Comparison of 64-slice CT and 3-T-MRI with DWI for the detection of hepatocellular carcinoma

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HCC is worldwide one of the most frequent carcinomas with increasing incidence. It is well known that liver cirrhosis is a precancerous condition for sequential carcinogenesis from regeneration of liver tissue to overt HCC (Figure 1). Risk factors mainly include chronic hepatitis B and C as well as alcohol abuse. In addition nonalcoholic steatohepatitis (NASH), primary biliary cirrhosis (PBC), hemochromatosis, alpha-1 antitrypsin deficiency and autoimmune hepatits (AIH) are also part of the causal chain [1-3]. However de novo hepatocarcinogenesis has also been described [4].

Currently HCC can be diagnosed by Ultrasound, MDCT (Multidetector Computer Tomography) and 1.5 Tesla MRI (Magnetic Resonance Imaging) with contrast agents. Nevertheless definite diagnosis is often challenging especially differentiation of regenerative nodules versus hcc. In recent years CT has developed dramatically with the introduction of multislice technology which allows thinner slice thickness and faster acquisition times. In the field of MRI new sequences, higher field strength and new contrast agents have been evolved [5,6].

Purpose of our study is the comparison of contrast-enhanced 64-slice computed tomography (ceCT) with 3-Tesla magnetic resonance imaging (MRI) using Gd-EOB-DTPA and additional diffusion-weighted imaging in diagnosing hepatocellular carcinoma.
Fig. 0: Figure 1: sequential hepatocarcinogenesis

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Methods and Materials

50 patients (median age 60.6 years; 42 male, 8 female) with suspected or proven HCC underwent a 3-phase-liver-CT (Collimation of 64 x 0.625 mm, Rotation time of 0.75 s, Tube voltage of 120 kV, Slice thickness of 3 mm) with iopromide (100ml) at a rate of 3 ml/s. Unenhanced phase, Early arterial phase 10 s after Bolustracking and portal venous phase 60 s p.i. were achieved.

An additional 3-Tesla-MRI-examination with Gd-EOB-DTPA was accomplished within the next two days (median duration 2.2 days). MRI was performed using a 3 Tesla MR scanner.

The study protocol covered:

(1) T2w-HASTE coronar and axial (TR 800ms, TE 83 s, flip angle 160°, slice thickness 5 mm, matrix 320*)

(2) T1w-VIBE coronar unenhanced, axial unenhanced and dynamic after Care Bolus (20s, 50s, 2min and 20min p.i.; TR 2.92 ms, TE 0.86 ms, flip angle 10°, slice thickness 3 mm, matrix 256*) with Gd-EOB-DTPA with 0,1ml/kg bodyweight at a rate of 2ml/s by power injector

(3) Diffusion-weighted sequence coronar and axial (TR 2000 ms, TE 60 ms, slice thickness 5 mm, matrix 192, b-value 0, 50 and 400 s/mm²)

(4) T2w-TSE with fatsat coronar (TR 2000 ms, TE 81 ms, flip angle 120°, slice thickness 5 mm, matrix 320*)

(5) T1w fl2D in phase and out of phase axial (TR 212 ms, TE 2.32 ms, flip angle 65°, slice thickness 5 mm, matrix 256*)

The anonymized images were evaluated by a radiologist. Positive diagnosis of hcc was based on hypervascularization in arterial phase and washout in portal venous phase or delayed phase (Figure 2) as suggested by EASL and AASLD (American Association for the Study of Liver Disease) for both, MRI and CT [3].

26 of 50 patients were positive for HCC in the goldstandard, defined by histological findings after tumor resection or biopsy or a surrogate of clinical and paraclinical findings and follow-up. They were considered for further calculation of number, size and ADC-values of liver lesions. Detectability and image quality were evaluated with a 5-point Likert-scale (1=excellent, 2=good, 3=fair, 4=poor, 5=unacceptable).
Sensitivity, specificity, positive and negative predictive values (PPV and NPV) were calculated for both methods.
Fig. 0: Figure 2: Typical enhancement in CT and MRI.

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**Results**

More malignant liver tumours were detected with MRI (71 lesions) compared with MDCT (overall 59 neoplasms) (Figure 3). That means that 2.7 lesions per patient were detected in MRI vs. 2.3 tumours per patient in CT.

Size of lesions was marginally greater in CT with an average greatest diameter of 31 mm vs. 29 mm in MRI (spread from 26 to 33 mm between sequences).

We also measured the **ADC-value** in 32 lesions with extremely heterogenous values: $1.2 \pm 0.2 \times 10^{-3} \text{mm}^2/\text{s}$ (range from $0.07 \pm 0.1$ to $3.0 \pm 0.1 \times 10^{-3} \text{mm}^2/\text{s}$, Figure 4, 5).

Detectability of identified lesions was superior for CT vs. MRI (2.6 vs. 3.4). For MRI the rating for detectability of lesions ranged from 2.6 to 4.0 between sequences (1 = excellent, 5 = unacceptable).

Image quality was rated similar for CT and MRI (2.2 vs. 2.3; 2 = good, 3 = fair). But it was more scattered within the sequences of MRI (1.8 in T1w HASTE and 2.9 in T2w-TSE).

Sensitivity, PPV and NPV were evaluated superior for MRI (sensitivity 92%, PPV 80% and NPV 90% vs. sensitivity 85%, PPV 79% and NPV 82% for CT). **Specificity** was 75% for both methods.

Reading time of MR-images was at an average of 17 minutes longer than the reading time of the CT-Scans at an average of 5 minutes.
**Fig. 0:** Figure 3: Lesion just seen in MRI.

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Figure 4: Range of ADC-Values in lesions suspicious of HCC.

Fig. 0: Figure 4: Scatter plot ADC-values.

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Fig. 0: Figure 5: DWI and ADC-map.

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Conclusion

Although detectability of liver lesions was rated better with 64-slice CT-scans compared to 3T-MRI, less lesions per patient were detected. This can be important for therapeutic decisions as for example between curative or palliative treatment.

Bruegel et al. showed possible additional characterizations to distinguish between benign and malignant liver lesions using ADC-measurements [7]. We measured an ADC-Value of $1.2 \pm 0.2 \times 10^{-3} \text{mm}^2/\text{s}$ which is similar to the value given in literature, but it is very heterogenous depending on the tissue components, e.g. necrosis after TACE [8]. ADC-values of HCC might be helpful in unclear cases but can be similar to ADC-value of metastasis and do not always allow further differentiation.

Gd-EOB-DTPA-enhanced MRI showed higher sensitivity, positive and negative predictive values in detection of HCC similar to results of Akai et al. [9]. In our study we showed equal specificity for both methods.

After all our results show that MRI still is the better image modality for detection of HCC although MDCT has developed favourably in recent years and allows faster scanning and shorter reading times.
References


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