Optimization of acquisition protocol in multiphasic computed tomography imaging of the liver with high-concentration contrast media

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Purpose

- Optimization of the acquisition protocols of HCC patients undergoing multiphasic CT of the liver by exploiting the intrinsic properties of iodine enhancement at low kVp.

- Compare Exposure indexes (CTDvol) and abdominal organ dose of standard and optimised scans.

- Compare peak aortic attenuation at the origin of the coeliac trunk as a quantitative index of image quality of standard and optimised scans.

- Compare Likert score as a qualitative assessment of image quality of standard and optimised scans.
Materials and Methods

CT scanner: Brilliance ICT 256 slices Philips
Contrast Agent: Iomeprol 400mgI/ml (HCCM)

Patients

N= 59 HCC patients in follow-up with and without known focal liver lesion were prospectively randomised to be scanned either with the optimised (N=32) or the standard protocol (N=27) for a multiphase CT study of the liver.
Standard Protocol

Automatic Tube current modulation (100-500 mAs)
- Dose Right Index = 21
- Tension= 100 kV
- Slice Thickness = 1.25 mm
- Reconstruction: Iterative iDose$^4$ (L6; 70%/30% blend of IR/FBP)
## Optimised Protocols

<table>
<thead>
<tr>
<th>Patients ≤ 80 kg</th>
<th>Patients &gt;80 kg</th>
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<tbody>
<tr>
<td>(N=21; mean BMI=23.3)</td>
<td>(N=11; mean BMI=30.1)</td>
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<tr>
<td>Automatic Tube current modulation (100-500 mAs); Dose right Index = 21</td>
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<tr>
<td>1,3 ml/kg flow 3ml/s</td>
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<td><strong>Tension</strong></td>
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<tr>
<td>• Unenhanced 100 kV; <strong>Sl.Thick= 5 mm</strong></td>
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<tr>
<td>• Hepatic Arterial 80 kV</td>
<td>• Hepatic Arterial 100 kV</td>
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<tr>
<td>• Portal Venous 100 kV</td>
<td>• Portal Venous 100 kV</td>
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<tr>
<td>• Equilibrium 100 kV</td>
<td>• Equilibrium 120 kV</td>
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<tr>
<td>• Reconstruction Iterative iDose⁴ L6</td>
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Results: $CTD_{\text{vol}}$ (mGy)

$CTD_{\text{vol}}$ reduction in arterial phase in normal weight pts: -37% $P<0.0001$

$CTD_{\text{vol}}$ reduction in unenhanced phase in normal weight pts: -35% $P<0.0001$
Liver dose reduction in arterial phase: -40% $P<0.001$
Results: peak aortic enhancement

Peak Aortic Attenuation: +44% P=0.003
Results: Image quality qualitative assessment

Likert score analysis

Likert score: 23.2±3.3 vs 22.1±3.9 p=0.20 Non significant
Conclusions

• Our optimised protocol with use of 80 kVp and high iodine concentration for arterial phase in normal weight patients resulted in a substantial improvement of aortic attenuation and radiation dose reduction in patients ≤80 kg.

• Image quality assessed through Likert scale evaluation did not show any significant difference between Optimized and standard protocol.

• This is a pilot project for the dose team, which is gradually overhauling all CT protocols at our institution.

• A shift towards CT acquisitions which are increasingly tailored on the individual patient is necessary.