C.Harshitha et al /J. Pharm. Sci. & Res. Vol. 9(12), 2017, 2332-2334

ISSN:0975-1459
Journal of Pharmaceutical Sciences and Research
www.jpsr.pharmainfo.in

Effect of Radiotherapy on the Oral Cavity

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Abstract:

Radiotherapy for tumours in the head and neck is a one of the treatment modality. A wide range of potentially debilitating dental complications may accompany the treatment. The deleterious effect of radiation causes damage not only in the oral mucosa but also on the adjacent salivary glands, bone, dentition and other associated structures of the oral cavity. These oral complications lower the quality of life and predispose patients to serious clinical disorder. In this review, we focus on the effect of radiotherapy on the oral cavity and highlight the prevention and treatment options available for these complications.

Keywords: Radiotherapy, Xerostomia, Osteoradionecrosis

INTRODUCTION:

Radiotherapy is a therapy that is largely used in head and neck cancer. It uses ionising radiation that is used to kill or damage the cancer cells thereby stop them from growing and multiplying. This treatment modality not only affects the part of the body where the radiation is directed but also the adjacent normal tissues. When radiotherapy is indicated for the head and neck region, it is imperative that the health of the oral cavity be assessed initially as well as throughout the therapy. This is due to incidence of acute or chronic nature of direct and indirect effects on the oral and related structures. Some of the complications of radiotherapy are mucositis, xerostomia, dental caries, loss of taste, trismus, infection and osteoradionecrosis.

This review describes the effect of radiotherapy on the oral cavity and highlight the prevention and treatment options available for these complications.

COMPLICATIONS OF RADIOTHERAPY

Acute and Sub Acute Complications

Mucositis

Mucositis is the most common acute side effect in head and neck radiotherapy. Mucosal damage occurs due to the decreased cell renewal in the epithelium, which causes mucosal atrophy and ulceration. Acute mucositis results from the loss of squamous epithelial cells because of radiation-induced mitotic death of basal keratinocytes. Thus, leading to a linear decrease in the number of epithelial cells. As treatment continues, there will be a steady state between death and regeneration of mucosal cells can occur because surviving cells are produced at an increased rate. The cell regeneration often cannot match with the rate of cell death thus resulting in denudation of the mucosa. [1]

Symptoms of radiation-induced mucositis include severe pain, dysphagia, anorexia and difficult speaking. The pain is so severe that it can pose difficulty in oral intake and thus greatly affect quality of life. Signs of mucositis include bleeding, erythema, ulceration and necrosis. [4]

The elimination of oral gram-negative bacilli by using lozenges of amphotericin B, polymycin E and tobramycin can prevent the onset of severe mucositis. [2] The discomfort of mucositis can be reduced with coating agents, topical anaesthetics, analgesics and systemic analgesics.[3] Aluminium hydroxide/magnesium hydroxide (milk of magnesia-Maalox) and sucralfate have been suggested as coating agents for the oral mucosa. [4]

Of all available mouth rinses that can be used as treatments for mucositis, the least costly and easiest for patients to prepare is a simple mouthwash comprising a teaspoon (10 mL) of salt and a teaspoon (10 mL) of baking soda (sodium bicarbonate) in 8 ounces (250 mL) of water. A comparison among salt and soda mouthwashes, mouthwashes prepared from lidocaine and diphenhydramine with Maalox, and mouthwashes of 0.12% chlorhexidine gluconate found that the 3 options were equally effective in the treatment of chemotherapy-induced mucositis.[5]

Xerostomia

Radiation treatment of tumours of the head and neck commonly damages the salivary glands leading to decrease in flow rate and changes the salivary composition. [6]

Several mechanisms cause radiotherapy induced salivary gland dysfunction. Initial changes result from damage to the plasma membrane of acinar cells or disturbances in intracellular signalling; later, damage may be the result of a lack of proper cell renewal because of damage to the DNA of progenitor cells and stem cells. [7] Xerostomia causes oral discomfort, an increased risk of dental caries, difficulty speaking, oral infection, dysphagia and has a detrimental effect on patient's quality of life. If at all recovery occurs, it could take years.[8] Classic free-radical generation has been associated with radiation-induced damage to salivary tissue. Antioxidants have been used to lessen some of the toxic effects of radiation in healthy cells.[9] Artificial saliva or saliva substitutes (oral rinses containing hyetellose, hyprolose, or carmellose) are purely palliative substances that relieve the discomfort of xerostomia by temporarily wetting the oral mucosa.

