

CHRONIC RADIODERMATITIS FROM FLUOROSCOPICALLY GUIDED PROCEDURES: LITERATURE REVIEW

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Abstract. Interventional radiology has developed rapidly in medical services. Fluoroscopy is one of the modalities used in interventional radiology services. The benefits of fluoroscopically guided interventional procedures are reflected in the increasing number of interventions performed each year. More than 700,000 interventional procedures are performed in the United States. However, this procedure can deliver a high dose of radiation to the patient's skin, resulting in some patients being injured by radiation. Dermatitis is one of the effects that arise from the use of fluoroscopy. A review was carried out on the nine articles obtained. This research is a literature review. The author analyzes and synthesizes the results of previous studies regarding the effect of using fluoroscopy on the occurrence of chronic dermatitis. The article search process was carried out extensively through a database of internationally validated research journals in the form of PubMed, SCOPUS, Science Direct, and Google Scholar. The author stipulates that the deadline for publication of research journals is to be analyzed and synthesized in the last ten (10) years of research. The keywords used in the article search were radiation, injuries, accident, effect, patient, fluoroscopy, and dermatitis. The type of research that is reviewed is in the form of a case study or case report. With the inclusion criteria, the article is a case study or case report, the article uses English, and the research article discusses dermatitis due to fluoroscopy. The research articles obtained amounted to 12 cases from nine articles which the authors then analyzed and synthesized. The location of the skin injury depends on the type of procedure and in all cases corresponds to the site of entry of the beam. The site of injury is on the back when the tube is in a posteroanterior projection (eg placement of a transjugular intrahepatic portosystemic shunt (TIPS) or some coronary procedures), over the scapula when the beam is oriented in the left or right anterior oblique plane. eg, coronary intervention), or in the axilla when the tube is positioned laterally (eg, radiofrequency ablation and some coronary interventions). The nine articles that we reviewed reported health problems in the form of dermatitis due to radiation in patients undergoing fluoroscopy examination. The patient we reviewed had a history of long-term exposure to radiation during a fluoroscopy procedure. Of the 12 patients we reviewed, 6 patients did not have an explanation for the amount of dose received. One patient was described as having a long exposure but did not explain the duration. Six patients received long exposure in the range of 5 - > 14 hours of radiation exposure from fluoroscopy procedures but there was no record of the dose received.

Keywords: [Dermatitis, Radiation, Fluoroscopy]

INTRODUCTION

Radiation is a process of energy movement that can occur without going through an intermediary medium. Ionizing radiation is electromagnetic waves and charged particles because the energy they have can ionize the medium in which they pass[1]. Utilization of radiation sources in Radiology apart from providing enormous benefits, also carries a risk of danger to workers and the public and the surrounding environment. The biggest contribution of radiation exposure due to the use of nuclear energy received by humans is from the health sector, and 90% of this is a contribution from radiology with X-ray sources [2]. Since the discovery of X-Rays by Röntgen in 1895 they have been increasingly used in industrial and medical imaging [3]. Currently, most artificial radiation sources are used in the medical field, including for diagnostic radiology examinations, nuclear medicine, and radiotherapy [4].

When radiation interacts with biological materials, there will be interactions with biological materials that will cause biological effects. The biological response is in the form of cell death which can extend to the scale of tissues and organs, resulting in death [5]. Ionizing radiation causes effects that arise due to the interaction of radiation with the human body. These effects begin with changes at the molecular level that develop into clinical symptoms. The severity, symptoms, and when these effects will appear to depend on the magnitude of the absorbed radiation dose and the absorption rate of the organ it is subjected to. Ionizing radiation causes effects that arise due to the interaction of radiation with the human body. These effects begin with changes at the molecular level that develop into clinical symptoms [6].

The severity, symptoms, and when these effects will appear to depend on the amount of radiation dose absorbed and the absorption rate of the organ it is exposed [6].

