September 12-14
2018
Les Comtes de Méan
Liège, Belgium

6th International Meeting on Aortic Diseases

New insights into an old problem CHU Liège, APF

www.chuliege-imaa.be

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

Anders Wanhainen

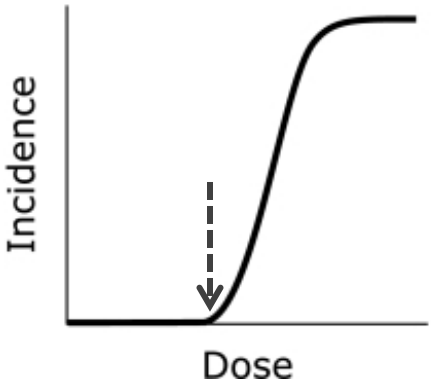
Professor of Surgery
Chief dep. of Vascular Surgery
Uppsala University Hospital
Sweden

CHU de Liège

High radiation dose in the endosuit

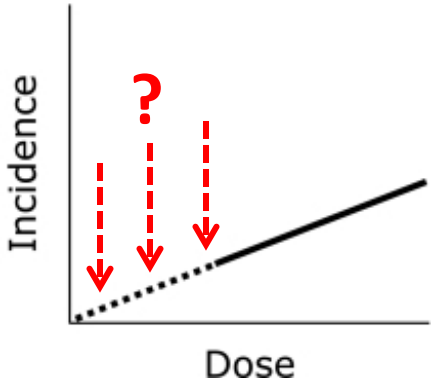
Deterministic effects

- 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 !**

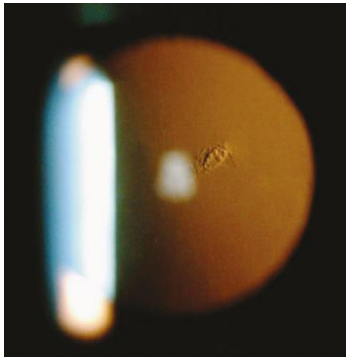


The eye lens is a highly radiosensitive tissue

Radiation induced cataracts (RIC)

Posterior sub-capsular (PSC) cataract

Cancer-like pathology resulting from genotoxic mutagenic events



Radiation-associated Lens Opacities in Catheterization Personnel: Results of a Survey and Direct Assessments

Eliseo Vano, PhD, Norman J. Kleiman, PhD, Ariel Duran, MD, Mariana Romano-Miller, MD, and Madan M. Rehani, PhD

Buenos Aires

- 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

J Vasc Interv Radiol 2013

Radiation induced cataracts (RIC)

