CASE REPORT

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Autofluorescence image of post-radiation maxillary bone osteonecrosis in a 64-year-old patient – Case Report

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Abstract

Introduction. Maxilliary bone necrosis is often a complication which follows an oncological therapy. The radiated area often shows signs of reduced regenerative function of both soft and hard tissues, which leads frequently to the formation of open healing wounds with protruding bone tissue. The area of these wounds may be often diagnosed with necrosis. The treatment involves surgical removal of the necrotic areas. The VELscope VX, which enables a precise distinction of the necrotic and normal tissue with autofluorescence imaging, has been successfully used for intra-procedural demarcation in patients with maxillary osteonecrosis in several centres in Germany. The paper presents a case of vast post-radiation maxillary osteonecrosis in a 64-year-old patient treated surgically after autofluorescence imaging of the area with VELscope VX tool.
Conclusions. Post-radiation necrosis of the oral cavity bones should be treated surgically as this kind of treatment guarantees the best healing of the wound. The VELscope VX enables demarcation of the normal bone tissue from the necrotic areas which makes the procedure simpler and ensures the sparing of most of the healthy tissue.

Key words

Post-radiation necrosis, VELscope VX, dental surgery

INTRODUCTION

Radiotherapy is an effective tool for treating cancer of the head and neck. It can be used as a separate method or, as is more popular, in conjunction with surgery and/or chemotherapy. The state of the art treatment of early cancer stages with the use of radiotherapy has reached up to 80–90% success, which is on par with surgical treatment. Radiotherapy is recommended as the main treatment method in early stage tumours of the throat and larynx. It is used as an augmentation therapy in most cases of cancer of the oral cavity and throat, despite their early stages, and as a routine therapy in more developed tumours. The choice of therapy is dictated by the location and the stage of the tumour (according to the TNM staging system). The most popular form of radiotherapy consists of delivering a large local dose of radiation applied in small fractional doses twice a day for five days over the length of a week for 6–8 weeks [1].

Modern tools used in targeted radiotherapy and proper techniques of applying radiation enable a high rate of success while retaining the functions of the organs. However, the radiation may cause side-effects in the tissues surrounding the radiated area [2].

Osteoradionecrosis (post-radiation necrosis of bone) is more common in the area of the mandible rather than maxilla due to worse blood circulation in the former. The main symptoms of this aliment are: pain, swelling, exposure of the bone, fistulas and trismus, as well as pathological fractures. Patients often suffer from dry mouth and troubles with oral hygiene. Consumption of food also becomes troublesome. Developing a state of bacterial or fungal infections, which intensify the symptoms of acute radiation-induced reaction, may also be often observed. Radiation often causes damage or destruction of osteoblasts which results in an imbalance of the osteoid matrix and increased activity of the osteoclasts.

Fluorescent imaging is a modern supplementary diagnostic technique used for detecting abnormal tissue on the surface of mucosa in different areas of the body (gastrointestinal tract, respiratory organs, oral cavity). This method uses the phenomenon of fluorescence, which accumulates and re-emits photons with a lower energy level and longer wavelength, compared with the absorbed radiation. Human cells and tissues contain compounds capable of such emissions, which are called endogenous fluorophores (chromophores) ex. tyrosine, phenylalanine, elastine, collagen, coenzymes FAD, FMN, NADH, NADPH, flavines, porphyrins or lipofuscin [3].

The VELscope VX enables a non-invasive analysis of tissue auto-fluorescence on the surface of oral cavity mucosa in real time. The examination consists of radiating the observed surface with blue light from approximately 8–10 cm, and subsequent observation of the emitted radiation through a specialized visor. In short, observing auto-fluorescence of the tissue through the VELscope VX visor may provide information on metabolical activity of the tissue which reflects its proliferational activity [4]. Healthy mucosa is visible as spaces emitting fluorescent light (bright green areas). Pathological changes, depending on their type, level of metabolic activity and quantity of haemoglobin in the tissue, manifest as dark stains (a range of black), diagnosed as 'loss of auto fluorescence' areas. Bone tissue which is not covered by a mucoperiosteal flap, but still vital, can be seen as a bright white area strongly contrasting with its surroundings. In areas of necrotic bone, a drop in intensity of white is observed, resulting in clearly visible areas of fluorescence loss (dark spaces, black stains).

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Some researchers have discovered additional possibilities of using the Velscope VX device. Pautke et al. [5] discovered that some antibiotics with a high penetration level of the bone tissue may cause an increase in fluorescence. In treating bone necrosis induced by the use of bisphosphonate based medicaments (*MRONJ – medication-related osteoradionecrosis of the jaw)* they used derivatives of tetracycline to mark the healthy tissue. With the use of VELscopeVX for direct visualization of necrotic and vital bone they performed a surgical procedure resulting in precise, total removal of the necrotic bony fragments. Well-conducted demarcation was possible due to the fact that the antibiotics only penetrated in these areas, which were well supplied with blood circulation (healthy tissue). This issue is described in more detail in a later part of this study.