There are two effects of radiation on the body of the person exposed, namely the stochastic effect and the deterministic effect. This stochastic effect occurs in low-dose radiation exposure of around 0.25 – 1,000mSv and is in the form of cancer or damage to body tissue cells or genetic damage that causes hereditary defects. There is no threshold dose for stochastic effects. No matter how low the dose hits the body, there is still a chance for changes to occur in the body's biological systems at the molecular and cellular levels. In this condition, the cell does not die but changes, either a change in form or a change in function. If somatic cells change, the form is cell growth towards cancer over time, such as leukemia. Deterministic effects arise when body tissues are exposed to certain doses of radiation. A deterministic effect will occur if the dose received exceeds the threshold dose. Events that arise from a deterministic effect are not long after excessive exposure and the severity will increase when the dose received is larger, such as cataracts, infertility, erythema, decreased blood cell counts, epilepsy, and early menopause [3][6]. In general, the effects that arise due to radiation exposure can be in the form of skin changes, fatigue, and long-term radiation effects. Effects on the skin can include dryness, itching, blistering, or peeling of the skin.

Ionizing radiation is required for invasive cardiology procedures such as coronary angiography, percutaneous coronary intervention (PCI), and diagnostics or therapy [7]. Approximately 12% of all radiological examinations are interventional cardiac procedures, resulting in exposure to the highest radiation dose (up to 50% of the total collective effective dose). Therefore, such examinations are of serious concern to interventional cardiologists and high-exposure patients [8]. Interventional radiology started in the 1960s. There was rapid growth from 1985 to 2000. In some countries, the number of procedures is doubling every 2 to 4 years [9]. The benefits of fluoroscopically guided interventional procedures are reflected in the increasing number of interventions performed each year. More than 700,000 interventional procedures are performed in the United States [10]. However, this procedure can deliver high doses of radiation to the patient's skin, resulting in some patients being injured by radiation [11].

Radiodermatitis can occur in acute, subacute, or chronic forms as a result of exposure to ionizing radiation. Outside of radiation therapy, widespread use of fluoroscopy has been reported, especially for minimally invasive vascular procedures, such as; radiofrequency catheter ablation, renal angioplasty, interventional neuroradiology, and implantation of cardiac defibrillators and pacemakers [12]. Fluoroscopy-induced chronic radiation dermatitis (FICRD) is a rare condition with an incidence of less than 0.01% per procedure [13]. The diagnosis of FICRD may be overlooked because of patient unconsciousness and the period between radiation exposure during a surgical procedure and the manifestation of a skin injury varies from months to years [14]. Due to the risk of developing skin malignancies in the affected area, awareness of this entity and early diagnosis is important [15].

METHODS

This research is a literature review, to collect and take the essence of previous research and analyze several expert overviews written in the text. The author analyzes and synthesizes the results of previous studies regarding the effect of using fluoroscopy on the occurrence of chronic dermatitis. The article search process was carried out extensively through a database of internationally validated research journals in the form of PubMed, SCOPUS, Science Direct, and Google Scholar. The author stipulates that the deadline for publication of research journals is to be analyzed and synthesized in the last ten (10) years of research. The keywords used in the article search were radiation, injuries, accident, effect, patient, fluoroscopy, and dermatitis.

The type of research is a literature review. The inclusion criteria, the article is a case study or case report, the article uses English, and the research article discusses dermatitis due to fluoroscopy. Exclusion criteria were articles that were not case studies or case reports and articles in the form of literature reviews. The research articles obtained amounted to 12 cases from nine articles which the authors then analyzed and synthesized in tabular format. The article selection process chart is shown in Figure 1.

