Optimal use of the ClarityIQ System to reduce radiation for patient and staff

J. Teßarek, F. Al-Odeh, H. Görtz
Vascular Surgery
Bonifatius Hospital Lingen
Germany
MAC 2016
Disclosures

no conflict of interest
Basic principles of radiation safety (in the German Radiation Protection Law)

To reduce the risk of a stochastic damage, ... three imperatives have been anchored in the German Law in terms of radiation use:

• Imperative for correct indication,
• Imperative for dose limitation (practical aspects, technical innovations) and
• Imperative for continuous optimisation (technical and practical aspects)
Radiation represented and still represents a real existing risk

Memorial with the names of 159 victims of radiation from various countries in the St. Georg Hospital Garden in Hamburg

Retrospective literature review reporting about
- Five more left side brain tumors (2 cardiologists and 3 radiologists)
- Higher incidence of left side mammarial cancer in female interventional cardiologists

Beside this long known reports about
Retrolenticular cataract as a result of radiation
Radiation induced skin necrosis
Radiation dose is dependent on many factors:

- Maximum of scattered radiation
- FF-distance
- Collimation (imaging quality)
- Pulsrate (imaging quality)
- Fluoroscopy time (experience)
- Disciplin
- Complexity of the procedure
- C-Arm position
- Target region (EVAR or BTK PTA)
- BMI
Individual protection and technical developments

Clarity IQ Phillips

Keep detector close to patient.
Collimate.
Position shield in between patient and operator.
Radiation safety cap
Radiation safety glasses (with side panels).
Lead skirt and vest with thyroid collar.
Movable lead skirt.
Disposable shielding.

EA_2016Jan_KumarRab_Figure1
What is Clarity, how does ClarityIQ work and how can we optimize it`s use??

Clarity is an Add On for all Phillips AlluraXpert systems

To reduce radiation dose
Without loosing imaging quality
Clarity is s kind of Dolby Surround for your eyes?

The differences in acquisition factors include increased spectral filtration and decreased energy per pulse with the use of AlluraClarity, which yielded lower radiation dose. With respect to image processing, AlluraClarity enabled noise reduction by performing automatic pixel shifting for motion correction and also used improved spatial and temporal filtering algorithms for noise reduction and image enhancement.

Reduced emission
by using physical copper and aluminium filters
and reduced signal frequency and intensity

and for image processing a digital change of signal to noise ratio
Imaging quality without and with Clarity

Difference between left and right: 70% of radiation dose
Proven principle

*AJR* 2014; 203:904–908

Preclinical Study in a Piglet Model

Significant Dose Reduction for Pediatric Digital Subtraction Angiography *Without* Impairing Image Quality
Significant reduction of Air Kerma
INTERVENTIONAL NEURORADIOLOGY: Radiation dose in neuroangiography using image noise reduction technology: a population study based on 614 patients; Söderman et al., Springer epub 5.09.2013

Even more effective reduction for those c-arm position when a higher exposure is unavoidable

- Significant reduction for ap-projections: 62%
- Significant reduction for lateral projections: 67%

Ketteler A et al. Radiation exposure in endovascular procedures, JVS Suppl.1 2011 (pp32-36)

Weiss and colleagues evaluated BMI (body mass index) in patients undergoing EVAR and found that obese patients had up to three times higher DAP and peak skin doses than patients with a normal BMI.
Distribution of peer-reviewed comparative studies per clinical area

- Procedural patient dose reduction of 57%, 71% and 56% for patient with weight group <10kg, 10-40kg and > 40kg, respectively (Bad Oeynhausen)
- Procedural patient dose reduction of 70% in TAVI procedures, with no changes in radiation dose

Clinical:
- 75% procedural dose reduction at equivalent IQ (Gent)
- 66% procedural dose reduction, with similar reduction per cardiologist (Kyoto)
- 46% and 34% reduction for diagnostic and interventional procedure respectively (Denver)
- 50% reduction in DAP cine at equivalent IQ (Nijmegen)

Phantoms:
- Radiation dose reduction in cine compared to other systems (Texas)

Piglets:
- Reduction on DSA of a factor 4 without IQ degradation

Pediatric IR procedures:
- Procedure patient dose reduction ranged from 49% to 82%
Special interest for EVAR/FEVAR/TEVAR/aortic procedures

Fluoroscopy and substraction (high energy) angio of the torso

With the operator close to the radiation source and scattered radiation

C-arm coming from the head

Variety of oblique projections
Working in a exposed manner
### Standard EVAR between 9/14 and 5/15

<table>
<thead>
<tr>
<th></th>
<th>Prä Clarity</th>
<th>Post Clarity</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-38a.14</td>
<td>34</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>27.33</td>
<td>28.66</td>
<td>0.695</td>
</tr>
<tr>
<td>KM</td>
<td>68.48</td>
<td>63.3</td>
<td>0.364</td>
</tr>
<tr>
<td>DL Zeit (min)</td>
<td>12.51 (5.0-48.13)</td>
<td>13.04 (4.5-45.15)</td>
<td>0.319</td>
</tr>
<tr>
<td>DAP (mGy/cm²)</td>
<td>201078.21</td>
<td>109383.40</td>
<td>0.0038</td>
</tr>
</tbody>
</table>

The Dose Area Product (Gy*cm² = 100cGy*cm²) is defined as the product of exposed area (in cm²) and the effective dose (in Gray).
Complex EVAR

<table>
<thead>
<tr>
<th></th>
<th>Prä Clarity</th>
<th>Post Clarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-38a.1....</td>
<td>12</td>
<td>7 (excluding CO2)</td>
</tr>
<tr>
<td>BMI</td>
<td>26,22</td>
<td>27,22</td>
</tr>
<tr>
<td>KM</td>
<td>41-133</td>
<td>38-115</td>
</tr>
<tr>
<td>DL Zeit (min)</td>
<td>28-113</td>
<td>21,5-144</td>
</tr>
<tr>
<td>DAP</td>
<td>315499-996345</td>
<td>141325-799419</td>
</tr>
</tbody>
</table>

Non comparable cases: 2-5 fenestrations or branches but again a obvious tendency
Further dose reduction using the vessel navigator (Phillips)

Stangenberg L et al; A novel tool for three-dimensional roadmapping reduces radiation exposure and contrast agent dose in complex endovascular interventions  JVS September 2014, Volume 60, Issue 3, Pages 826–827

Beneficial side effect: significant reduction of iodinated contrast: 235 +/− 145 mL for 2D vs 225 +/− 119 mL for 3D vs 65 +/− 28 mL for image fusion; P < .0001

CO2 could solve the renal side of the problem but requires elevated radiation doses
Further dose reduction for the staff members

Special problem of CO2 angiography

• Aortic imaging with CO2 requires high energy
• Switch to standard for fluoroscopy with overlay or bone markers
• Switch to standard imaging for peripheral CO2 angiography (90% of cases sufficient imaging quality)
In conclusion

Nobody wants to be a name on this list
The radiation related risk for staff and patients cannot be overestimated
The need for optimal use of any radiation safety tool is evident
The implementation of any radiation safety tool is a must (in Germany)
Beside the technical equipment (Clarity in combination with fusion)
Individual solutions and standards of practice (SOP) are mandatory
Team training
Continuous teaching of newcomers → awareness
And training, training, discipline, training, experince, disciplin,...
Thank you for your attention!

e-mail: joerg.tessarek@hospital-lingen.de

Bonifatius Hospital  Lingen