2016 CX symposium

"Huge Debt" owed to endovascular pioneers affected by radiation

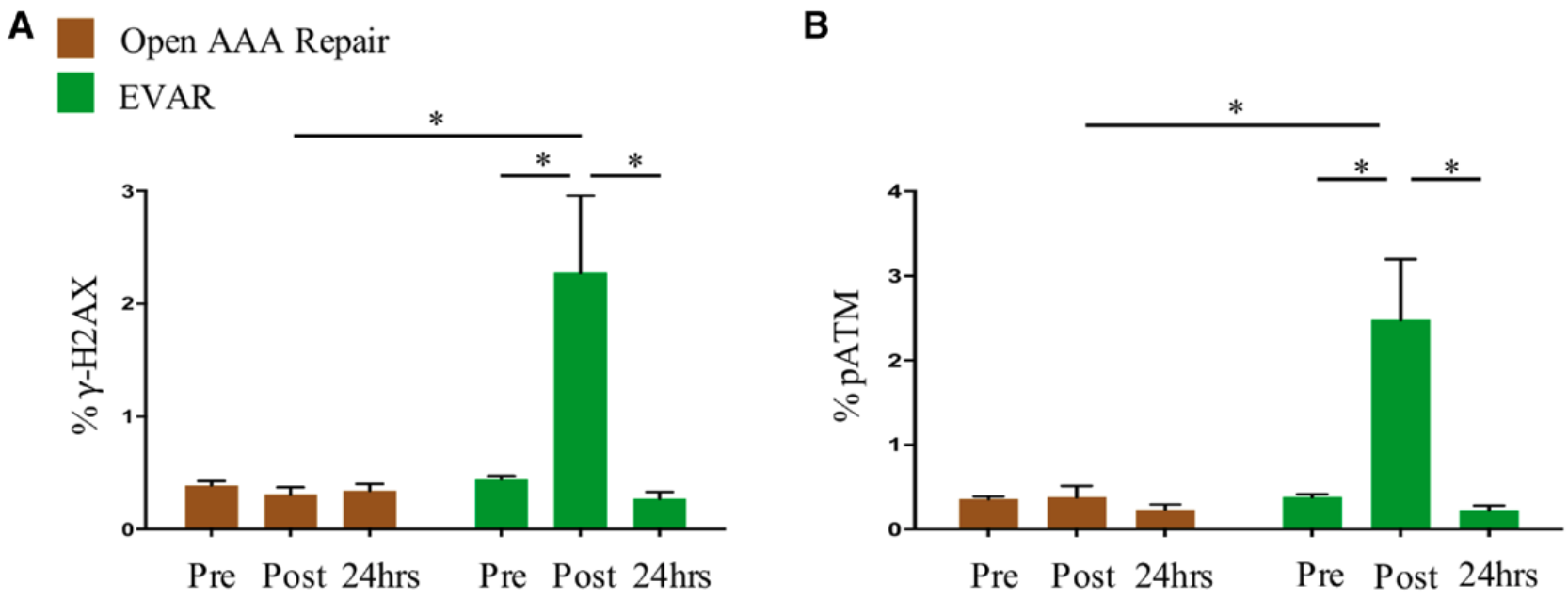
Ted Diethrich

Krassi Ivancev

ORIGINAL RESEARCH ARTICLE

Radiation-Induced DNA Damage in Operators Performing Endovascular Aortic Repair

Tamer El-Sayed*
Ashish S. Patel, PhD*
Jun S. Cho
James A. Kelly
Francesca E. Ludwinski, PhD
Prakash Saha, PhD
Oliver T. Lyons, PhD
Alberto Smith, PhD
Bijan Modarai, PhD
Guy's and St Thomas' Cardiovascular Research Collaborative



Circulation. 2017;136:2406–2416

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)

REVIEW

Editor's Choice — Minimizing Radiation Exposure During Endovascular Procedures: Basic Knowledge, Literature Review, and Reporting Standards

A. Hertault [a], B. Maurel [a], M. Midulla [b], C. Bordier [c], L. Desponds [c], M. Saeed Kilani [b], J. Sobocinski [a], S. Haulon [a,*]