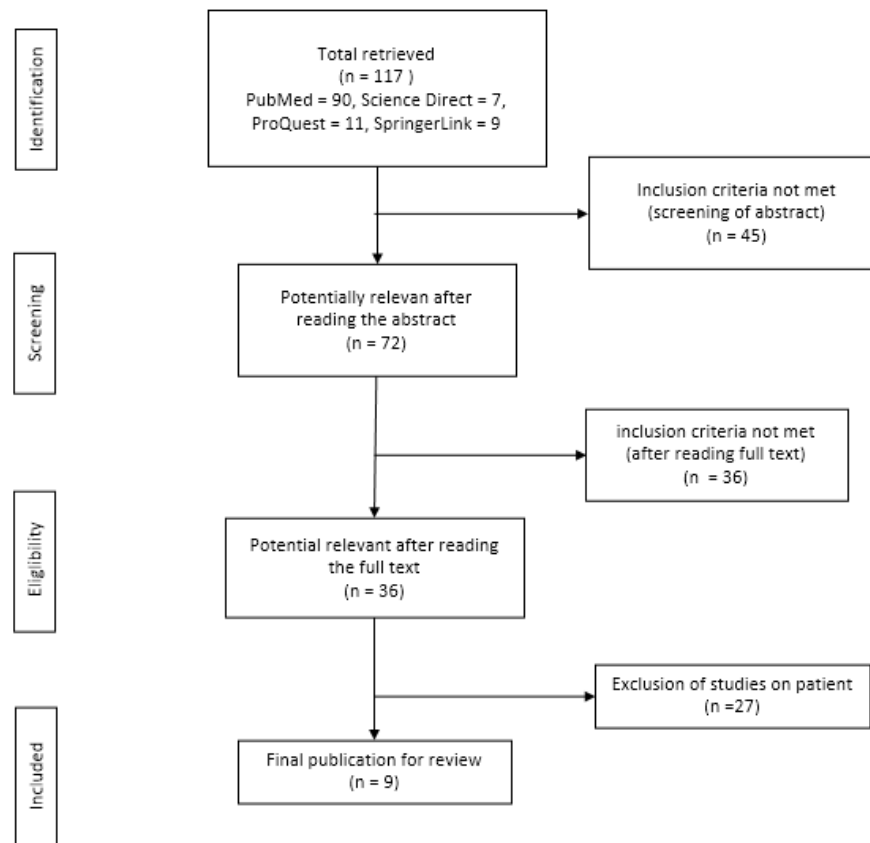


Figure 1. Article search diagram

RESULTS AND DISCUSSION

The use of fluoroscopy for radiodiagnosis activities causes several effects, one of which is injury to the patient's skin. One of the injuries that arise due to the use of fluoroscopy is dermatitis. We review articles in the form of case studies or case reports that examine dermatitis that occurs on examination using fluoroscopy. Our summary of the article is presented in Table 1.

Table 1. Overview of cases that have been reviewed

No	Author, Year	Title	Description case
1.	Boncher J (2012) [16]	Fluoroscopy- induced chronic radiation dermatitis: a report of two additional cases and a brief review of the literature	The patient came in for evaluation of a rash on his back, which had been present for several years and was slightly itchy. The skin rash is not bothersome. The patient had a history of transposition of the great vessels and coarctation of the aorta with surgical correction in childhood. The patient has a history of radiofrequency ablation of the heart. There is a large poikilodermatous lateral dorsal patch with telangiectasia and atrophy located around the well-healing thoracotomy scar. Skin biopsy shows mildly atrophic epidermis overlying hyalinized collagen with telangiectatic vessels and stellate fibroblasts in the superficial dermis. The patient was diagnosed with radiation dermatitis.
2.	Boncher J (2012) [16]		Patient with a 1-year history of an eruption involving the left scapula. On initial presentation to the dermatology department, a physical examination revealed a 10 cm, erythematous, hard left-sided plaque with atrophy, telangiectasia, and shallow ulceration. Initial skin biopsy showed homogeneous superficial and deep hyalinized dermal fibrosis with loss of adnexal structures. The patient was examined by plastic surgery for possible surgical management. The patient had a history of mesenteric angiography and stent placement approximately 6 weeks before the development of the rash. A review of the skin biopsy was carried out considering the history of radiation exposure. Diagnosis of dermatitis and telangiectasia, consistent with radiation effects.
3.	Spiker, A (2012) [17]	Fluoroscopy- induced chronic radiation dermatitis	Patient with a history of itchy and painless skin lesions above his right scapula which has been present for 5 years. Medical history of hypertension, hyperlipidemia, heart failure, coronary artery disease, and extensive smoking. The patient has a history of 2 cardiac catheterizations with stent placement 8 and 9 years previously. The second cardiac catheterization patient had a damaged stent

