

Original Articles

Guidelines For Surgical Management of Radiation Injuries

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Abstract : Radiation therapy is being used with increasing frequency for treatment of cancer and other disease etiologies. Despite the benefits of radiotherapy, the resultant chronic changes may be lifelong and cumulative, which will need reconstruction with well vascularized, undamaged tissues. Ten patients (5 males and 5 females) with radionecrosis and osteoradionecrosis complex wounds were treated with myocutaneous flaps after radical debridement. The results revealed sound healing in seven out of the ten patients. Persistent sinus remained in two patients and major flap necrosis in one patient. In conclusion, the guidelines for surgical management of radiation injuries are debridement of necrotic tissues, coverage with myocutaneous flap, obliteration of dead space, rule out recurrence of malignancy, restore function, and keep in mind another solution if the first flap fail

INTRODUCTION:

Radiation therapy has become a mainstay treatment of many types of malignancy. However; radiation damage can lead to micro vascular fibrosis with thrombosis. Delay in wound healing, wound breakdown, and infection (1). The nature of tissue injury from ionizing radiation is thought to be caused by:

- 1- DNA and cell division disruption.
- 2-Generation of oxygen free radicals which has a direct toxic effect of the cell.
- 3- Destruction of stem cells necessary for both revascularization and fibroplasias (2).

Acute effects of radiation: They are characterized by an inflammatory response in rapidly proliferating tissues, such as the skin and mucosal surfaces. Most patients manifest by erythema and hyperpigmentation of the skin. Mucosal surfaces may exhibit mucositis and desquamation limited to the portal of therapy (3).

Late effects of radiation: Tissue fibrosis with irregular epidermis with pigmentary changes. Hyalinization, swelling of collagen bundles, telangiectasia, sebaceous and sweat gland dysfunction, necrosis, and the potential for tumor ogenesis is present. Radiation induced changes most often worsen with time. Areas unsightly and thus require wide resection and reconstruction (4). Over the past 30 years, the development of antibiotics, synthetic mesh, hyperbaric oxygen, and myocutaneous flaps, has enabled surgeons to reconstruct complicated defects. When confronted with a wound that has late radiation changes, the plastic surgeon first step is to rule out the

presence of a recurrent or new tumor possibly radiation induced. Diagnosis is often assisted by X ray, CT scan, MRI scan and with tissue biopsy (5). If tumor is not present, the most critical first step in management of irradiated wounds is complete resection and debridement of all non-viable irradiated tissues and foreign bodies. The extent of radiation injury often exceeds what grossly appears to be the boundary of damaged tissue. The main cause of recurrent infections, sinus tracts, and wound healing problems is retention of non-viable materials such as foreign bodies, bone, or cartilage secondary to inadequate debridement (6).When planning the reconstruction, the plastic surgeon when performing a reconstruction, irradiated muscles should be avoided, as this may result in partial or complete muscle necrosis. The transfer of a muscle whose pedicle has been irradiated may also be associated with a higher complication rate (7).

PATIENTS AND METHODS:

Ten patients with radionecrosis and osteoradionecrosis had been managed in the last 6 years by radical debridement and myocutaneous flap reconstruction, five were males and five were females, their ages ranged from 35 to 66 years. Four patients had chest wall defects, another four patients had head and neck defects, and the last two patients had groin defects. The myocutaneous flaps used were the pectoralis major, the vertical rectus abdominus, and the tensor fascialata. In one case we used the deltopectoral fasciocutaneous flap in addition to pectoralis major myocutaneous flap.

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RESULTS: (Fig1:6)



Fig (1): Osteoradionecrosis of the left cheek after radiotherapy for cancer left maxilla-radical debridement of necrosed soft tissues and bones-reconstruction with pectoralis major myocutaneous flap as an inner lining and deltopectoral flap as an outer lining-major necrosis of the inner lining had occurred postoperatively mostly due to previous irradiation of the thoracoacromial artery, the main blood supply of the pectoralis major myocutaneous flap.



Fig (2): Osteoradionecrosis of the left parotid region with exposure of the zygomatic arch and mastoid bone 8 years after radiotherapy for cancer parotid-radical debridement of necrosed soft tissues and bones reconstruction with pectoralis major myocutaneous flap post operative hyper baric oxygen was applied.



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Fig (3): Radionecrosis of the left orbital region after radiotherapy for xeroderma pigmentosa with malignant transformation into squamous and basal cell carcinoma – radical debridement and pectoralis major myocutaneous flap for coverage.



