

Reduction of Radiation Dose to the Female Breast: Preliminary Data with a Custom-Designed Tungsten-Antimony Composite Breast Shield

Mark S. Parker, MD
Jiyeon K. Chung, MD
Panos P. Fatouros, PhD
Jessica A. Hoots, MD
Nicole M. Kelleher, MD
Stanley H. Benedict, PhD

Thoracic Imaging Section, Department of Radiology, Medical College of Virginia Hospitals, VCU Health System, Richmond, Virginia

KEY WORDS: antimony, breast shield, multi-detector computed tomography, radiation exposure, tungsten

ABSTRACT

Objective: This purpose of this study was to estimate the radiation dose to the female breast incurred during chest computed tomography (CT) and to determine if that dose can be reduced by the external application of a custom-designed tungsten-antimony breast shield.

Materials and Methods: A 6.0-cm thick breast tissue equivalent slab phantom (53% adipose/47% water) was placed on the chest wall of an anthropomorphic head and torso phantom. Thermoluminescent dosimeters (TLDs) were positioned on the breast phantom surface at the 12 o'clock, 3 o'clock, and 6 o'clock positions; at the nipple level equivalent;

and underneath the breast phantom on the chest wall. The phantom combination was scanned four times on a 16-head multi-detector CT, with identical TLD positioning, and imaging parameters simulating our pulmonary embolus protocol. The first and third scans employed no breast shielding. The second scan used a commercially available bismuth breast shield. The fourth scan utilized our custom-designed tungsten-antimony composite (0.25 lead equivalent) breast shield. An automated TLD reader read the exposed TLDs.

Results: The unshielded breast phantom radiation dose ranged from 84.8 to 122.9 mGy. The bismuth shield reduced the dose 37% at the 12 o'clock position, 56% at 3 o'clock, 30% at 6 o'clock, 42% at the nipple level, and 28% at the chest wall. Our tungsten-antimony composite breast shield reduced the unshielded dose by 55% at the 12 o'clock position,