No	Author, Year	Title	Description case
			in the ostial right coronary artery requiring prolonged fluoroscopic exposure to remove the damaged stent. The total fluoroscopy time and total radiation dose delivered during catheterization are not known. On physical examination, the lesion was 8-6 cm in size, well-demarcated, erythematous reticulated atrophic plaque with telangiectasia and ulceration overlying the right scapula. The characteristic histological findings of radiation dermatitis lead to the clinical diagnosis of fluoroscopy-induced chronic radiation dermatitis.
4.	Mundi et al (2013) [18]	Fluoroscopy-associated radiation dermatitis	The patient was referred to the skin and cancer department for evaluation of a well-defined rectangular skin ulcer on his right midback that had been present for seven months. The ulcer is preceded by a change in skin texture and color. The patient underwent a skin biopsy in the center of the involved area outside the facility. His previous medical history included hypertension, hyperlipidemia, diabetes mellitus, and coronary artery disease. The patient had a history of cardiac catheterization and coronary artery bypass graft surgery and two additional cardiac catheterization procedures with multiple stent placement, 3 and 5 months previously. On the right midback, there is an atrophic plaque measuring 7 x 8 cm, well-demarcated, erythematous, and indurated, with telangiectasia within which there is an ulcer measuring 3.8 x 4.5 cm. The patient was stated to have dermatitis due to fluoroscopic radiation.
5.	Herz-Ruelas et al (2014) [12]	Ulcerated Radiodermatitis Induced after Fluoroscopically Guided Stent Implantation Angioplasty	Obese male patient with hypertension, dyslipidemia, and coronary artery disease and had a history of fluoroscopically guided stent implantation angioplasty six months before Dermatology consultation. The patient had erythematous over his left scapula on discharge from the hospital. The lesions develop within 3 months into pruritic, tender, painful atrophic plaques. Over the next 3 months, the lesions became indurated, ulcerated, progressed to hypopigmentation and hyperpigmentation, and superficial telangiectasia. The well-circumscribed lesion, 8 x 5 cm. The skin biopsy specimen showed changes consistent with chronic radiation dermatitis. Histological findings, together with the location above the left scapula and a history of fluoroscopic exposure during cardiac catheterization, lead to the clinical diagnosis of fluoroscopy-induced chronic radiation dermatitis.
6.	Reichman, E (2014) [19]	Fluoroscopy-induced radiation dermatitis	Patient with anterolateral myocardial infarction (MI). The patient underwent cardiac catheterization, angioplasty, and stenting, the patient was discharged 3 days later. 7 days after the angioplasty, the patient had a red, scaly, slightly watery, non-itchy, and non-painful rash on his back. The main complaint area is localized between the scapulae, rectangular, sharply demarcated, erythematous, non-tender, and with a central area of necrosis and ulceration. Thick, raised, and scarred skin with mild induration surrounds the area of necrosis and scab. The diagnosis of radiation dermatitis due to prolonged fluoroscopy during catheterization was made in the ED.
7.	Lyons A, (2015) [20]	Fluoroscopy-induced chronic radiation dermatitis (FICRD) after endovascular abdominal aortic aneurysm endoleak repair	Patient with a complex medical history after repair of an abdominal aortic aneurysm and comorbid obesity (body mass index 46 kg/m ²). Patients with a history of more than 1 year suffer from ulcers in the lower back. There was a sclerotic plaque with telangiectasia and a 5 cm ulceration in the center of the lesion on the lower aspect of the back. The biopsy specimen from the lateral aspect of the plaque shows dermal sclerosis with focal atypical fibroblasts and dilated superficial vessels consistent with radiation dermatitis. The cumulative operating time for the 3 procedures exceeded 14 hours, and fluoroscopy was used extensively during each procedure. With a long history of fluoroscopy exposure and characteristic clinical and histopathological findings of radiation dermatitis, the patient was diagnosed with FICRD.
8.	Ting Ting Cheng (2022) [21]	Chronic radiation dermatitis induced by cardiac catheterization: a case report and literature review	A Patient (BMI=42 kg/m ²) with itchy and painful skin lesions on the left side of his back that has lasted for 7 years. His medical history includes hypertension, diabetes mellitus, dyslipidemia, and coronary artery disease. On physical examination, the skin lesion is an atrophic erythematous plaque, approx. 8 cm long and 6 cm wide, rectangular, and well-defined, with depigmentation, telangiectasia, and multiple superficial ulcerations. The patient has a history of three times undergoing catheterization procedures with a total fluoroscopy time of more than 4 hours for stent placement. The doctor attempted a microcatheter to stent through the distal CTO LCX lesion due to severe calcification, the stent procedure was performed within 3 hours. The total radiation dose exposure is unknown. The clinical and histopathological findings are consistent with the diagnosis of fluoroscopically induced chronic radiation dermatitis (FICRD).
9.	Karaali, MG	Fluoroscopy-induced chronic radiation	A patient with hypertension, diabetes mellitus, and severe coronary artery disease has an ulcer on his back. She had a history of coronary angioplasty and fluoroscopy-guided stenting 7 years ago, lasting 5 hours on the first day and 3

