

## Chronic radiodermatitis following percutaneous coronary interventions: a report of two cases

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### ABSTRACT

We describe two patients in whom chronic radiodermatitis with therapy-resistant ulceration of the right scapular region developed, following percutaneous coronary intervention with fluoroscopic imaging. Contrary to most reported cases in the literature, which involve numerous cardiac catheterization procedures, in both patients described here the total radiation dose was given during two successive procedures, involving difficult and prolonged coronary intervention with stent implantation. In both cases, local treatment of the ulcerative lesions was insufficient, necessitating excision of the radiodermatitis area and replacement with a skin graft, with good therapeutic result. The incidence of radiodermatitis after percutaneous coronary interventions is rising with the increasing number and complexity of these procedures. The main risk factor is a long duration of fluoroscopy using the same incidence. The skin lesions encompass a wide spectrum, ranging from erythema, telangiectasia, atrophy, hyperpigmentation and hypopigmentation to necrosis, chronic ulceration and squamous cell carcinoma. The lesions can appear from 15 days to 10 years after the procedure. To prevent radiation-induced injury, the radiation dose has to be limited and monitored. Also, careful inspection of the skin at the site of exposure is necessary and the radiographic beam has to be restricted to the smallest field size. A good clinical follow-up at regular intervals is important after long and complicated procedures.

**Key words:** ionizing radiation, percutaneous coronary intervention, radiodermatitis

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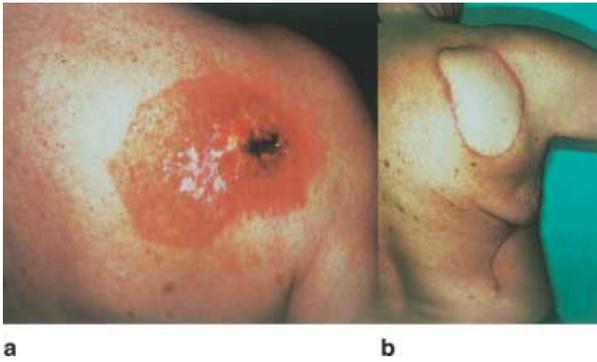
### Introduction

Cardiac angiography is frequently used in diagnostic and therapeutic coronary procedures. A less well known characteristic of this technique is that it involves the highest radiation levels in diagnostic radiology.<sup>1</sup> Cutaneous side-effects are the main dose-dependent effects of ionizing radiation. A large dose of irradiation can cause inflammation of the skin, adnexal structures and subcutaneous tissue. This reaction is termed radiodermatitis and can be acute or chronic and is triggered by known threshold doses. Skin reactions indicative of acute radiodermatitis start to develop 7–14 days after exposure. The threshold doses for the development of erythema, permanent epilation, moist desquamation and necrosis are 3–10, 7–10, 12–25 and 25 Gy, respectively.<sup>1,2</sup>

Chronic radiodermatitis may develop months to years after radiation exposure. Chronic radiodermatitis is a non-stochastic reaction, indicating that the dose is important for the effect and that there is a relatively high threshold dose. The cumulative dose necessary to induce chronic radiodermatitis is estimated to be greater than 10–12 Gy.<sup>2</sup> Clinical symptoms caused by irradiation exposure in excess of these thresholds include atrophy, telangiectasia, sclerosis, pigmentary changes, ulcerations and premalignant or malignant neoplasms.<sup>3</sup> We describe two patients in whom chronic radiodermatitis developed after cardiac procedures with prolonged fluoroscopic imaging.

### Case 1

A 75-year-old man presented in July 2000 with an ulceration on

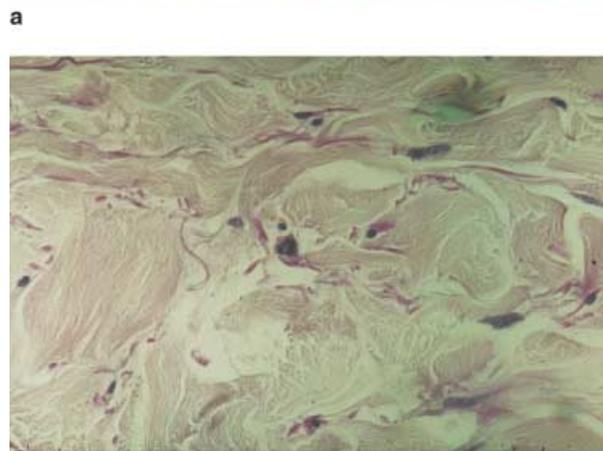
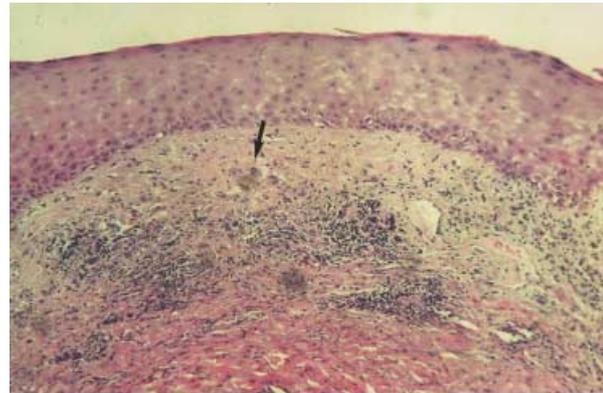


