

PCR 2108: Enhanced Summary

A New Device to Markedly Reduce Personnel Radiation Exposure in the Cardiac Cath Lab

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Background

Radiation exposure that physicians and hospital staff receive while treating patients has recently been associated with a marked increase in cancer, cataracts, and skin lesions. Staff in cardiac catheterization and interventional radiology laboratories have the highest radiation exposure of any profession, despite the use of standard x-ray shields.

Methods

We studied the effectiveness of a new radiation protection system, the **EggNest** (Egg Medical, Inc., Maple Grove, MN, USA) designed for cardiac catheterization and interventional radiology laboratories. The system replaces the patient mattress on the x-ray table. Passive shielding moves with the patient and passively swings with the motion of the x-ray system, while conforming to x-ray gantry angulation.

We used a standard C-arm x-ray system (Toshiba Infinix with standard fluoroscopy settings) and an anthropomorphic radiographic phantom that produces scatter radiation similar to an average size human (US Department of Energy). Scatter radiation measurements were taken in six positions around the x-ray table where personnel typically stand. Importantly, these measurements were taken using 5 standard x-ray angulated projections used for clinical treatment. We compared scatter radiation dose measurements using no shielding, standard shielding (a hanging shield and a table skirt with 0.5mm Pb equivalence), and the EggNest system.

Results

We found that without shielding 69% of the scatter x-radiation dose received by personnel comes from below the table top. Positions near the head of the table results in the largest x-ray doses to personnel. The nurse who stands 1.5 meters from the table receives a higher radiation dose than the assistant next to the operator.

The **EggNest** system markedly reduced personnel radiation exposure around the x-ray table. Compared to standard shielding in the PA projection, the EggNest reduced personnel dose by an average of 90%. In the angulated projections, x-ray dose to personnel was reduced by 87-94% (compared to standard shielding). The dose to the nurse 1.5 M from the table was reduced by 94%.

Standard shielding was somewhat effective in reducing the x-ray dose to the operator and assistant compared to no shielding at all (average reduction in x-ray dose 37% and 66% respectively, for all angulations). Shielding had no effect for the table head positions and very minimal effect for the nurse position (9% dose reduction).

Summary

The EggNest system markedly reduces **all** staff radiation exposure around the x-ray table, including femoral/radial/subclavian/jugular access, echocardiographic, and nursing positions. Compared to standard shielding, exposure was significantly reduced for the angled views typically used for cardiac applications. This system has the potential to markedly attenuate personnel radiation exposure in x-ray laboratories and reduce the risk of radiation related illnesses.

Abstract

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Background: Radiation exposure (RE) of cardiac catheterization laboratory (CCL) staff is a significant health risk. We evaluated the effectiveness of a new, passive protection system (the EggNest) to reduce personnel exposure. The system is composed of a carbon fiber sled that replaces the x-ray table patient mattress in combination with radiation shielding that moves passively with the x-ray system and the patient.

Methods: RE measurements were taken at five positions around an anthropomorphic human shape phantom (US DOE) with 70keV, 15 f/s fluoroscopy from 10 cm to 200 cm above the floor with typical shielding (table skirt and hanging shield, both 0.5mm Pb), with and without the EggNest.

Results: Without shielding, 69% of the radiation dose to personnel emanated below the top of the patient mattress. RE varied with position around the cath lab table (Table 1). Standard shielding reduced RE for the operator and assistant at the radial/femoral access position, but not for other personnel. Compared to standard shielding, the EggNest markedly reduced RE in all positions (Table 1) and angiographic angles tested (Table 2).

Position around table	Operator	Assistant	Biopsy	Right neck	Left echo	Nurse
Mean RE with standard shielding alone ($\mu\text{Sv/h}$)	358	106	1665	1319	985	313
EggNest RE reduction compared to standard shield (%)	-90%	-82%	-92%	-89%	-97%	-92%

Operator Dose Reduction by X-ray Angulation	PA	RAO30 Caud20	RAO 30 Cran30	LAO40 Cran30	LAO40 Caud30
EggNest RE reduction compared to standard shielding (%)	-92	-88	-90	-87	-94

Conclusion: The EggNest system markedly reduces RE around the CCL table, including femoral/radial, subclavian/jugular, and echocardiographic access positions. Importantly, exposure was also significantly reduced for the angled views typically used for cardiac applications.