No	Author, Year	Title	Description case
	(2020) [22]	dermatitis treated with excision and reconstructed with rhomboid flap	hours on consecutive days. He had another angioplasty which lasted 3 hours, 2 years ago. There was an erythematous measuring 4x5 cm, violaceous, telangiectatic, sclerotic, indurated, rectangular-shaped plaque, and a 2.5x5 cm well-defined green-gray, necrotic, crusted ulcer on the left scapular area. Biopsy showed loss of epidermis, necrobiosis, and appearance of eosinophilic collagen consistent with chronic radiation dermatitis. Histopathological findings, together with a history of radiation exposure, according to the affected area of involvement, lead to the clinical diagnosis of FICRD.
10.	Tugbay F, (2016) [14]	Fluoroscopy-Induced Chronic Radiodermatitis.	Patient with a 2-year history of ulcers on his back. Physical examination reveals well-defined, rectangular, indurated, atrophic erythematous plaques with telangiectasia. The ulcer is well demarcated with yellow sticky fibrin and a thick yellow-brown crust in the center of the lesion. Histopathological examination revealed vessel wall thickening and swelling of the endothelial cells, odd-looking pleomorphic fibroblastic cells with large hyperchromatic nuclei along with eosinophilic homogeneous collagen fibers in the dermis. The patient had a history of coronary artery bypass graft surgery 20 years ago and coronary artery stenting 2 years ago which lasted 8 hours. With clinical and histopathological findings, the diagnosis of FICRD was established.
11.	Tugbay F, (2016) [14]	Fluoroscopy-Induced Chronic Radiodermatitis.	Patient with a 5-month history of non-itchy healing wounds on the back of the right shoulder. Well-defined, angular, atrophic erythematous plaque with telangiectasia was observed on the right lateral side of the scapula. On histopathological examination epidermal loss, interstitial and perivascular mixed-type inflammatory cell infiltration, eosinophilic appearance of collagen fibers, and thickness and fibrin exudation in the dermis were observed. The patient has undergone 2 diagnostic cardiac catheterizations four years ago, and in the same year, he has undergone 3 coronary artery stenting implants. In light of these findings, the patient was diagnosed with FICRD.
12.	Tugbay F, (2016) [14]	Fluoroscopy-Induced Chronic Radiodermatitis.	Patient with a 13-year history of itchy, non-healing sores on the right lower back. Physical examination revealed well-defined erythematous atrophic plaques with telangiectasia which was observed on the dorsolateral back. The patient had a history of prolonged cardiac radiofrequency catheter ablation 13 years ago which lasted 5 hours. A punch biopsy was performed and histopathological findings revealed a rough, swollen, eosinophilic, and partially hyalinized appearance of collagen bundles and an increased amount of elastic fibers in the dermis. Based on the history, clinical and histopathological findings, the diagnosis of FICRD was established.

