Key Points in Radiation Protection in the Angio Lab
Experiences and Advices from an Endovascular Pioneer

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Nothing to disclose
Why is radiation protection important?
Why is radiation protection important?

Radiation erythema

Radiation ulcer

Fluoroscopy Time

- Coronary angiography: 7 min
- PCI: 51 min
- Skin surface dose: 20 Sv
Biological Effects of Radiation

➢ Exposure of the patient

➢ Exposure of the physician and personal
Biological Effects of Radiation

➢ DNA damage
  ▪ Tumor induction

➢ Drop of lymphocyte count
  ▪ Weakening of the immune system
A x-ray dose of 450 - 900 mSv/y leads to clouding of the lense.

Brain tumor

Left hemisphere especially affected.
Closer to x-ray beam.
How does the skin react ...

Fluoroscopy time → Surface dose

<table>
<thead>
<tr>
<th>Skin Reaction</th>
<th>Threshold dose (Gy)</th>
<th>Elapsing time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transient erythema</td>
<td>2</td>
<td>hours</td>
</tr>
<tr>
<td>Temporary hair loss</td>
<td>3</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Permanent hair loss</td>
<td>7</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Skin atrophy</td>
<td>11</td>
<td>≥14 weeks</td>
</tr>
<tr>
<td>Teleangiectasia</td>
<td>12</td>
<td>≥52 weeks</td>
</tr>
<tr>
<td>Wet desquamation</td>
<td>15</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Skin necrosis</td>
<td>18</td>
<td>≥10 weeks</td>
</tr>
</tbody>
</table>
When is the exposure especially high?
High radiation exposure: Obese patients!

Dose doubles every 3 - 5 cm
Dose grows not linearly, but exponentially
Radiation Exposure of the Patient

Surface dose: 100%

Patient

Scattered radiation

Outcoming dose: 1%

Detector: 0.5 %
High radiation exposure!

Complex procedures

Fluoro time 48 min
How do we protect the patient and us?

- training
- planning
- experience
Radiation Protection

Experience of the Interventionalist

Durchleuchtungszeit in min

<table>
<thead>
<tr>
<th>Coronarangiographie</th>
<th>PTCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;300 Coro, &gt;200 PTCA</td>
<td>3.9</td>
</tr>
<tr>
<td>&lt;75 Coro, &lt;50 PTCA</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Erfahrung in Maßnahmen/Jahr

Gleichmann 1993
How do we protect the patient and us?

**Basic x-ray rules**

- keep the fluoroscopy time as short as possible
- use shutters
- bring the detector close to the patient
- use last image hold and road map technique
Distance to the x-ray tube is important

\[ r_2 = 2 \, r_1; \quad F_2 = 4 \, F_1 = \left(\frac{r_2}{r_1}\right)^2 \, F_1 \]

\[ I_2 = \left(\frac{r_1}{r_2}\right)^2 \, I_1 \]

Distance doubled
Dose 1/4
How to protect oneself?

Tube above table, Tube below table

→ *keep the x-ray tube below the table!*

*Less radiation to the head.*
Position of physician is important

- Scattered radiation - Fluoroscopy of chest
- Dose higher with fluoroscopy of the abdomen
Does the access site matter?

Radial access not better!

<table>
<thead>
<tr>
<th>TABLE II. Fluoroscopy and Radiation Measurements</th>
<th>Femoral</th>
<th>Radial</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary angiography (n)</td>
<td>103</td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>Fluoroscopy time (min)</td>
<td>$1.7 \pm 1.4$</td>
<td>$2.8 \pm 2.1$</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Dose-area product (Gy \cdot cm^2)</td>
<td>$13.1 \pm 8.5$</td>
<td>$15.1 \pm 8.4$</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Radiation exposure (µSv)^a</td>
<td>$32 \pm 39$</td>
<td>$64 \pm 55$</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Percutaneous intervention (n)</td>
<td>48</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>Fluoroscopy time (min)</td>
<td>$10.4 \pm 6.8$</td>
<td>$11.4 \pm 8.4$</td>
<td>NS</td>
</tr>
<tr>
<td>Dose-area product (Gy \cdot cm^2)</td>
<td>$51.0 \pm 29.4$</td>
<td>$46.3 \pm 28.7$</td>
<td>NS</td>
</tr>
<tr>
<td>Radiation exposure (µSv)^a</td>
<td>$110 \pm 115$</td>
<td>$166 \pm 188$</td>
<td>&lt; 0.05</td>
</tr>
</tbody>
</table>

^a Ambient dose equivalent H*(10).
How to protect oneself?

Radiation protection

➢ Lead apron or coat
  one- or two-parts
➢ Thyroid protection
➢ Protection glasses
➢ Dosimeter
How to protect oneself?

Protection shield

as close as possible to the patient
Is protection 100%?

Absorption of scattered radiation

- Lead apron or coat 85%
- Thyroid protection 85%
- Protection glasses 70%

100 Gycm² DAP → 0.02 mSv dose of legs protected
→ 1.0 mSv dose of legs unprotected

M. Whitby, Br J Radiol 2003;76:321
Protection for physician 100%

Magellan™ Robotic System

Magellan™ Robotic System offers unique intravascular catheter shaping and rock-solid stability for therapy delivery, all from a remote physician workstation.

The Magellan Robotic System is designed for multi-specialty peripheral vascular procedures. Magellan’s proprietary robotic catheter technology is designed to deliver stability¹ and distal tip control of guidewires, catheters and guide. Now with Magellan, the physician is seated away from the radiation source and can perform key elements of the procedure from a centralized, remote workstation.
Protection for physician 100%
Protection for physician 100%

Even complex aortic procedures can be performed without exposure of physician and personal.
6 points you should keep in mind

➢ Education
➢ Planning
➢ Preparation
➢ Experience
➢ Distance
➢ Duration
Thank you for your interest!