**fig. 1** Right scapular area of patient 1, (A) before and (B) after skin grafting. (A) The right scapula showed a well-demarcated red-brown macule, with scarification. In the lateral border there was ulceration covered with a dark necrotic crust. (B) Right scapular area after skin grafting (latissimus dorsi flap).

the right scapular region. This ulceration developed in a brown macule, which had been present for approximately 1 year. The patient denied any contact with radioactive materials or overt exposure to possible radiation sources. However, he was admitted to the hospital in March 1999 for diagnostic evaluation of chest pain. During this hospitalization he underwent a diagnostic cardiac catheterization that included a pulmonary angiography and a right ventricular angiogram resulting in a prolonged radiation exposure time (5 min). The diagnostic procedure was followed 2 days later by an intervention involving angioplasty and stenting of the proximal left anterior descending coronary artery (LAD). This procedure, however, was complicated by an extension of the stenosis into the left main stem, which required semiurgent coronary artery bypass grafting.

The patient recalls having a brown macule on the right scapular region when he was discharged from the hospital. This brown macule was not painful, until 15 months later when it became ulcerated. Clinically, the right scapula showed a well-demarcated red-brown macule of 11 cm by 8 cm with a few flame-like erythematous offshoots. In the centre we found scarification and some red and white infiltrated areas. In the lateral border there was an ulceration covered with a black necrotic crust (fig. 1a). Histology of a biopsy specimen showed irregular acanthosis, oedema of the dermis and many large, bizarre, stellate fibroblasts amidst homogenized collagen. Deep dermal blood vessels showed narrowing of the lumen due to fibrous thickening of their walls (fig. 2). The histology was that of radiation dermatitis.

Because skin ulceration and pain insufficiently responded to local treatment with an antiseptic (povidon iodine) and a hydrogel (Flamigel®), the lesion was surgically removed well into the healthy muscle tissue and replaced by a homograft. This homograft was removed after 1 week and the wound was closed with a latissimus dorsi flap (fig. 1b). The patient is presently free of pain and was seen for follow up 6 months after removal of the radiodermatitis area.



**fig. 2** (a) Histology of skin biopsy taken from the lesion of patient 1, showing a moderately thickened epidermis above a dermis with several bizarre fibroblasts (arrow), teleangiectatic blood vessels and a mononuclear inflammatory infiltrate. Original magnification,  $\times 97$ , haematoxylin and eosin stain. (b) High magnification (original magnification  $\times 400$ ) of part of the dermis of skin histology shown in part (a), demonstrative for the fine morphology of the dermal cells, clearly showing large, bizarre, stellate fibroblasts amidst homogenized collagen.

## Case 2

A 65-year-old woman developed a brown macule on the right subscapular region in 1996 after diagnostic coronary angiography followed by a percutaneous transluminal coronary angioplasty (PTCA) of a proximal right coronary artery stenosis. The procedure was complicated by a large dissection necessitating implantation of four consecutive stents in the distal part of the right coronary artery. Because of persistent distal occlusion, a fifth stent was deployed. The patient developed pronounced bradycardia, which required implantation of a temporary pacemaker. In 1997 she underwent another diagnostic coronary angiogram because of chest discomfort but no new stenoses were identified. In March 2000, she underwent radiotherapy of the right breast because of a tumour. Subsequently, the lesion on her back became itchy and crusty with a burning and painful sensation.



**fig. 3** Right scapular area of patient 2, showing a depressed lesion, with peripheral telangiectasia and atrophic white areas in the centre of the lesion. On subsequent visits, small ulcerations were noted in the centre of the lesion.