Table 2. Patients with dermatitis induce Fluoroscopy

No	Sex, Age	Procedure	Lokasi Dermatitis	Time
1.	Men, 44	Transposition of the great vessels and coarctation of the aorta with surgical correction, Cardiac radiofrequency ablation	Lateral back	Not explained
2.	Men, 64	Angiography Pemasangan stent	Above left-back	Not explained
3.	Men, 62	2 kateterisasi jantung, stent Removal of a damaged stent	Above the Right scapula	Prolonged Fluoroscopy Exposure
4.	Men, 67	Kateterisasi jantung dan operasi cangkuk bypass arteri koroner 2 prosedur kateterisasi jantung	Right mid back	Not explained
5.	Men, 46	Angiography, Stent	Above left scapula, above right axilla	Not explained
6.	Men, 58	Angioplasty	Mid back scapula	Not explained
7.	Men, 72	PTCA	Mid Back	14 hours
8.	Men, 55	3 Cateterisasi Pemasangan stent	Left Back	> 4 hours
9.	Men, 68	4 Angioplasty	Left Scapula	3 hours
10.	Men, 84	Cardiac transplantation Stent	Lateral right scapula	Total > 7 hours
11.	Men, 73	2 Angiography 3 pemasangan stent	Right lateral scapula	Total 14 Hours
12.	Women, 63	Ablation, Angiography	Right mid back	8 hours

We got 12 cases from nine articles in the 2012 – 2022 range from searches through several sources. The mean age of the patients was 63 years and 91.67% of them were male. The number of men who experience cases of dermatitis reflects the distribution of coronary heart disease by sex. The location of the skin injury depends on the type of procedure and in all cases corresponds to the site of entry of the beam. The site of injury is on the back when the tube is in a posteroanterior projection (eg placement of a transjugular intrahepatic portosystemic shunt (TIPS) or some coronary procedures), over the scapula when the beam is oriented in the left or right anterior oblique plane. eg, coronary intervention), or in the axilla when the tube is positioned laterally (eg, radiofrequency ablation and some coronary interventions). The nine articles that we reviewed reported health problems in the form of dermatitis due to radiation in patients undergoing fluoroscopy examination. The patient we reviewed had a history of long-term exposure to radiation during a fluoroscopy procedure. Of the 12 patients we reviewed, 6 patients did not have an explanation for the amount of dose received. One patient was described as having a long exposure but did not explain the duration. Six patients received long exposure in the range of 5 - > 14 hours of radiation exposure from fluoroscopy procedures but there was no record of the dose received.

The use of radiation for health services continues to grow both for radiodiagnostics and radiotherapy. The use of radiation for medicine in addition to providing benefits also has an unwanted impact/effect. These radiation side effects arise as a result of procedures that are not complied with as well as effects that arise accompanying the procedures carried out and the occurrence of work accidents.

Fluoroscopy is used as guidance in placing cardiac stents and removing damaged stents. Fluoroscopy provides real-time radiological visualization during various interventional and diagnostic procedures [18]. Interventional fluoroscopy provides real-time radiological visualization during a variety of interventional and diagnostic procedures. With fluoroscopy, the doctor can monitor the placement of the stent properly or remove a damaged stent. The flow of radiopaque contrast medium injected into the body is visualized by fluoroscopy. Although fluoroscopic X-rays rapidly diminish in tissue, the beam entry point is exposed to the maximum level of radiation [11]. Ionizing radiation causes damage to the keratinocytes in the basal layer; inflammation is initiated and cell proliferation is disturbed [23]. The Food and Drug Administration alerted radiologists and cardiologists to radiation-induced skin damage after prolonged exposure to fluoroscopic procedures [24]. The X-rays used in fluoroscopy do not cause sensation while the individual is being exposed. There is a long delay between exposure and the onset of dermatitis symptoms. These characteristics explain why, even today, this dermatitis can confuse exposed individuals and their physicians. This is in stark contrast to the usual thermal burns where the sensation of heat immediately warns one of potential injury and where the flame or hot object is easily recognized [25].

