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Sciatic nerve injury after contact with a radioactive metal piece containing iridium-192 isotope

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Abstract

Gamma ray sources containing the iridium-192 isotope are widely used for industrial radiologic imaging. Irradiation causes biological damages and tissue injuries by the interaction of molecules in the body. The injury is correlated with the amount of energy absorbed. Peripheral nerves are more resistant to radiation injuries than other tissues because of their protected positions, low metabolic rates and low reproductive capabilities. We present here a 17-year-old male who had sciatic nerve denervation after handling a radioactive metal piece containing iridium-192 isotope that dropped accidentally from an industrial radiography machine. Although there are previous case reports of radiation injury after handling gamma ray projector inadvertently, this is the first case with sciatic nerve injury.

Keywords: Radiation injury, gamma rays, sciatic nerve

INTRODUCTION

Peripheral nerves (PNs) are more resistant to radiation injuries (RIs) than other tissues because of their protected positions, low metabolic rates and low reproductive capabilities. However, intense exposures could acutely result in transient electrophysiological and biochemical changes combined with an altered vascular permeability.[1,2] The delayed radiation effects could also be seen from: i) direct axonal injury and demyelination; ii) indirect connective tissue damage from extensive fibrosis within and surrounding nerve trunks, and iii) ischemia by injury of capillaries supplying PNs.

The X rays are the main types of waves used in medical scanning, whereas gamma rays (in particular, formed when using the iridium-192 isotope) are widely utilized for radiological imaging of large objects, such as oil pipes and aircraft wings. Negative effects of radiation in human body can be divided into deterministic (= somatic) and stochastic (= random / genetic) damages. The biological damages due to the interaction of molecules in the body with the radiation is directly correlated with the amount of the absorbed energy, it is called deterministic injuries. Several cases of deterministic RIs after direct contact with gamma projectors containing iridium-192 have been previously reported. Most of the injuries were from handling the radioisotope inadvertently, resulting in damages to the hand region and fingers.[3-7] We report here a case of sciatic nerve injury, together with the skin and muscle injuries on both hips and the left hand following contact with iridium-192 isotope.

CASE REPORT

A 17-year-old male was referred to our electroneuromyography (ENMG) laboratory for weakness in his right foot. There was a history of RI from a piece of radioactive metal piece containing an iridium-192 isotope which had been inadvertently dropped from a radiography machine used in a dam construction, 20 months earlier. He found the radioactive metal piece when working, handled and played with it with his left hand, and then carried it in his right back pocket for approximately two hours. In the same evening, he experienced nausea, vomiting, pain on both hips, and was admitted to an emergency department of a hospital. However, as the cause of the illness could not been ascertained, he was discharged after some symptomatic treatment. The diagnosis was again not made upon the admission to another hospital for dizziness on the next day. He was admitted to our hospital because of erythema and prominent desquamation in his left hand and skin of both hips (more on the right side) on the third day. After further questioning from the patient and the workplace, the history of radiation exposure was obtained and diagnosed

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of radiation injury made.

He was then hospitalized and further investigations performed. Complete blood count every 12 hours did not revealed any significant reduction in haemoglobin, lymphocyte, neutrophil and platelet counts. There was slight increase in creatinine kinase levels to 352 U/L (normal: 30-200 U/L) was observed on the second day. The estimated radiation exposure dose was 13 Gy. Prophylactic antibiotic, intravenous ethylenediaminetetraacetic acid (EDTA) infusion and hyperbaric oxygen therapy were given. However, his wounds worsened, and he was then transferred to another specialized tertiary hospital for further management. The last physical examination in our hospital just before the transfer revealed a 8 x 5.5 cm hyperemic area in the left hip skin with 1 x 5 cm and 1 x 1 cm peels on the middle of that area as a result of superficial wounds, and 13 x 10.5 cm hyperemic area on the right hip with a 1.5 x 3 cm peels in the middle of that hyperemic area. His wounds on left hand and both hips worsened on the following weeks when he was in the hospital being transferred to. Distal phalanxes of two fingers on his left hand were amputated. There was weakness in his right leg by the end of the third week. The necrotic tissues were debrided on his fingers and buttocks, and reconstruction operations including random skin flap transfer from thigh skin to both hip areas were performed after two months. The surgical debridement and random skin transfer were not so deep as to cause sciatic nerve injury.

A total loss of dorsiflexion and plantar flexion of the right ankle and toes, of knee flexion, and of foot inversion and eversion were observed on physical examination in our laboratory. Prominent muscle atrophy was present on his right lower leg. (Figure 1) Nerve conduction studies revealed loss of motor responses on tibial and peroneal nerves

Figure 1: Industrial radiography machine and its gamma ray source containing iridium 192 isotope (upper row). Images of soft tissue damage in left hand during follow-up of the patient (middle row). Prominent atrophy of biceps femoris, tibialis anterior, peroneus longus, gastrocnemius and extensor digitorum brevis muscles due to the sciatic nerve injury in the right lower leg (lower row)

and of sensory response on sural nerve whereas the conduction values in left lower extremity were normal. Muscle studies with concentric ENMG needle showed intense denervation findings on all sciatic nerve innervated muscles and voluntary contractions could not be achieved in right lower leg. (Figure 2) Spontaneous denervation activities were not observed on quadriceps muscles during resting state, and normal motor unit potentials were recorded during the voluntary contractions. The patient was then referred to our physiotherapy and rehabilitation services.