OBJECTIVE

To present a case of a 64-year-old patient with vast osteonecrosis of the maxillary process and autofluorescence imaging of the area using VELscope VX device.

CASE DESCRIPTION

A 64-year-old patient was admitted to the Oral Surgery Department of the Medical University of Lodz, Poland, to consult and treat a large pathological lesion localized on the right and central part of the maxillary alveolar process. The patient stated that the lesion occurred after a series of radiotheraphy and continued to grow for over two months with no signs of healing.

During the interview, the patient revealed that approximately two years previously he had been treated surgically at the Oncology Centre of the Copernicus Memorial Hospital, Lodz, where he had a prostate tumour surgically removed. Chemotherapy was also applied. After finishing chemotherapy, periodic health examinations were recommended. After six and 12 months, the patient had a bone scan using the 99mTc-MDP and was diagnosed with areas of accumulated radiopharmaceuticals in the bones of the facial skeleton, both shoulder joints, lateral epiphyses of humeri, sternum (several areas), ribs on both sides, numerous vertebrae and both sides of the pelvis. The examination revealed several metastases of the tumour. The second examination revealed several new areas of accumulation in the sternum and single ribs on both sides, in addition to those ones revealed previously. The patient was referred for radiotherapy and received two cycles of radiation treatment: the first consisted of 70 applications, the second had nine fractional doses. Due to the many areas of accumulation the prognosis was doubtful.

Approximately two weeks after the first cycle of radiotherapy, the patient noticed the formation of painful and non-healing wounds in the area of soft tissues of the alveolar process and left submandibular lymph nodes. The patient stated that the wounds enlarged gradually over the period of three months, which led to the exposure of bone tissue over a considerable area of the alveolar process. The condition of the patient remained unchanged over the period of 3–4 months until the patient checked-in at our clinic. During this period, the patient experienced severe pain while eating which finally led to a body mass reduction of approximately 10 kg, from 78 kg to 68 kg. The patient also stated that about two weeks earlier he started to experience throat pain and difficulties in swallowing saliva, food and liquids, which he attributed to infection of the upper airways.

Physical examination revealed sustained symmetry of the patient's face. Further examination showed no pain of the trigeminal nerve ducts. Palpation detected swelling and sensitivity of submandibular lymph nodes B and C, mobile against the layers and the skin. Intraoral examination showed many missing teeth and considerably enlarged tonsils. A large area of bone tissue devoid of mucous membrane was visible on the frontal and distal part of the alveolar process on the right side of the mouth (Fig. 1). The exposed bone was located between the left canine and left maxillary tuberosity, which was also exposed. The pathological lesion took most of the width of the alveolar process and its surface was estimated at about 5–6 cm^2. In this area, several interstitial haemorrhages were detected. The exposed bone had an irregular colour, ranging from ivory to yellow, and a lumpy surface. The patient stated that this area was highly painful during eating.

Despite targeted treatment and antibiotics the wound failed to heal, and for that reason surgical procedure was performed. Using an antibiotic premedication (Amoxicillin 500 mg and Clavulanic acid 125 mg for 2 days) in local anaesthesia with 2% lidocaine, a trapezoidal mucoperiosteal flap was formed to overlap the midline on the mesial side, approximately 5 mm over the left tuber maxillae. The periosteum was cut to enable formation of a longer flap. Using a counter angle curette and Rongeur forceps, the necrotic bone was removed. This stage of the procedure was observed and controlled with the use of VELscope VX, which at the same time enabled a clear distinction between vital bone (bright white areas) and necrotic bone (black spots on the white surface). Areas affected by microorganisms manifested in Velscope's visor as areas of yellow and red colour. They were treated as necrotic tissue and removed with a drill. After finishing this stage, the oral cavity was once again inspected using the Velscope VX. Fluorescence imaging showed an even, bright white area of the exposed bone, which confirmed the complete removal of the necrotic tissue. In the final part of the procedure, the edges of the bone were ground, periosteum cut at the base of the flap on the labial side, the sides of the flap were formed in a linear manner without much strain on the tissue, and the wound was patched-up with simple interrupted stitches. The intra-operative period was uneventful. Histopathological examination of the removed tissues confirmed chronic inflammation with bone necrosis. Follow-up visits after 24 hours, 7, 14 and 21 days showed satisfactory effects. The prognosis was good, due to the fact of complete healing of the post-surgical wound in 21 days. The comfort of the patient increased significantly, mostly because he was able to eat without experiencing any pain. Regretfully, due to the many metastases in the patient's body the overall prognosis was bad in distant perspective.

