Improved protection for operator and assistant from occupational scatter radiation in interventional cardiologic procedures with a suspended radiation protection system – A per-procedure live-dosimetry analysis

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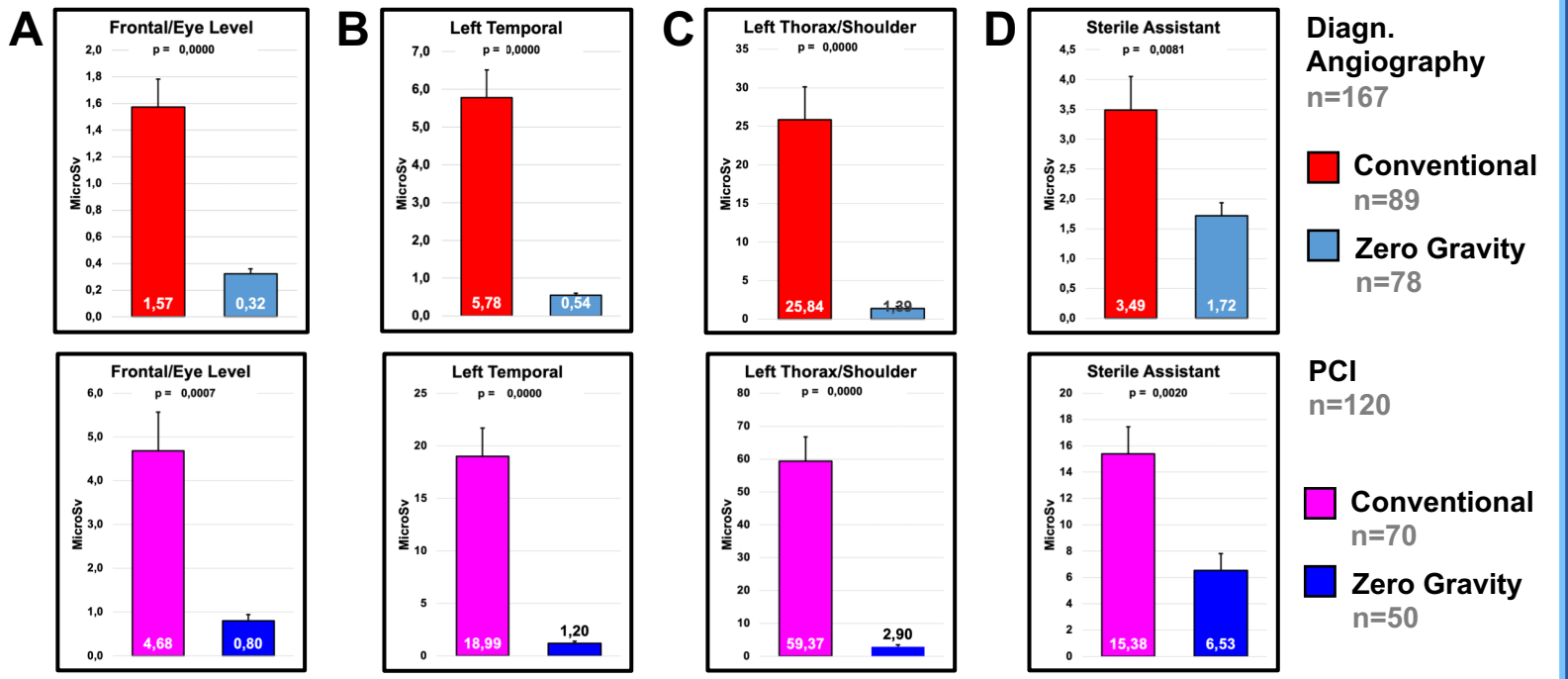
Introduction

Interventional cardiologists (IC) are exposed to the highest doses of radiation compared to all other medical specialties. Although head and eyes are exposed to a significant dose of scatter radiation (SCR), precise per-procedure data is sparse. Taking effect in 2021, the federal guidelines for maximum eye lens SCR doses have been reduced from 150 mSv to 20 mSv per year. It is still unclear, how these stricter values can be met in current cathlab setups. A ceiling suspended operator radiation protection system (Zero Gravity, Tidi Products, MI, USA), which was developed to reduce weight for the interventionalists' spine and shoulders, has shown additional benefits with respect to SCR protection. Up to now, most publications with ZG are based on selected radiologic interventional procedures. Individual per-procedure SCR data including a representative array of cardiologic procedures is still lacking.

Methods

The purpose of this study was (A) to measure realistic per-procedure SCR doses at critical anatomical locations of the IC (frontal head at eye level, left lateral head, left shoulder) and sterile assistant (Left head/neck) and (B) to study the impact of the ZG system on IC and sterile assistant (SA) SCR exposure when used in addition to the current standard of X-ray protection (SXP) in unselected all-comers cardiologic procedures. Methods: IC and SA were equipped with Unfors RaySafe i3 live-dosimeters at prespecified locations. 287 consecutive cardiac procedures were recorded, in which either both IC and SA were using SXP (lead apron, thyroid shield) or the IC was using the ZG system and the SA was wearing SXP. In all procedures a suspended lead shield, patient lead cover and an adjustable lead side-shield were present. Diagnostic angiographies (DA) and interventions (PCI) were grouped separately. Within both groups, the IC's and SA's SCR doses were compared. Statistic averages are shown as Mean±SEM. Groups were compared with the two-sample t-test and Mann-Whitney's nonparametric test, $p<0.05$ was considered statistically significant.

Results



Conclusion

Analysis of individual procedural data for IC and SA SCR exposure showed a substantial degree of dose variation depending on procedure complexity and numerous other factors. These variations are poorly represented in conventional cumulative dose measurements. Consistent with previous phantom-studies, the frontal dosimeter underestimated the SCR eye dose compared to the left lateral dosimeter position. In a representative all-comers cohort of cardiac procedures, the ZG X-ray protection system demonstrated an impressive potential for SCR reduction. ZG provided significant protection for ICs in critical anatomical areas - even in a state-of-the-art cathlab inventory with multiple SCR reduction measures already in place. Remarkably, the protective effect also included the sterile assistant at the table wearing SXP. The implementation of additional X-ray protection systems like ZG may be a viable approach to reach the new federal goal to drastically reduce cathlab staff SCR exposure at the head and eye level.

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