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Lead Aprons Are a Lead Exposure Hazard

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Introduction

Shields to protect staff and patients from ionizing radiation during diagnostic x-ray and therapeutic fluoroscopic image-guided procedures often contain lead as the protective material. Lead-containing and lead-equivalent shields, usually referred to as "lead aprons" or simply as "lead" in hospital slang, may be worn for several hours each day within the fields of radiology, cardiology, gastroenterology, pain management, urology, vascular surgery, orthopedic surgery, neurosurgery, anesthesia, and dentistry.

The construction method and lead content of aprons varies by manufacturer, but traditionally lead powder with or without other metals is mixed with rubber or polyvinyl chloride to form sheets, which are then sewn on the inside of nylon fabric coated with urethane on the side in contact with the lead. Although lead-free shields are available, those containing lead remain the predominant type in use in the United States.

With daily use, bending, or improper handling, the lead sheets and covering layers may split and, with growing gaps, lose their effectiveness as protection against scattered ionizing radiation. For these reasons, shields undergo regular radiographic assessment for gaps and cracks and those deemed unacceptable are removed from circulation.

Although lead is a highly toxic metal, during the entire history of the use of lead aprons no prior study has ever assessed the risk of lead exposure to patients and health care workers from the use of tese aprons. This study was designed to assess whether lead aprons, long believed to be nonhazardous, expose wearers to lead particles present in dust on exterior shield surfaces. Secondarily we assessed whether a US Environmental Protection Agency (EPA)-approved qualitative on-site test could be used to identify the presence of lead instead of the more time-consuming and expensive method of flame atomic absorption spectrometry (FAAS).

Purpose

To determine whether lead-containing shields have lead dust on the external surface.

Methods

Institutional review board approval was obtained for this descriptive study of a convenience sample of 172 shields. Each shield was tested for external lead dust via a qualitative rapid on-site test and a laboratory-based quantitative dust wipe analysis, flame atomic absorption spectrometry (FAAS). The test was used to test the association with age, type of shield, lead sheet thickness, storage method, and visual and radiographic appearance.

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Results

Sixty-three percent (95% confidence interval [CI]: 56%-70%) of the shields had detectable surface lead by FAAS and 50% (95% CI: 43%-57%) by the qualitative method. Lead dust by FAAS ranged from undetectable to 998 µg/ft2. The quantitative detection of lead was significantly associated with the following: (1) visual appearance of the shield (1 = best, 3 = worst): 88% of shields that scored 3 had detectable dust lead; (2) type of shield: a greater proportion of the pediatric patient, full-body, and thyroid shields were positive than vests and skirts; (3) use of a hanger for storage: 27% of shields on a hanger were positive versus 67% not on hangers. Radiographic determination of shield intactness, thickness of interior lead sheets, and age of shield were unrelated to presence of surface dust lead.

Conclusions

Sixty-three percent of shields had detectable surface lead that was associated with visual appearance, type of shield, and storage method. Lead-containing shields are a newly identified, potentially widespread source of lead exposure in the health industry.

Take-Home Points

• Sixty-three percent of the aprons had quantifiable amounts of lead-containing dust on the external surface. A larger proportion of the thyroid shields, full-body-style aprons, and small pediatric patient shields had elevated surface lead dust compared with vests and skirts.

• Even radiographically intact lead shields with a poor visual appearance are associated with surface lead dust.

• A rapid on-site negative qualitative swab is not adequate to exclude the presence of lead on shield surfaces; but a positive swab is likely to be confirmed as indicating lead dust on quantitative testing (dust wipe method).