Mastication is a normal physiological stimulus for salivation and vigorous chewing should therefore be encouraged. Low-joule foods such as celery and carrots or sugarless gum are especially suitable. Frequent chewing of sugarless gum over a period of two weeks has been shown to increase parotid salivary output and increase the pH and buffer capacities of whole saliva. [9]

Candidiasis:

Candida species are normal commensals of oral cavity. However, an overgrowth in the mouth is considered as pathology and should be treated promptly. Oral candidiasis is commonly associated with mucositis. Colonisation of the yeast on damaged tissue can intensify the symptomatic effects of radiation. [10] Antibiotics and steroid drugs are often used when a patient receiving chemotherapy. These drugs alter the balance of bacteria in the mouth, making it easier for a fungal overgrowth to occur. [11]

Management of patients with oral pharyngeal candidiasis include both topical and systemic treatment. Nystatin topical solution has been used with mixed efficacy. Other topical solutions include clotrimazole troche which is recommended for edentulous patients and angular cheilitis. Currently, the best medication for oral or systemic candidiasis is Diflucan. The treatment regimen includes a 200 mg loading dose the first day, followed by a 100 mg /day dose for the remaining thirteen days. [11]

Bacterial infections:

Local infections can lead to sialadenitis, ulceration, abscesses, periodontitis and pericoronitis. Treatment of bacterial infections include using medicated and peroxide mouth rinses along with brushing and flossing.

Bleeding:

Radiotherapy effects on periodontal health include direct effects on the periodontium as well as indirect effects of changes in the oral microflora caused by radiation-induced xerostomia. An accelerated periodontal attachment loss and increased risk for osteoradionecrosis (ORN) associated with periodontal disease predispose to bleeding.

Gingival bleeding may be the first sign of thrombocytopenia. Patient will be unable to maintain adequate oral hygiene. In such patients, flossing can be discontinued. Chlorhexidine rinses may be required to reduce pathogens found in plaque.

Thus to conclude, a dental practitioner can collaborate with the radiation oncologist to provide a proper dental care which can reduce or relieve the deleterious effect of radiotherapy and promote the maintenance of oral hygiene.

Chronic Complication

Osteoradionecrosis

It is one of the most devastating complication of radiation therapy to the head and neck region. It is a condition of non vital bone in a site of radiation injury which may present with hypovascularity, hypocellularity and local tissue hypoxia.[12]

It may present on the skin such as thin skin, pigmentary changes, lack of hair and telangiectasis. Intraorally, the mucosa may be dry with frothy sputum following radiotherapy.[13]

This process may be spontaneous or result from trauma, leading to non healing soft tissue and bone lesions, followed by bone necrosis.

Radiation produces its deleterious effects through production of free radicals, which results in mitotic cell death. Remodelling cells like fibroblasts, osteoblasts and osteoclasts will show changes when they try to divide, such as during healing.[14]

Damage to the microvasculature results in initial hyperaemia followed by endarteritis, thrombosis and eventual obliteration. This results in the picture described by Marx as the 3 ‘H’s or Hypocellularity, Hypoxia and hypovascularity.

Trismus

Trismus is a prolonged spasm of the jaw muscles by which normal opening of the mouth is restricted. Trismus patients may experience a marked restriction of jaw movements which can hamper overall physical and mental health of the patient.

It may be a significant side-effect of radiotherapy, especially in combination with muscular tumour invasion and surgery.[16]

Following radio- therapy, trismus results mainly due to fibrosis of muscles of mastication. This fibrosis is not apparent immediately following radiation treatment but occurs progressively as mucositis subsides. Severity of trismus is dependent on the radiation source, dose and number of fields radiated.[17][18]

Correction of trismus by surgery is routinely done to eradicate postoperative sequelae. But, second surgery in cancer patients to relieve trismus is generally avoided because history of radiotherapy in the area, refusal to undergo surgery and financial constraints.[15]. Patients at risk of trismus should be put on home exercises to maintain maximum opening and jaw mobility as soon as radiotherapy begins.[19]

Long Term Complications

Radiation Induce Dental Caries

The most threatening complication for the dentition, however, is radiation-related caries. Radiation caries is a highly destructive form of dental caries which has a rapid onset and progression.[20]

Radiation caries is mainly an indirect effect of irradiation-induced changes in salivary gland tissue that result in hypo salivation, altered salivary composition, a shift in oral flora toward cariogenic bacteria (S. mutans, Lactobacillus species), and dietary changes.[16]. Prevention therefore has to be directed to the treatment of xerostomia-related complaints, meticulous oral hygiene, change of diet, control of cariogenic flora, and prevention of caries with frequent fluoride applications (Vissink et al., 2003).

ALTERATION IN DENTITION

Radiotherapy may alter dental integrity and craniofacial development.

Irradiation may also induce disturbances in odontogenesis. Abnormally small teeth (microdontia), short or blunted roots, small crowns, malocclusion, incomplete calcification, enlarged pulp chambers (taurodontism), premature closure of apices and delayed or arrested development of teeth have been reported.[22] Atrophy of underlying soft tissue, enamel hypoplasia, or incomplete calcification also can result. [21]

The most severe disturbances in odontogenesis are seen when exposure to irradiation occurs in the performative and differentiation phases rather than in the mature stages. These changes in the primary teeth can cause significant malocclusion and may adversely affect facial development.[23]

CONCLUSION

A complete and thorough understanding of the complications due to radiotherapy in the head and neck region is necessary, so as to prevent and treat the acute and chronic complications and to relieve the patients from any undue discomfort and suffering. It is the responsibility of the dental practitioner to reduce the mordacity of the patients before, after or during the course of radiotherapy.

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