Radiation-induced dermatitis is common in about 90% of patients receiving radiotherapy for cancer [23]. Fluoroscopy-induced radiation dermatitis is rare because the radiation dose received during fluoroscopic procedures is usually low and does not reach the threshold required for skin injury [26]. The incidence of radiation-induced skin injury from fluoroscopy is estimated to be less than 0.01%; however, to date, more than 100 cases have been reported in the literature [13]. A fluoroscopic procedure emits 0.02-0.05 Gy per minute with an average cardiac catheterization using about 2.5 Gy. The use of fluoroscopy that exceeds the specified time causes the patient to get excessive radiation exposure [25].

Radiation dermatitis can occur after fluoroscopically guided interventional procedures such as coronary angiography, percutaneous transluminal coronary angioplasty, and radiofrequency cardiac catheter ablation [24], [27]. The location of skin injury correlates with the site of entry of the radiation beam and varies depending on the procedure [28]. Radiation dermatitis from cardiac examination procedures is commonly found in the mid-back, scapular area, right anterolateral chest, and right axilla [24]. The clinical presentation of radiation dermatitis induced by fluoroscopy can vary from an initial reaction of erythema, epilation, and dermal atrophy to chronic changes such as telangiectasia, ulceration, and necrosis [28]. Typical histologic features of radiation dermatitis include epidermal atrophy, dermal sclerosis, dilated superficial vessels, and atypical stellate fibroblasts [16]. Fluoroscopy-induced radiation dermatitis is diagnosed by correlating the patient's history of fluoroscopy-guided procedures with the location of the skin lesions and the characteristic histological findings [27]. Chronic radiation-induced dermatitis occurs months to years after exposure and usually features permanent erythema and telangiectasia, skin fragility, ulceration, loss of follicular structure, late-onset dermal necrosis, and secondary skin malignancy [16], [17].

Fluoroscopy-induced chronic radiodermatitis (FICRD) has a long time of onset (months to years), a cumulative dose threshold of 1000 rad (10 Gy), and is represented clinically as permanent erythema, skin atrophy, and ulceration [25]. The degree of skin toxicity correlates directly with the 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) [29]. FICRD usually occurs after exposure to radiation doses of 10 Gy or higher [16]. In addition, repeated interventions, size and location of exposed areas, smoking, obesity, diabetes mellitus, malnutrition, thyroid disease, collagen tissue disease, autoimmune diseases, medications, and some drugs can increase dermatitis [29] [29].

The operative record revealed that the patient was exposed to at least 25 Gy (dose exposure not documented for fluoroscopic procedures). Patients undergoing fluoroscopically guided procedures should be informed about the possibility of radiation dermatitis, especially if they will be exposed to 4 Gy [30]. In most patients, the threshold dose for clinically significant skin and hair changes is 5 Gy [30], [31]. If a patient receives an estimated total radiation dose of 10 Gy, appropriate medical follow-up is required. After a fluoroscopic procedure, patients should be advised to monitor for any skin changes in the fluoroscopically exposed area and should receive an immediate skin evaluation if exposed to higher doses [30]. Fluoroscopic procedures (especially long interventional procedures) may involve high patient radiation doses. The radiation dose will depend on the type of examination, patient size, equipment, technique, and many other factors [31], [32]. The performance of fluoroscopic systems concerning radiation dose is best characterized by the exposure to the receptor and the degree of exposure to the skin, which should be periodically assessed. Management of patient exposure involves not only measuring these levels but also clinical monitoring of patient doses. Direct monitoring of the patient's skin dose during the procedure is necessary, but current methods have limitations [30].