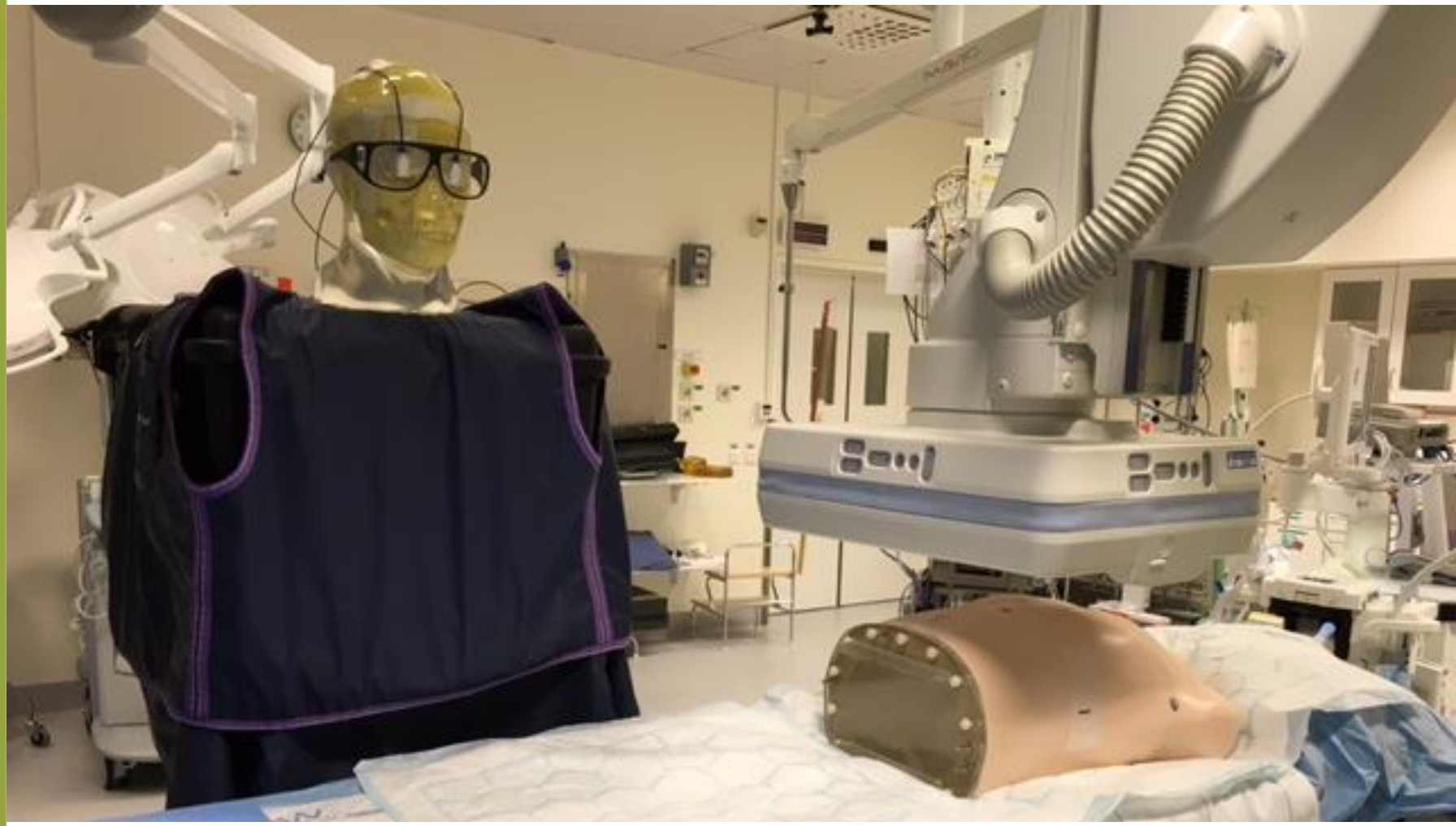
[a] Vascular Surgery Aortic Centre, Hôpital Cardiologique, CHRU Lille, France
[b] Vascular Radiology, Aortic Centre, Hôpital Cardiologique, CHRU Lille, France
[c] GE Healthcare, Buc, France

EJVES 2015

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)

Dose reduction at left eye (%)

Eyeglass 9941 Ultralite ScanFlex		15-50%
Eyeglass 553 s Metalite Scanflex		10-15%
Fit over eyeglass 89 Fit over Scanflex		80%
Fit over + personal glasses under 89 Fit over Scanflex		20-75%
Visor - downward angled BRV501 Mavig		70-75%
Visor - non-angled BRV501 Mavig		10-15%
Ceiling mounted shield OT 50001 Mavig		90-95%