Fig (4): Osteoradionecrosis of the right pectoral region after radiotherapy for right cancer breast – radical debridement with excision of two adjacent ribs – reconstruction with contralateral vertical rectus abdominis myocutaneous flap

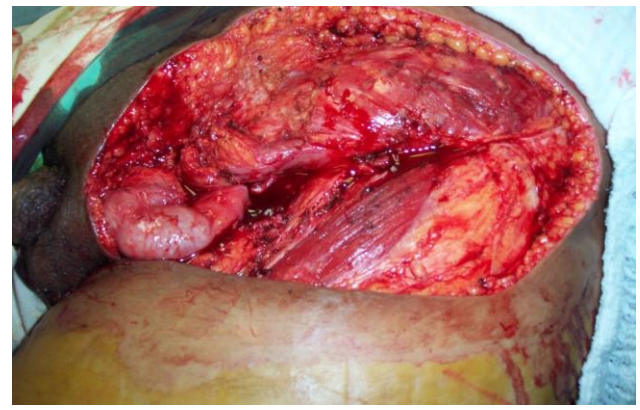




Fig (5): Radionecrosis of the left groin region after radiotherapy for malignant lymph nodes secondary to cancer urethra-radical debridement with closure by tensor fascia lata myocutaneous flap.



Fig (6) Radionecrosis of the left pectoral region after radiotherapy for left cancer breast-radical debridement with closure by contralateral vertical rectus abdominus myocutaneous flap.

DISCUSSION:

With the discovery of x-ray by Wilhelm Roentgen in 1895, ionizing radiation became a diagnostic tool and a therapeutic modality.

The goals of ionizing radiation, alone or with surgical extirpation, are local regional tumor control and functional preservation. Radiation may be delivered by external beam therapy (linear accelerators, cobalt) or by brachytherapy, with radioactive isotopes applied close to the lesion (8).

The minimal tolerance dose (TD) is defined as that dose that will create a complication in 5% of the patients at 5 years for that specific tissue (TD5/5). The organ that most reveals the effects of radiation therapy is the skin. The clinical endpoint for complications is necrosis and telangiectasia. For the muscle, the clinical myositis is the endpoint. For bones, osteoradionecrosis, pathological fracture, and growth arrest are the endpoints of radiation complications. Peripheral nerves are somewhat radioresistant. Since radiation affects cellular DNA, the risk of late malignant changes is present (9).

The use of hyperbaric oxygen in the management of poor wound healing and radiation necrosis was introduced in the mid-1980s through the creation of steep oxygen gradients which can revascularize the irradiated tissue (10).

Treatment of head and neck tumours typically employs radiotherapy. Larson et al demonstrated at least one significant complication involving bone or soft tissue in 40% to 70% of these patients. Radial forearm free flap, fibula free flap, and pectoralis major myocutaneous flap are commonly used in the treatment of radiation necrosis of head and neck tumors (11).

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Resection of chest wall lesions in previously irradiated fields also requires the transfer of well vascularized tissue. The latissimus dorsi, pectoralis major, rectus abdominis muscle or the omentum can provide the necessary tissue for adequate wound healing. The surgeon must carefully evaluate the pedicle before flap transfer and should avoid the flaps in previously irradiated fields (12). After adequate debridement of radiated tissue, a variety of muscle and myocutaneous flaps have been employed for abdominal and perineal reconstruction. The gracilis muscle, TRAM flap, tensor fascia lata, rectus femoris, omentum, and free tissue transfer (13).

In our study, pectoralis major myocutaneous pedicle flap was used in the 4 cases of head and neck radionecrosis, while vertical rectus abdominis myocutaneous flap was used in the 4 cases of chest wall radionecrosis, and tensor fascia lata myocutaneous flap was used in groin radionecrosis reconstruction in 2 cases. There was sound healing of the radiation defects in seven patients out of the ten (70%). Two patients (20%) still had persistent sinuses postoperatively most properly due to incomplete debridement of the necrotic infected tissues. Another one patient (10%) had major flap necrosis mostly due to previous irradiation of the main pedicle.

CONCLUSION:

The guidelines of management of irradiated wounds are as follows:

- 1-Establish a diagnosis to rule out malignancy and to determine the extent of tissue damage.
- 2-Thoroughly debride the radiated wound of all non-viable tissue and foreign bodies.
- 3-Coverage of the composite defect with well vascularized non irradiated myocutaneous flap.
- 4-In case of pedicled flaps, it is better to base the flap on a non-irradiated pedicle.
- 5-Obliteration of dead space.
- 6-Restoration of function.
- 7-Reconstruction of these defects is challenging with high complication rates, so always have a plan B in mind and anticipate complications.

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