Radiation Protection during Hybrid Procedures: Innovation Creates New Challenges

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ABSTRACT: Background. The cooperation between interventional cardiologists and cardiothoracic surgeons has expanded the spectrum of treatment modalities for patients with congenital heart disease. These hybrid techniques have created new challenges, one of which being the provision of adequate but practical radiation protection. This study evaluates the use of a lightweight radiation protection drape (RADPAD®) that may be suitable for shielding during hybrid procedures. **Methods.** To simulate a pediatric patient, an 8.7 liter water-filled tub was placed on an X-ray table and exposed to 10-second cine acquisition runs. Radiation exposure was measured at twelve specified locations around the table using a model with three different levels of radiation protection: no shielding, shielding using a traditional 0.35 mm lead-equivalent apron, and shielding using the 0.25 mm lead-equivalent RADPAD. **Results.** The traditional lead apron and the RADPAD significantly reduced the amount of radiation dose when compared with no shielding. The standard lead apron provided slightly greater radiation protection than the RADPAD (0.000064 radiation absorbed dose [rad] vs. 0.000091 rad; $p = 0.012$). The measured rad was significantly higher on the right side of the table, and the measured radiation dose decreased significantly with increasing distance from the table. **Conclusions.** The RADPAD has been shown to function as an efficient shielding device, even though it does not quite match the protection that can be expected from a standard lead apron. It complies with regulatory radiation protection requirements and its lightweight and sterile use make it particularly useful during hybrid procedures in the operating room.

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The term "hybrid procedure" describes the intraprocedural cooperation between interventional cardiologist and cardiothoracic surgeon. The spectrum of hybrid procedures performed in the treatment of patients with congenital heart disease has increased considerably over the last 10 years. It includes a diverse spectrum of procedures such as completion angiograms after cardiothoracic surgery,[1] hybrid balloon pulmonary valvuloplasty in premature infants,[2] intra-operative stent placement for stenotic vascular lesions[3] and hybrid palliation of patients with hypoplastic left heart syndrome.[4]

Fluoroscopy and angiography are essential imaging modalities to facilitate these hybrid interventions. However, while the use of these modalities has become commonplace within a cardiothoracic hybrid operating room, suitable lightweight and practical radiation protection that also satisfies regulatory requirements remains nonexistent.

The RADPAD® *(Worldwide Innovations & Technologies, Inc., Overland Park, Kansas)* is a commercially available sterile, lead-free, primarily bismuth-based disposable radiation protection drape (Figure 1) that was originally developed to reduce the exposure of staff to scatter radiation.[6] This study evaluates its potential use as a customized radiation protection drape that can be utilized during hybrid procedures.

Materials and Methods

The study was conducted within a custom-designed hybrid cardiac catheterization laboratory with a fixed installed C-arm *(Toshiba CFB 5-Axis biplane system, Toshiba America Medical Systems, Inc., Tustin, California)*. Institutional review board approval

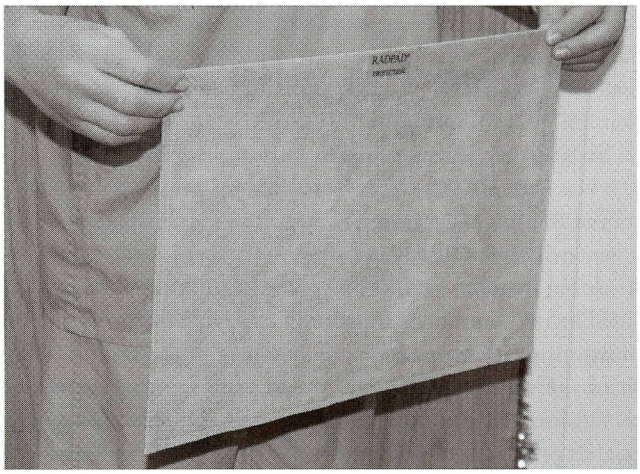

Figure 1. *The RADPAD® (Worldwide Innovations & Technologies, Inc., Overland Park, Kansas) is a lead-free, primarily bismuth-based disposable radiation protection drape. It is available in single sterile units and is designed for single use.*

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