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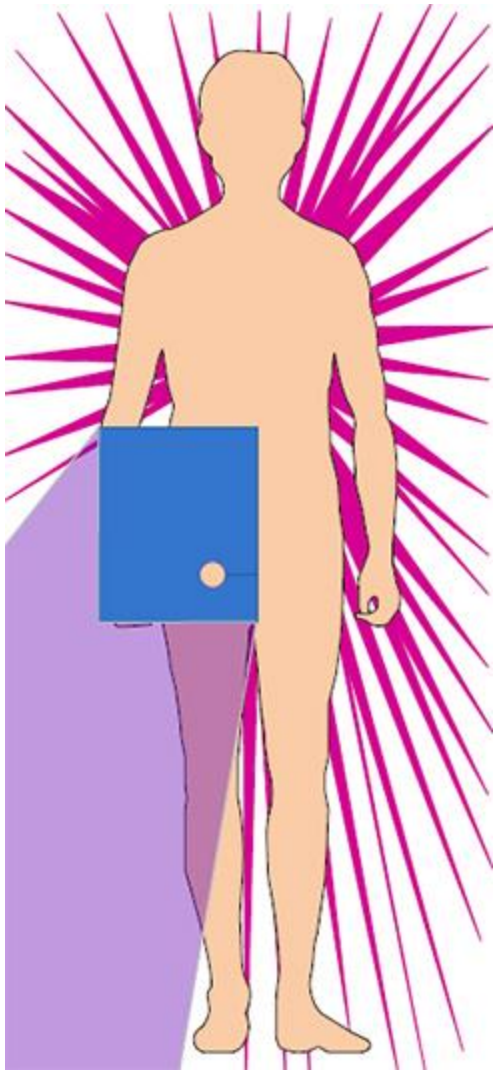
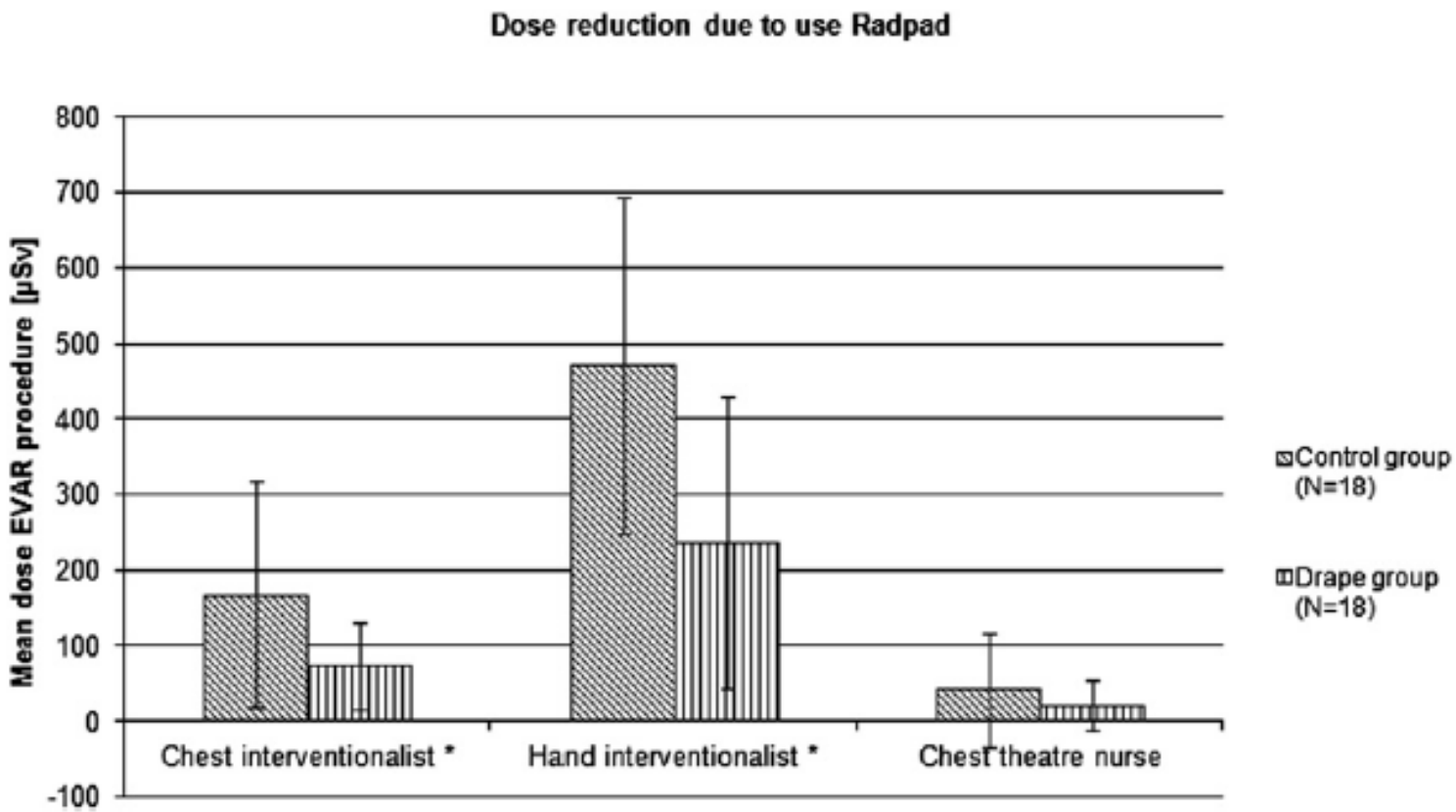
RadPad radiation protection surgical drapes



