Gd-EOB-DTPA (Primovist®) MRI in evaluating residual liver tumor after radiofrequency ablation (RFA)

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Purpose

- Hepatocellular Carcinoma (HCC) is the seventh most extended cancer all over the world. HCC is highly linked with viral chronic hepatitis or cirrhosis. About 80% of HCC on their showing affect many systems, hence patients are not eligible for surgical liver resection and a big quote of this population can't be treated in accordance to their multi-organs compromised functionality. Remaining 20% patients, only liver suffering:
  - 1/3 of cases undergo surgery.
  - 3/4 of cases will not be surgery treated due to their bi-lobar liver or vital structures involvement.
Therefore Radiofrequency Ablation (RFA) is one of the most commonly employed non-surgical modalities of patient treatment due to its lower mortality index.
During patient staging, detection of small nodules and early recognition of residual/ recurring tumor is a relevant goal to optimize patient management and improve survival rate.
- Gd-EOB-DTPA is a double-effect contrast agent, which can be employed to study the focal liver lesions both during the vascular phase and during the subsequent liver-specific phase.
- Aim of this study was to evaluate the diagnostic efficacy of Magnetic Resonance imaging (MRI) performed administering the new liver-specific contrast agent gadoxetic-acid (Gd-EOB-DTPA) and multidetector CT (MDCT), after RFA, to assess the accuracy in demonstrating necrosis and detecting the residual viable tumour or its regrowth.

Methods and Materials

Patients

- Twenty patients with histologically proven HCC nodules & ultrasound-guided RFA treatment
- Nineteen men and 1 woman
- Mean age: 56 years old (range 46-65 years)
- All patients underwent pretreatment Gd-EOB-DTPA-enhanced MRI and MDCT staging
- All patients were followed up with both imaging modalities at the 1st month and every 3 months during one year

MR Imaging

- 1.5T scanner, multichannel abdominal phased array coil
- AX T2-W breath-hold TFI and AX T1-W breath-hold TSE
- AX T1-W breath-hold TSE dynamic acquisition after injection of 0.1 mmol/Kg (2 ml/Kg) of Gd-EOB-DTPA at 2.5 ml/s speed
- AX and COR T1-W breath-hold TSE, 20 minutes after Gd-EOB-DTPA administration
CT Imaging

- Sixteen detector-row MDCT scanner
- Non-enhanced and triple-phase contrast-enhanced technique (bolus-tracked arterial phase at about 30", venous phase at 70", and delayed phase at 120"), 2-mm acquisition thickness, pitch 1.5, 140 ml of ionic contrast medium (350-370 mg I/ml), at 4 ml/s

RFA technique

- Generator supplying up to 100 W (RF 2000) or 200 W (RF 3000) of power
- Fifteen gauge LeVeen monopolar array electrode (3.5- and 4.0-cm maximum array diameter) with 10 hooks
- For tumors <2.5 cm, the electrode was placed at the center of the tumor
- For larger lesions, the electrode was first placed at the most posterior interface between the tumor and the liver parenchyma; then the electrode was withdrawn and redeployed anteriorly at 1.5- to 2.0-cm intervals in the tumor.

MRI studies analysis

- Retrospective revision of pre-RFA and post-RFA images by two radiologists blinded to MDCT studies and pathology results
- HCC (native, residual, and recurrent): low signal intensity on T1-w, intermediate-to-high signal intensity on T2-w, arterial enhancement with delayed wash-out on T1-w dynamic acquisitions; low signal intensity (poorly-differentiated HCC) or high signal intensity (well-differentiated HCC) on T1-w images obtained during the hepatocitary phase
- Subtraction images (arterial phase minus pre contrast acquisition) to identify signal enhancement on T1-w images

CT studies analysis

- Retrospective revision of pre and post-RF images by two radiologists, blinded to MRI studies and pathology results
- HCC (native, residual, and recurrent): hyperattenuation on arterial-phase images with a wash-out on portal- and delayed-phase images

Results

- Performing MDCT before RFA, 22 HCC lesions were depicted, and after 7 residual tumors and 3 new HCC foci were shown. Dynamic MRI before RFA treatments detected 28 HCC and after 10 residual tumours; during 20 minutes delayed MRI acquisitions 5 new HCC foci were showed (Graph.1).
Graph. 1: global evaluated lesions before and after RFA treatments on both techniques.

- A gain in detecting tumors performing MRI versus MDCT, adminstering Gd-EOB-DTPA, of 3 residual tumors and 2 new HCC foci was obtained (Graph 2); one patient, during 20 min delayed acquisitions (reported as the typical liver specific phase) showed a growing lesion in its transforming into a well differentiated HCC, that was clearly recognizable and after histological proven (Fig.3).
Fig.

**Graph. 2:** the gain obtained using MRI vs MDCT is well shown in this graph.
- In following cases MRI depicted presence of residual tumor that was not recognizable performing MDCT
Fig.: A-D: (A) Tipically appearance of the cavity on T2-w imaging as low signal intensity area. (B) Nodular enhancement in the arterial phase, indicating presence of residual tumor, in dynamic T1-w acquisitions. (C) The signal absence during the subsequent liver-specific phase indicates that the lesion corresponds to an undifferentiated HCC. (D) Absence of enhancement in CT bolus-tracked arterial phase. In this case MRI depicted the presence of residual tumor not evaluable in CT examination, histological characterized as an undifferentiated HCC.
**Fig.:** A-F: The cavity shows soft signal hyperintensity on T2-w imaging (A), low signal intensity in unenhanced dynamic T1-w images (B), signal hyperintensity during arterial phase in dynamic T1-w, (C) and rapid wash-out in portal phase (D), index of residual tumor. E: the signal absence during delayed liver specific phase underlines the presence of an undifferentiated HCC. Absence of enhancement in CT bolus-tracked arterial phase (F). In this case only MRI showed the presence of residual tumor, histological characterized as an undifferentiated HCC.
**Fig.:** A-I: The round area (arrow) shows soft signal hyperintensity on T2-w imaging (A), high signal intensity during arterial phase in dynamic T1-w (D-F) with fast wash-in and wash-out on A/T curve (B). Multiple lesions, with very low signal intensity are shown in the liver delayed phase, bigger one is marked by the arrow (C). Absence of enhancement in CT bolus-tracked arterial phase (G-I). MRI alone showed new recurrences, histological characterized as undifferentiated HCC.
Fig.: The cavity is of low signal intensity on T2-w imaging (A), no rim-enhanced in the MRI arterial phase (B) and in bolus-tracked arterial MDCT phase (C) indicating the absence of residual tumor. Both techniques show, in the arterial phase, a new lesion in the IV segment (arrow in B and C). MR imaging demonstrates, on lower cavity border, an area of enhancement in the arterial phase (E) persistent on delayed hepatocitic phase (F). No enhancement in CT bolus-tracked arterial phase (G). MRI displayed a new recurrence, histological characterized as well differentiated HCC.

Conclusion

- Gd-EOB-DTPA-enhanced MRI is a one-stop two-step examination, combining two phases, the early vascular phase and the 20-minutes delayed hepatocitary phase.
Use of Gd-EOB-DTPA-enhanced MRI made us able to identify more residual HCCs after RFA treatment and more new HCCs than MDCT.