When she first came to the outpatient clinic in May 2000, examination revealed a brown depressed lesion of 9 cm by 5.5 cm on the right subscapular region with peripheral telangiectasia and atrophic white areas (fig. 3). On subsequent visits, small ulcerations were noted in the centre of the lesion. Histological analysis of a skin biopsy demonstrated a thinned epidermis. The superficial dermis showed multiple dilated vessels surrounded by a lymphocytic infiltrate; the deep dermis showed extensive fibrosis and contained some stellate-shaped fibroblasts. These histological findings were those of radiation dermatitis.

The skin defect in the radiodermatitis area did not close despite appropriate local treatment with an absorbent silicone-coated foam dressing (Mepilex®), a hydrocolloid dressing (Comfeel®) and a cream with chloramine. Moreover, the patient complained of persistent pain in this area, unresponsive to the local treatment. Therefore she was referred to the plastic surgeons for an excision of the radiodermatitis area and the resulting skin defect was covered with a skin graft, with good therapeutic result and satisfactory long-term clinical outcome.

## Discussion

Chronic radiodermatitis is a rare complication of previous exposure to ionizing radiation for diagnostic or therapeutic purposes. It is often misdiagnosed because of the insidious and late onset of the clinical symptoms, which in turn encompass a wide spectrum ranging from erythema to telangiectasia, atrophy, hyperpigmentation, ulceration and necrosis. The variable onset in time of these clinical features render the association with previous angiographic procedures often difficult. The lesions are mistaken for a fixed drug reaction or a morphea and as such are wrongly treated. Yet, the incidence of radiodermatitis after cardiac interventions rises, because of the increased incidence and progressively more complex nature of these procedures, which exposes patients to prolonged radiation doses.

In most cases reported in the literature, patients had undergone numerous cardiac catheterization procedures. In both patients described here, the total radiation dose was given during two successive procedures, involving difficult and prolonged coronary intervention with stent implantation. This resulted in extended periods of fluoroscopy in a limited number of projections. Fluoroscopy results in radiation exposures of 0.02–0.05 Gy every minute, and in extreme circumstances doses can reach up to 0.5 Gy per minute. Image recording involves even higher doses.<sup>4,5</sup> A routine cardiac catheterization procedure exposes a patient to an average dose of radiation of 2.5 Gy, whereas percutaneous interventions result in an average dose of 6.4 Gy.<sup>6</sup>

The brown macule appeared rather quickly (i.e. within weeks) in both patients but was not associated with the prior radiation exposure. Moreover, the clinical symptoms of pain and ulceration only appeared after several years. This pain is usually a burning sensation and often the reason for seeking medical attention. It is unlikely that the radiotherapy for the breast tumour in our second patient plays a major role in the process because the projection of the beam is different and because it does not involve the back of the chest.

Several elements in the clinical history may help to diagnose radiodermatitis and should raise the level of clinical suspicion from the part of the treating physician. Although the time of onset is variable, the distribution pattern is rather characteristic and involves the right axillar region or the right dorsal subscapular region, depending on the coronary artery that is explored (right vs. left main coronary artery). These predilection areas are also accounted for in part by different degrees of radiosensitivity of different regions of the skin. Whereas the neck is very resistant to radiodermatitis, the chest, abdomen, thigh, back and face are progressively more radiosensitive.<sup>2</sup> During most cardiac procedures, the upper back receives the highest exposure because the left and right anterior oblique projections are used most frequently during fluoroscopy and angiography.<sup>2</sup> Moreover, the occurrence of spontaneous ulceration in skin regions of atrophy and scarring is highly suggestive of radiodermatitis. Finally, failure of adequate local treatment to resolve skin lesions and the persistent excruciating pain should strongly suggest the possibility of a chronic radiodermatitis. In those cases, wide surgical excision into the healthy tissue is necessary followed by covering the defect with skin grafts.

Given the insidious nature of radiodermatitis lesions and the inherent risk of developing spinocellular carcinomas, it is important to prevent these complications to the greatest possible extent. Physicians performing cardiac procedures should be aware of the risk and carefully check whether the patient underwent prior procedures, which caused exposure to ionizing radiation. Before repeated exposure to ionizing radiation, an inspection of the skin areas that will be exposed is necessary. The cumulative radiation dose has to be limited and monitored and collimation of the beam to the region of interest

is mandatory. Also, the radiology equipment needs regular maintenance to avoid undue radiation levels.

Awareness of the risk of chronic radiodermatitis after protracted or repeated cardiac interventions should keep physicians focused on the importance of preventive measures. Under all circumstances, diligent clinical follow-up is necessary.

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