RESULTS AND DISCUSSION

The radiant energy interacts locally on the tissues and causes several after-effects. It may cause immediate local or remote damage and destruction of cells, seizure of cell division and reproduction, as well as improper cell reconstruction. The

effects vary depending on the area of radiation, dosage, fractionation, and number of cycles and period of time since the end of radiotherapy. The effects of the radiation are not limited exclusively to the tumour itself, but also to the surrounding tissues, causing several symptoms known as post-radiation reactions. They can persist several weeks, months or even years after radiotherapy [6], and are divided into early (manifesting during treatment and up to six months after the therapy) and long-term (later than 6 months after treatment). Early complications are usually treatable and last for a relatively short time provided that a proper treatment is applied quickly. Post-radiation reaction may manifest locally or throughout the whole body. The local reaction manifests only in the area exposed directly to the radiation as an erythema or mucous inflammation, evolving into a fibrosis, fistula or osteoradionecrosis. The whole body reaction may involve nausea, vomiting, high temperature or dyspepsia. Damage of the bone marrow may also occur. In rare cases a radiation-induced tumour may also be a side-effect [1].

Post-radiation reaction treatment consists mainly of local and systemic medicaments. Vitamin and steroid injections, fungicides (locally: nystatin, systemically: derivatives of imidazole) and antibiotics are used as primary therapy. A proper diet is also recommended. Products that may cause irritation to the mucous membrane are forbidden, in rare cases parenteral nutrition may be necessary. In the case of intense post-radiation reactions, the treatment is limited exclusively to analgesic therapy with opiates and anti-inflammatory treatment with the use of glucocorticosteroids.

Dische's colourimetric method is often used to classify the reaction during radiotherapy, which takes into consideration both afflictions induced by the radiation and the surface of the mucosal reaction, compared to the radiated area [7]. For the patients, the most onerous are long-term reactions. According to Ziółkowska et al. [1], treatment of these reactions is very difficult and often does not produce the desired effects. Swift implementation of the treatment considerably reduces pain caused by the after-effects of radiotherapy.

Osteoradionecrosis is usually treated surgically. In the case of acute inflammation, the procedure is limited to extraction of infected and loosened teeth, and incision and drainage of the abscesses. In cases of chronic inflammation, the areas of osteonecrosis are removed (sequestered). Non-vital bone is decorticated, resected and reconstructed if needed [8]. It should be pointed out that that necrotic bone fragments are not supplied with blood; due to this fact, antibiotic treatment of these areas proves to be ineffective, which fosters the spread of the infection. A shallow extraction of the compact bone with exposure of the marrow cavity and direct coverage with a mucoperisteal flap is called saucerisation (Obwegeser procedure). This enables the removal of all necrotic tissue, and at the same time improves the bone blood flow. The procedure is usually conducted on the mandibular bone and sporadically on the maxillary bone. A more radical procedure is the decortication, which is a complete removal of the total cortex affected with the infection. The removed area should range from 1–2 cm from the infected area to the marrow cavity.

The VELscope VX device used intra-procedurally can help to determine the necrotic areas of bone tissue in the operation field. Using this tool may facilitate the procedure and help in more precise preparation of the necrotic tissue without layer removal of large fragments of bony tissue, limiting the excision only to necrotic tissue. Pautke et al. [5, 9] and s Ristow et al. [10] were pioneers in using this technique for intra-procedural demarcation of necrotic bone in the oral cavity. They studied cases of osteonecrosis resulting from bisphosphonates intake due to oral cancer treatment. They successfully used a 10-day premedication with doxycycline solution before performing the surgical procedure, which induced fluorescence of vital bone tissue. Complete success, according to the above-mentioned authors, is the complete closure of the wound (complete healing of the flap covering the wound) and complete recovery in four weeks after the procedure. The authors state that they were able to achieve approximately 85% of successful cases, which proved the efficiency of this method. Alas, more or less 15% of patients who underwent such a procedure developed a minor dehiscence of the mucous membrane of the alveolar process (mandible). Further observation showed a gradual improvement until full healing due to pharmacological and conservative treatment. Yoshiga et al. [11] used a minocycline solution (Minocycline 200mg, once a day for 10 days) and conducted a surgical resection of necrotic areas of maxillary and mandibular osteonecrosis (after-effect of bisphosphonate treatment) with the use of VELscope VX in six cases. A full recovery was observed in 100% of the cases. Assaf et al., in a period of 18 months conducted similar research on a group of 20 patients treated with bisphosphonates, who had developed necrosis and exposure of bone tissue on the alveolar processes of both maxillary and mandibular bones. They also used a 10-day premedication with doxycycline and further surgical removal of the necrotic bone tissue with the use of VELscope VX, as well as plastic surgery of the resected soft tissues. A full recovery was observed in 19 out of 20 cases. A full recovery was also observed in the case described in the presented study. Examination made 21 days after the procedure showed complete healing of the surgical incision. This fact confirms the high success rate of the described technique in treating osteoradionecrosis.