The skin dose received by the patient can be reduced by using intermittent exposure, eliminating the use of grids, last image retention, dose spreading, light filtration, intermittent fluoroscopy, and other dose reduction techniques. Appropriate fluoroscopic operator training is necessary to understand the factors affecting radiation dose, and the use of various dose reduction techniques allows for effective patient dose management [33]. Staff education and training are essential for the prevention of FICRD. Physicians involved in this type of intervention should be aware of the FICRD and be careful about radiation dose and minimizing the area exposed to radiation [14]. The actual radiation dose delivered during fluoroscopy is low and does not exceed the threshold dose for skin damage. However, if the duration of exposure is prolonged or several procedures are carried out in a short time, it is necessary to be aware of the risk of FICRD. Therefore, follow-up is important, especially for patients who have radiation dose > 10 Gy [7] [31]

Although it is rare, the use of fluoroscopy affects the occurrence of dermatitis in patients who receive prolonged radiation exposure. In general, clinicians have difficulty identifying the cause of skin injuries due to fluoroscopy because these injuries are rare, and modern fluoroscopy is usually not associated with these injuries. Difficulties for doctors to recognize changes due to radiation lead to long misdiagnoses and treatment [18], [19]. Injuries induced by fluoroscopy can be recognized by the location of the injury that is congruent with the X-ray entrance and by the temporal pattern of injury about fluoroscopy. In addition, the injuries often show well-defined borders, which occur when the beam boundaries are not moved or resized in prolonged fluoroscopy [18], [19].

Some patients may be at greater risk of injury because of pre-existing medical conditions such as collagen vascular disease, diabetes mellitus, ataxia telangiectasia, or because of high radiation doses from previous procedures [16]. Good communication with patients is very important. Interviewing patients for high-risk conditions before fluoroscopy is recommended, as is counseling. Examination of the patient's skin condition should be considered for patients who have undergone examination procedures with fluoroscopy before. Further radiation from previous injuries should be kept to a minimum and the patient appropriately counseled [34]. If the procedure is prolonged or the skin dose is known to be high, the patient should be advised to examine himself or herself 2-3 weeks after the fluoroscopy procedure to look for skin changes and to contact an interventionist if any are observed. This information is not only good for patient care but also helps in quality control as it indicates when the dose level has reached a certain threshold [20], [34].

CONCLUSION

Fluoroscopy-induced radiation dermatitis is rare because the radiation dose received during

fluoroscopic procedures is usually low and does not reach the threshold required for skin injury. The use of fluoroscopy that exceeds the specified time causes the patient to get excessive radiation exposure. Fluoroscopy-induced radiation dermatitis is diagnosed by correlating the patient's history of fluoroscopy-guided procedures with the location of the skin lesions and the characteristic histologic findings. Chronic dermatitis (FICRD) occurs months to years after exposure and usually features permanent erythema and telangiectasia, skin fragility, ulceration, loss of follicular structure, late-onset dermal necrosis, and secondary skin malignancy. Repeated interventions, size and location of exposed areas, smoking, obesity, diabetes mellitus, malnutrition, thyroid disease, collagen tissue disease, autoimmune diseases, medications, and medications can increase dermatitis. Physicians involved in this type of intervention must be aware of the FICRD and be aware of radiation dose and minimize the area exposed to radiation. effective. Follow-up is important, especially for patients who have radiation doses > 10 Gy. If the procedure is prolonged or the skin dose is known to be high, the patient should be advised to examine himself or herself 2-3 weeks after the fluoroscopy procedure to look for skin changes and to contact an interventionist if any are observed. The performance of fluoroscopic systems concerning radiation dose is best characterized by the exposure to the receptor and the degree of exposure to the skin, which should be periodically assessed.

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