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,*]

[a] Department of Medical Physics, ICMT, Catharina Hospital, Eindhoven, The Netherlands

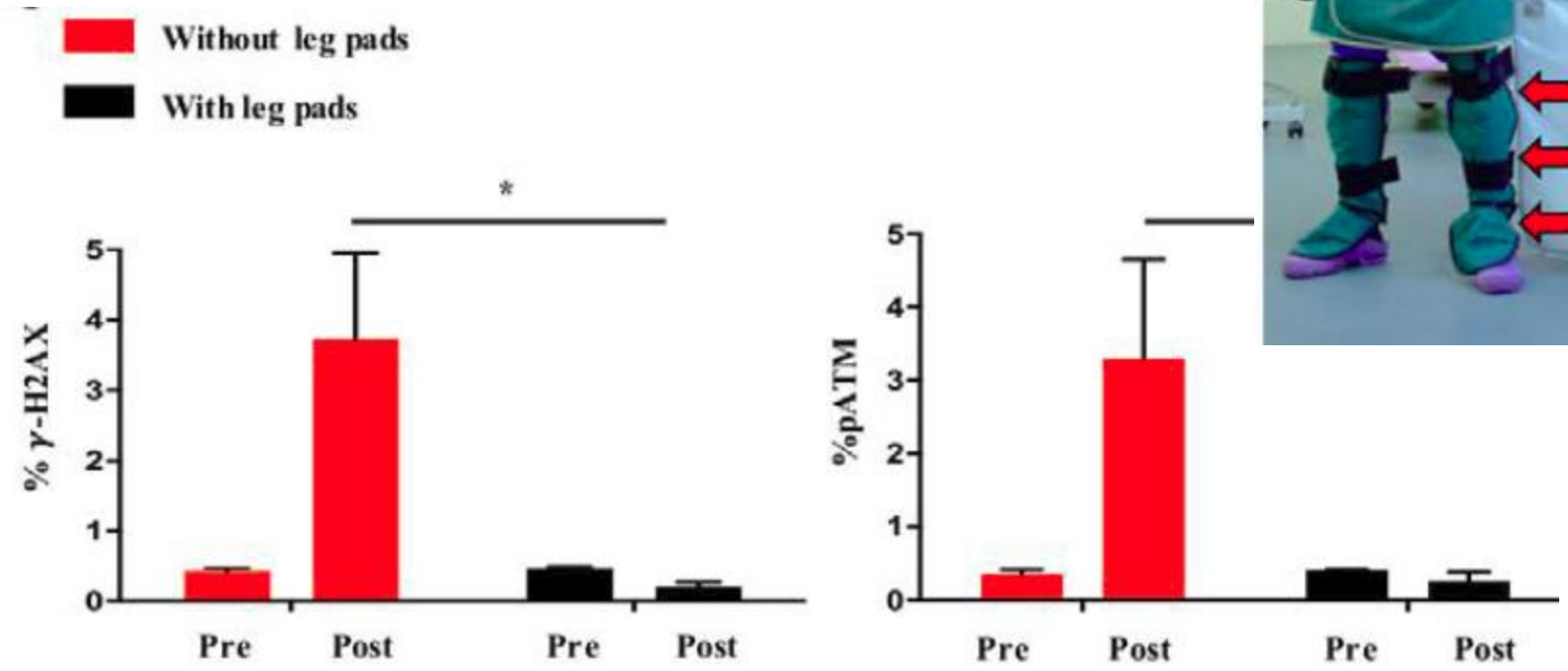


55% reduction in radiation exposure to chest and hand

EJVES 2014

ORIGINAL RESEARCH ARTICLE

Radiation-Induced DNA Damage in Operators Performing Endovascular Aortic Repair

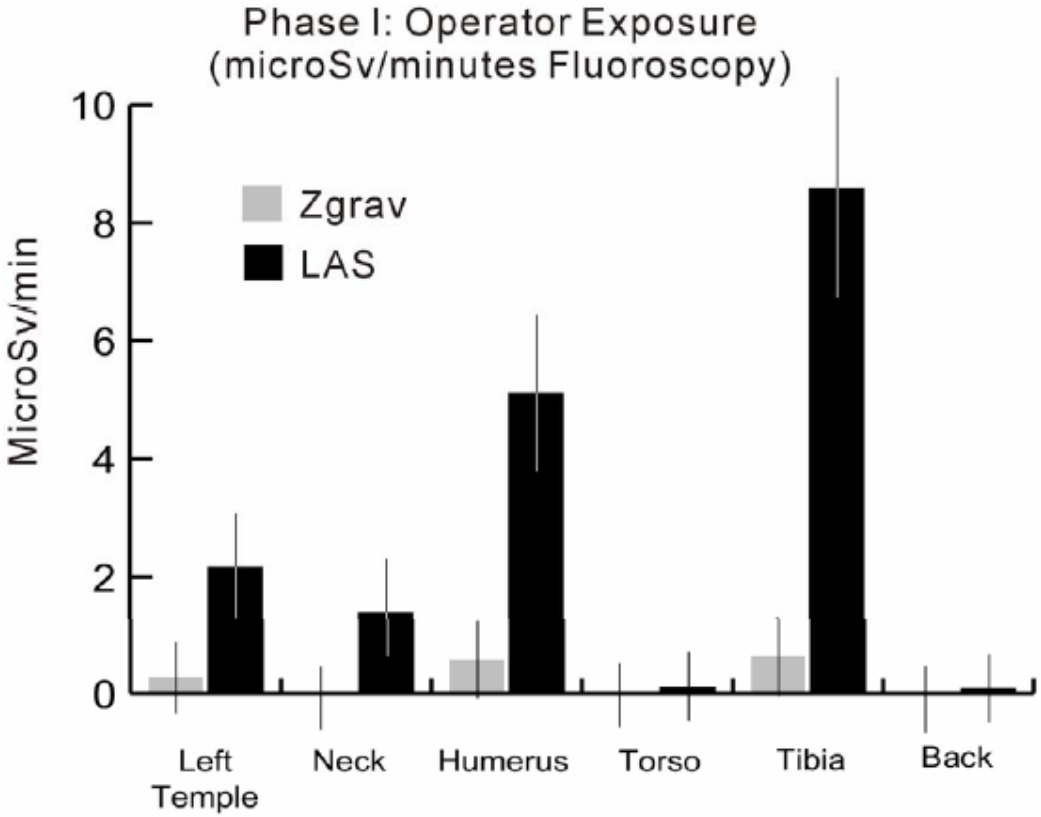


Circulation. 2017;136:2406–2416

Zero-Gravity radiation suit

Evaluation of a Suspended Personal Radiation Protection System vs. Conventional Apron and Shields in Clinical Interventional Procedures

Clare Savage[1*], Thomas M. Seale IV[2], Cathryn J. Shaw[2], Bruner P. Angela[2], Daniel Marichal[2], Chet R. Rees[2]
[1]River City Imaging, San Antonio, USA
[2]Department of Radiology, Medical Center, Baylor University, Dallas, USA



87-100% reduction in radiation exposure

Open Journal of Radiology, 2013, 3, 143-151

ORIGINAL RESEARCH

A prospective case control comparison of the ZeroGravity system versus a standard lead apron as radiation protection strategy in neuroendovascular procedures

Diogo C Haussen,[1] Imramsjah Martijn John Van Der Bom,[2] Raul G Nogueira[1]

Operator-received total dose (µSv)	ZeroGravity	Lead apron	Ratio
Head	1600	3380	2.1
Thyroid	320	4460	13.9
Chest	0	520	Infinite
Foot	1470	4870	3.3
Total	3390	13230	3.9

Haussen DC, et al. J NeuroIntervent Surg 2016;8:1052–1055

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*

ICRP

INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Recommended

occupational lens exposure limit

20 mSv/year

Reducing the dose

- Fluoroscopy pulse frequency ↓ (4p/s)
- Dose level ↓ (low dose mode)
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- Beam collimation (field size ↓)
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