CONCLUSIONS

Osteoradionecrosis of the jaws proves to be a hardly treatable reaction to radiotherapy of tumours of the head and neck regions. It is a chronic affliction in which necrotic bone fragments are not supplied with blood; therefore, antibiotic treatment is ineffective. In most cases, microorganisms infest the non-vital bone tissue. Patients experience severe pain and a non-healing wound makes even the most mundane activities, such as eating, a very hard endeavor. Surgical treatment consists of removal of the necrotic bone, which improves the blood circulation in the area and eliminates the area affected by microorganisms. Antibiotics are given as supportive treatment. Although therapy produces satisfactory effects, a long-term therapeutic success is difficult to achieve due to the high rate of osteoradionecrosis recurrence. The VELscope VX may prove useful for intra-procedural imaging of the areas of osteoradionecrosis and distinguishing between healthy and necrotic bone tissue. The above-mentioned tool also enables the identification of areas affected by microorganisms, which are red, orange or yellow in colour, easily distinguishable from the surrounding area, which may also be helpful in identifying the necrotic areas.

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REFERENCES

1. Ziółkowska E, Biedka M, Windborska W. Odczyn popromienny u chorych na raka regionu głowy i szyi: mechanizmy i konsekwencje. Otolaryngol. 2011; 4: 147–153.
2. Bartoszewicz R, Bruzgielewicz A, Osuch-Wójcikiewicz E, Sokołowski J, Niemczyk K. Martwica popromienna kości skroniowej. Otolaryngol Pol. 2011; 5: 85–92 (in Polish).
3. McNamara K, et al. The Role of Direct Visual Fluorescent Examination (Velscope) in Tumor Margin Delineation and Routine Screening for Oral Cancer. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010; 110(6): 18.
4. Milner P, Grzesiak-Janas G. Urządzenie VELscope VX do wykrywania nieprawidłowości na błonach śluzowych jamy ustnej. Zasada działania i zastosowanie. Twój Przegl Stom. 2013; 9: 62–67 (in Polish).
5. Pautke C, Bauer F, Otto S, et al. Fluorescence-Guided Bone Resection in Bisphosphonate-Related Osteonecrosis of the Jaws: First Clinical Results of a Prospective Pilot Study. J Oral Maxillofac Surg. 2011; 69: 84–91.
6. Wygoda A, Składowski K, Sąsiadek W, Hutnik M. Ostry odczyn popromienny błon śluzowych u chorych na raka regionu głowy i szyi. Współczesna Onkol. 2007; 4: 210–219 (in Polish).
7. Goleń M, Składowski K, Wygoda A, Przeorek W, Pilecki B, Syguła M, Kołosza Z. Ocena wzajemnych korelacji pomiędzy objawami późnego odczynu popromiennego u chorych na nowotwory głowy i szyi leczonych promieniami. Rep Pract Oncol Radiotherapy. 2003; 2: 248–249 (in Polish).
8. Sporniak-Tutak K, Myśliwiec L. Zapalenia kości szczęk – stały problem kliniczny. Czas Stomat. 2006; 2: 100–109 (in Polish).
9. Pautke C, Tischer T, Haczek C, et al. Polychrome labelling of bone using different tetracyclines and spectral image analysis. Int Journ Oral Maxillofac Surg. 2007; 11: 1032.
10. Ristow O, Pautke C. Auto-fluorescence of the bone and its use for delineation of bone necrosis. Int J Oral Maxillofac Surg. 2014; 43: 1391–1393.
11. Yoshiga D, Sasaguri M, Matsuo K, et al. Intraoperative detection of viable bone with fluorescence imaging using Visually Enhanced Lesion Scope in patients with bisphosphonate-related osteonecrosis of the jaw: clinical and pathological evaluation. Osteoporos Int. 2015; 03/06, DOI 10.1007/s00198-015-3096-z.
12. Assaf A, Zrnc T, Riecke B, et al. Intraoperative efficiency of fluorescence imaging by Visually Enhanced Lesion Scope (VELscope) in patients with bisphosphonate related osteonecrosis of the jaw (BRONJ). J Maxillofac Surg. 2014; 42: 157–164.