig. 2) and equilibrium (fig. 3) phases; T2 weighted MR images before (fig. 4) and after (fig. 5) SPIO administration show homogeneous contrast distribution in the liver with no focal abnormalities.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
Fig. 2: Small (1 cm) capillary hemangioma located in the VIII hepatic segment; dynamic MR images after gadolinium show focal enhancement by the lesion only in the arterial phase (fig. 1) with no focal abnormality in portal (fig. 2) and equilibrium (fig. 3) phases; T2 weighted MR images before (fig. 4) and after (fig. 5) SPIO administration show homogeneous contrast distribution in the liver with no focal abnormalities.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
Fig. 3: Small (1 cm) capillary hemangioma located in the VIII hepatic segment; dynamic MR images after gadolinium show focal enhancement by the lesion only in the arterial phase (fig. 1) with no focal abnormality in portal (fig. 2) and equilibrium (fig. 3) phases; T2 weighted MR images before (fig. 4) and after (fig. 5) SPIO administration show homogeneous contrast distribution in the liver with no focal abnormalities.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
**Fig. 4:** Small (1 cm) capillary hemangioma located in the VIII hepatic segment; dynamic MR images after gadolinium show focal enhancement by the lesion only in the arterial phase (fig. 1) with no focal abnormality in portal (fig. 2) and equilibrium (fig. 3) phases; T2 weighted MR images before (fig. 4) and after (fig.5) SPIO administration show homogeneous contrast distribution in the liver with no focal abnormalities.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
Fig. 5: Small (1 cm) capillary hemangioma located in the VIII hepatic segment; dynamic MR images after gadolinium show focal enhancement by the lesion only in the arterial phase (fig. 1) with no focal abnormality in portal (fig. 2) and equilibrium (fig. 3) phases; T2 weighted MR images before (fig. 4) and after (fig.5) SPIO administration show homogeneous contrast distribution in the liver with no focal abnormalities.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
**Fig. 6:** Small (1 cm) dysplastic nodule located in the VIII hepatic segment; dynamic MR images after gadolinium show focal enhancement by the lesion only in the arterial phase (fig. 6) with no focal abnormality in portal (fig. 7) and equilibrium (fig. 8) phases; T2 weighted MR images before (fig. 9) and after (fig. 10) SPIO administration show homogeneous contrast distribution in the liver with no focal abnormalities.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
Fig. 7: Small (1 cm) dysplastic nodule located in the VIII hepatic segment; dynamic MR images after gadolinium show focal enhancement by the lesion only in the arterial phase (fig. 6) with no focal abnormality in portal (fig. 7) and equilibrium (fig. 8) phases; T2 weighted MR images before (fig. 9) and after (fig. 10) SPIO administration show homogeneous contrast distribution in the liver with no focal abnormalities.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
**Fig. 8:** Small (1 cm) dysplastic nodule located in the VIII hepatic segment; dynamic MR images after gadolinium show focal enhancement by the lesion only in the arterial phase (fig. 6) with no focal abnormality in portal (fig. 7) and equilibrium (fig. 8) phases; T2 weighted MR images before (fig. 9) and after (fig. 10) SPIO administration show homogeneous contrast distribution in the liver with no focal abnormalities.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
**Fig. 9:** Small (1 cm) dysplastic nodule located in the VIII hepatic segment; dynamic MR images after gadolinium show focal enhancement by the lesion only in the arterial phase (fig. 6) with no focal abnormality in portal (fig. 7) and equilibrium (fig. 8) phases; T2 weighted MR images before (fig. 9) and after (fig. 10) SPIO administration show homogeneous contrast distribution in the liver with no focal abnormalities.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
Fig. 10: Small (1 cm) dysplastic nodule located in the VIII hepatic segment; dynamic MR images after gadolinium show focal enhancement by the lesion only in the arterial phase (fig. 6) with no focal abnormality in portal (fig. 7) and equilibrium (fig. 8) phases; T2 weighted MR images before (fig. 9) and after (fig. 10) SPIO administration show homogeneous contrast distribution in the liver with no focal abnormalities.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
**Fig. 11:** Small (mm) hepatocellular carcinoma located in the VI hepatic segment; dynamic MR images after gadolinium show no focal abnormalities in the arterial (fig. 11), portal (fig. 12) and equilibrium (fig. 13) phases; T2 weighted MR images before (fig. 14) and after (fig. 15) SPIO administration show focal hyperintensity in the VI hepatic segment in the post-contrast MR image.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
**Fig. 12**: Small (mm) hepatocellular carcinoma located in the VI hepatic segment; dynamic MR images after gadolinium show no focal abnormalities in the arterial (fig. 11), portal (fig. 12) and equilibrium (fig. 13) phases; T2 weighted MR images before (fig. 14) and after (fig. 15) SPIO administration show focal hyperintensity in the VI hepatic segment in the post-contrast MR image.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
**Fig. 13:** Small (mm) hepatocellular carcinoma located in the VI hepatic segment; dynamic MR images after gadolinium show no focal abnormalities in the arterial (fig. 11), portal (fig. 12) and equilibrium (fig. 13) phases; T2 weighted MR images before (fig. 14) and after (fig. 15) SPIO administration show focal hyperintensity in the VI hepatic segment in the post-contrast MR image.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
**Fig. 14:** Small (mm) hepatocellular carcinoma located in the VI hepatic segment; dynamic MR images after gadolinium show no focal abnormalities in the arterial (fig. 11), portal (fig. 12) and equilibrium (fig. 13) phases; T2 weighted MR images before (fig. 14) and after (fig. 15) SPIO administration show focal hyperintensity in the VI hepatic segment in the post-contrast MR image.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
Fig. 15: Small (mm) hepatocellular carcinoma located in the VI hepatic segment; dynamic MR images after gadolinium show no focal abnormalities in the arterial (fig. 11), portal (fig. 12) and equilibrium (fig. 13) phases; T2 weighted MR images before (fig. 14) and after (fig. 15) SPIO administration show focal hyperintensity in the VI hepatic segment in the post-contrast MR image.

© Scienze Biomorfologiche e Funzionali, University of Naples "Federico II", II Policlinico - Napoli/IT
Table 1: Table 1 illustrates the results of the comparative MR images acquired after the administration of Gd and SPIO in terms of accuracy, sensitivity, and diagnostic specificity, PPV and NPV; in particular, the statistically significant differences between the two series of post-contrast MR images were observed only in the values of diagnostic specificity and PPV that were significantly (p

<table>
<thead>
<tr>
<th></th>
<th>Paramagnetic contrast</th>
<th>Superparamagnetic contrast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic accuracy (%)</td>
<td>83%</td>
<td>92%</td>
</tr>
<tr>
<td>Sensitivity (%)</td>
<td>79%</td>
<td>74%</td>
</tr>
<tr>
<td>Specificity (%)</td>
<td>85%</td>
<td>99%*</td>
</tr>
<tr>
<td>PPV (%)</td>
<td>68%</td>
<td>96%*</td>
</tr>
<tr>
<td>NPV (%)</td>
<td>91%</td>
<td>90%</td>
</tr>
</tbody>
</table>

* p < 0.01
Conclusion

Our preliminary results suggest that SPIO-MR provides a diagnostic incremental value, as specificity and PPV, to characterize FLL compared to Gd-MR; thus, SPIO may be useful when FLL characterization is requested and Gd images are uncertain.
References


