Fluoroscopy-induced chronic radiation dermatitis (FICRD) after endovascular abdominal aortic aneurysm endoleak repair

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Key words: endovascular abdominal aortic aneurysm endoleak repair; fluoroscopy; fluoroscopy-induced chronic radiation dermatitis; obese; radiation; radiation dermatitis.

Fluoroscopy use has increased recently because of the growing use of minimally invasive surgical procedures. Fluoroscopy, and other procedures using radiation exposure, can induce acute and chronic skin damage. Diagnosis of fluoroscopy-induced chronic radiation dermatitis (FICRD) is challenging as patients are sometimes unaware of exposure to radiation and presentation often occurs after months or years.1,2 Early recognition is important to optimize both therapy and surveillance for radiation-induced malignancies.1 We present a case of a 72-year-old man with a greater than 1-year history of a nonhealing ulcer on the back. He had a history of endovascular abdominal aortic aneurysm repair with subsequent endoleak repairs, which required intraoperative use of fluoroscopy.

CASE REPORT
A 72-year-old man with a complex medical history significant for abdominal aortic aneurysm status postrepair and morbid obesity (body mass index 46 kg/m²) presented to our dermatology clinic with a greater than 1-year history of a painful nonhealing ulcer on the back. One year before presentation, the patient was treated with a 10-day course of acyclovir for a presumed diagnosis of herpes zoster of the corresponding area. Approximately 6 months before presentation, the patient underwent excisional debridement of the site and a course of antibiotics for worsening and progression of a presumed stage III decubitus ulcer. The patient was referred for a dermatology consultation when the site failed to heal despite extensive wound care efforts. On presentation, physical examination revealed a sclerotic plaque with telangiectasias and a 5-cm ulceration in the central portion of the lesion on the lower aspect of the back (Fig 1). Biopsy specimens from the lateral aspect of the plaque revealed dermal sclerosis with focal atypical fibroblasts and dilated superficial blood vessels consistent with radiation dermatitis (Fig 2). Further investigation of the patient’s surgical history revealed 3 endovascular abdominal aortic aneurysm endoleak repairs over the course of 3 years. The cumulative operative time for the 3 procedures exceeded 14 hours, and fluoroscopy had been used extensively during each procedure. Given the patient’s history of prolonged fluoroscopic exposure corresponding to the site of involvement, and the clinical and histopathologic findings characteristic of radiation dermatitis, the diagnosis of FICRD was established. Shortly after diagnosis, the patient was hospitalized for management of a pseudomonal infection of the ulcer and underlying osteomyelitis. Despite treatment with intravenous antibiotics, the patient continued to deteriorate. After consultation with general surgery, the patient was deemed a poor surgical candidate and was discharged home with hospice care where he died shortly thereafter.

DISCUSSION
Fluoroscopy provides real-time radiologic visualization during a variety of interventional and diagnostic procedures.3 The rate of fluoroscopic

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Funding sources: None.

Conflicts of interest: None declared.

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JAAD Case Reports 2015;1:403-5.
2352-5126
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http://dx.doi.org/10.1016/j.jder.2015.09.022

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procedures has been increasing with the majority of fluoroscopy-associated radiation dermatitis cases occurring after interventional cardiac procedures. Despite its widespread use, the incidence of radiation-induced skin injury from fluoroscopy is estimated to be less than 0.01%\(^4\); to date, over 100 cases have been reported in the literature.

Radiation dermatitis is categorized as acute, sub-acute, or chronic. Acute radiation dermatitis may occur up to 9 weeks after exposure and is characterized by erythema, desquamation, edema, and possible skin necrosis and ulceration. Chronic radiation dermatitis occurs months to years after exposure and typically features permanent erythema and telangiectasias, skin fragility, ulceration, loss of follicular structures, late-onset dermal necrosis, and secondary cutaneous malignancies.\(^1,2,5\)

Histologically confirmed radiation dermatitis reveals ulceration, prominent telangiectasias, atypical stellate fibroblasts, epidermal atrophy, and absence of inflammation.\(^1\)

The extent of skin toxicity correlates directly with exposure dose and ranges from early transient ischemia (2 Gy), permanent erythema (7 Gy),
telangiectasia (12 Gy), dermal necrosis (18 Gy), and secondary ulceration (20 Gy).6 FICRD usually occurs after exposure to radiation doses of 10 Gy or higher.1 A typical fluoroscopic procedure emits 0.02 to 0.05 Gy per minute with the average cardiac catheterization using approximately 2.5 Gy.2 Operative records reveal that our patient was exposed to at least 25 Gy (exposure dosage was not documented for 2010 fluoroscopic procedure).

The radiation threshold required to cause skin injury is patient-specific and depends on multiple factors.4 Treatment-related factors contributing to skin toxicity include higher radiation doses, short intervals between radiation exposures, size of irradiated site, and case complexity.1,4 Patient-specific factors include smoking, obesity, and poor nutritional status.1,4 Obese patients, such as the patient described in this report, require higher radiation output to penetrate the excess adipose tissue, resulting in radiation doses up to 3 times that for a person with a normal body mass index.7 Common sites of FICRD correspond to the sites of ionizing radiation beam entry during fluoroscopic procedures and include the axilla, scapula, and mid aspect of the back.1,5

Treatment of radiation dermatitis can include topical steroids or surgical excision with skin grafting, but there are no guidelines on definitive treatment.1,5 Provider education is essential for the prevention of FICRD. Precautions—including surveillance of radiation dosage and minimization of the area exposed to radiation—can help limit complications.6 A study by Kirkwood et al.7 found that educating vascular surgeons on better operating practices (including limiting fluoroscopy time, using pulsed fluoroscopy, and minimizing patient-to-detector distance) lowered radiation dose to the skin. Accordingly, radiation safety lectures can help raise physician awareness of FICRD and help lower radiation exposure during procedures.7 Providers should counsel patients on the possibility of acute radiation dermatitis and FICRD and instruct them to monitor for any cutaneous signs or symptoms. Close follow-up is essential to monitor for progression and malignant transformation into squamous cell carcinoma or basal cell carcinoma.8

Because of the low incidence of FICRD, primary care physicians, interventional radiologists, surgeons, and dermatologists often are unaware of its existence. Radiation dermatitis should be considered in any patient with previous fluoroscopy or other type of radiation exposure who presents with characteristic skin changes, including nonhealing ulcers. A thorough history should be obtained from these patients, with an emphasis on past fluoroscopic procedures. Understanding the patient’s medical and surgical history, along with the site of lesions, clinical presentation, and characteristic histopathologic findings are vital in establishing a diagnosis of FICRD.

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