Radiation protection in the endosuite and the importance of correct use of shields

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Professor of Surgery
Chief dep. of Vascular Surgery
Uppsala University Hospital
Sweden
High radiation dose in the endosuit

Deterministic effects
- A threshold dose below which no effect is seen
- Tissues specific threshold doses
- All early effects, and most normal tissue late effects

Stochastic effects
- Genotoxicity
- Late effects, including carcinogenesis and hereditary effects
- No threshold dose – no safe dose!
The eye lens is a highly radiosensitive tissue
Radiation induced cataracts (RIC)

Posterior sub-capsular (PSC) cataract
Cancer-like pathology resulting from genotoxic mutagenic events
• 27/54 (50%) interventional cardiologist showed PSC lens changes characteristic of radiation exposure

• Risk ↑ with duration of work

• Risk ↓ for regular users of protective lead eyeglasses

• **Conclusion:** Lens radiation injuries can easily be avoided by the appropriate use of radiation protection tools
Radiation induced cataracts (RIC)

2016 CX symposium
“Huge Debt” owed to endovascular pioneers affected by radiation

Ted Diethrich

Krassi Ivancev
Radiation-Induced DNA Damage in Operators Performing Endovascular Aortic Repair

A

Open AAA Repair
EVAR

B

%γ-H2AX

%pATM

Pre  Post 24hrs  Pre  Post 24hrs

0  1  2  3  4

* * *

* * *
Reducing the dose

- Fluoroscopy pulse frequency ↓ (4p/s)
- Dose level ↓ (low dose mode)
- Minimize DSA (replaced with fluoroscopy)
- Beam collimation (field size ↓)
- Avoid magnification (large image screen)
- Planning (3D image overlay)
Radiation shields

- Ceiling suspended shields
- Table mounted shields
- Shielding placed on the patient
- Flor standing mobile shields
- Lead aprons and thyroid shield
- Eye shields – glasses or visors
- Head shields (?)
- Hand shields – gloves (?)
Eye dose reduction with commercially available X-ray protection shields during endovascular procedures was evaluated in an experimental setting.

- Anthropomorphic head and thorax phantoms
- Dosimeter at the front of the eyes
- Siemens Axiom Artis FD C-arm
- EVAR protocol (~68 kV, 12 µGy/min)
<table>
<thead>
<tr>
<th>Product Description</th>
<th>Image</th>
<th>Dose Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyeglass - 9941 Ultralite ScanFlex</td>
<td><img src="image1.png" alt="Image" /></td>
<td>15-50%</td>
</tr>
<tr>
<td>Eyeglass - 553 s Metalite Scanflex</td>
<td><img src="image2.png" alt="Image" /></td>
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<tr>
<td>Fit over eyeglass - 89 Fit over Scanflex</td>
<td><img src="image3.png" alt="Image" /></td>
<td>80%</td>
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<tr>
<td>Fit over + personal glasses under - 89 Fit over Scanflex</td>
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<td>Visor - downward angled - BRV501 Mavig</td>
<td><img src="image5.png" alt="Image" /></td>
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<tr>
<td>Visor - non-angled - BRV501 Mavig</td>
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<td><img src="image7.png" alt="Image" /></td>
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<td>Ceiling mounted shield OT 50001 Mavig</td>
<td>![Shield Image]</td>
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RadPad radiation protection surgical drapes
Editor's Choice — Use of Disposable Radiation-absorbing Surgical Drapes Results in Significant Dose Reduction During EVAR Procedures

C. Kloeze a, E.G. Klompenhouwer b, P.J.M. Brands a, M.R.H.M. van Sambeek c, P.W.M. Cuypers c, J.A.W. Teijink c,d,*

aDepartment of Medical Physics, ICMT, Catharina Hospital, Eindhoven, The Netherlands

55% reduction in radiation exposure to chest and hand
Radiation-Induced DNA Damage in Operators Performing Endovascular Aortic Repair
Zero-Gravity radiation suit
Evaluation of a Suspended Personal Radiation Protection System vs. Conventional Apron and Shields in Clinical Interventional Procedures

Clare Savage¹, Thomas M. Seale IV², Cathryn J. Shaw², Bruner P. Angela², Daniel Marichal², Chet R. Rees²

¹River City Imaging, San Antonio, USA
²Department of Radiology, Medical Center, Baylor University, Dallas, USA

87-100% reduction in radiation exposure
A prospective case control comparison of the ZeroGravity system versus a standard lead apron as radiation protection strategy in neuroendovascular procedures

Diogo C Haussen, Imramsjah Martijn John Van Der Bom, Raul G Nogueira

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<th>Operator-received total dose (μSv)</th>
<th>ZeroGravity</th>
<th>Lead apron</th>
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<tr>
<td>Head</td>
<td>1600</td>
<td>3380</td>
<td>2.1</td>
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<tr>
<td>Thyroid</td>
<td>320</td>
<td>4460</td>
<td>13.9</td>
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<tr>
<td>Chest</td>
<td>0</td>
<td>520</td>
<td>Infinite</td>
</tr>
<tr>
<td>Foot</td>
<td>1470</td>
<td>4870</td>
<td>3.3</td>
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<td>Total</td>
<td>3390</td>
<td>13230</td>
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Conclusion

• Several radiation protection eyeglasses used today offer a highly limited dose reduction – *false sense of security*

• A proper use of ceiling mounted lead shield is essential for adequate protection of the eye lens

• Protection eyeglasses and visors should only be used as complement

• Consider using additional shielding devices – *maximize your protection*
Recommended occupational lens exposure limit

20 mSv/year
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