DISCUSSION

Direct contact of a radioisotope material initially causes a rash and itching at the point of exposure, it latter progress to ulceration and necrosis. This is followed by blistering and deep ulcers, after a latent phase mostly lasting several weeks, termed radiation burns. Sometimes, the tissue injury may reach underlying fascia, muscle, or bone. Increase in muscle enzymes may be a warning laboratory finding for deepening of tissue damage as in our patient. Deep necrosis on the fingers directly exposed to radioisotope often results in spontaneous or surgical amputation which was also the condition of two of the fingers of our patient.

There are a few previous reports of RI after inadvertent handling gamma ray projector. The tissue damages mostly seen on hand and fingers of regions were the site directly exposed to the radiation.[3-7] Sugiyama *et al*. in 1973 reported 6 workers having RIs after being in contact with iridium radioisotope in a shipyard, with a rather similar history as our patient.[3] The ulcers on the skin around the hip developed in two of the patients. However, there was no report of any PN injury. Annamalai *et al*. reported a case with gluteal region injury after carrying iridium containing metal piece in hip pocket for two hours as in our patient.[8] A large ulcer extending down to subcutaneous tissue occurred after two weeks, with near complete healing with a scar, but without any nerve injury at the end of one year. Milacic and Simic also reported a case that had carried the radioisotope on his left upper pocket mostly, and then put in his room inadvertently.[9] Despite the history of intensive skin changes, autotransplantation operations and deep ulcers on front wall of left thoracic girdle, different parts of both thighs and joints of both hands during the 20 years follow up, PN injury was not observed. To the best of our knowledge, our patient is the first

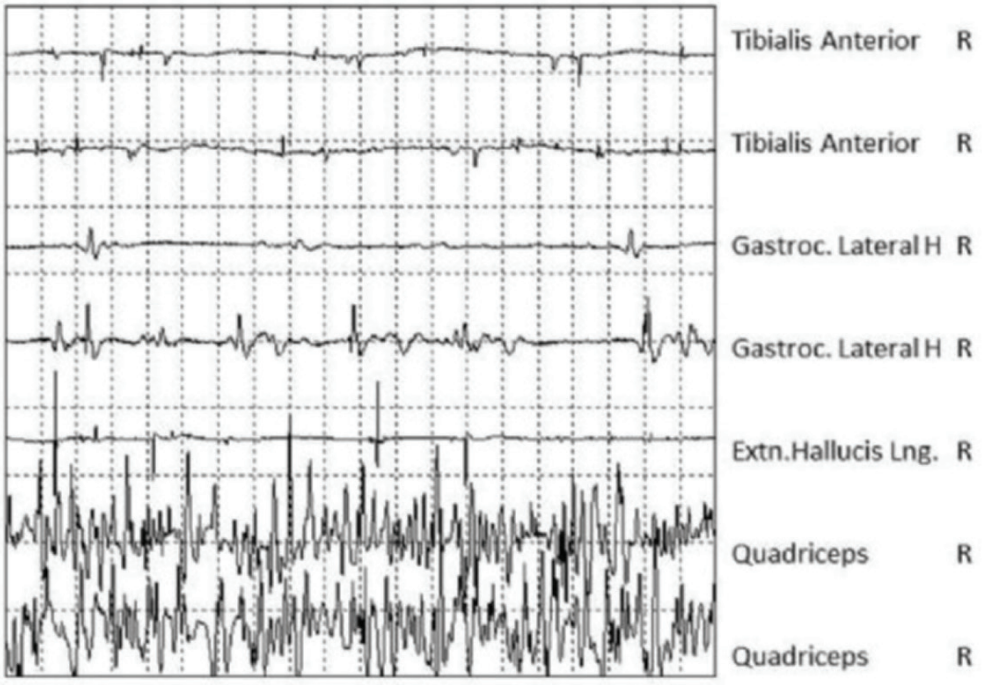

Figure 2. Traces of electromyography recordings with concentric needle electrode on right lower extremity muscles revealing spared motor unit potentials of quadriceps muscles, but spontaneous denervation activities in resting state on tibialis anterior, gastrocinemius and extensor hallucis longus muscles in which the voluntary contractions could not be elicited.

reported case with total sciatic nerve denervation following RI.

In conclusion, although the PNs are known to be more resistant to the irradiation than other tissues, intensive exposures could result in damage to PNs. Clinicians should be aware of the possibility of nerve damage which may be delayed. Early diagnosis of PN damage, and therefore prompt proper medical and surgical interventions may lead to better clinical outcomes.

DISCLOSURE

Conflicts of Interest: None

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