Oxygen, Hyperbaric Oxygen and Ozone as Therapeutic Agents in Oral and Maxillofacial Surgery: literature Review

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Abstract

Medical consideration in the surgical specialties such as Oral and Maxillofacial Surgery, in the form of prescribing medications for some diseases, preoperative preparation, post operative care and follow up, is an important and integrated part in management of surgical patients, Oxygen as the drug plays key role in treatment of surgical patient, and contributes strongly in treatment of major trauma, shock, sepsis; perioperative and postoperative considerations and in patients with various other medical comorbidities.

In this review we discussed the oxygen therapy as well as hyperbaric Oxygen in addition to the Oxygen with the 3 atoms, namely Ozone, in oral and Maxillofacial Surgery specialty.

Keywords: O 2 , supplement, adjunctive therapy, HBO, OZONE, osteonecrosis, Medication related necrosis

1- O 2

Oxygen therapy is the administration of oxygen at concentrations greater than that in ambient air (20.9%) with the intent of treating or preventing the symptoms and manifestations of hypoxia, which includes agitation, personality change, nausea, headache, tachycardia and cyanosis 1

Administration of supplemental oxygen is an essential element of appropriate management of many conditions including, major trauma, shock, sepsis; perioperative and postoperative considerations as well as for patients with various other medical comorbidities 2

1-1 In general anaesthesia on daily base surgery

Oxygen supplement use For Maintenance of routine anesthesia, during the induction as Preoxygenation is well accepted practice 3 as well as in post operative recovery, most postoperative surgical patients routinely receive supplemental oxygen therapy to prevent hypoxemia, and furtherly prevent its deleterious effects (arrhythmias, myocardial ischemia, and cognitive dysfunction), with its lately effect on the tissue oxygenation which will affect the tissue healing and the immune system ( Oxidative killing by neutrophils was impaired at low oxygen tensions often found in wounds) 4 to the degree that may precipitate infection 5 the goals of postoperative oxygen therapy should be to maintain normoxemia and avoid unnecessary oxygen administration

Causes which may precipitate postoperative hypoxemia are:

- Anaesthetic factors such as alveolar hypoventilation, ventilation/perfusion mismatching,
- Decreased cardiac output,
- Shivering (increased oxygen consumption) 6 (induced by volatile agents or recovery from intra-operative hypothermia).

Also, ‘diffusion hypoxia’ may transiently contribute to early hypoxemia as a result of the very soluble nitrous oxide diffusing out of the circulation into the alveoli when anesthesia is terminated, reducing the concentration of oxygen in the alveolar gas. 1

1-2 FOR Trauma patient

Supplementary oxygen is widely used for trauma patient in both prehospital, initial phase of treatment, as well as hospital phase. 7

Blood loss is one reason that can lead to hypoxia in trauma patient, due to the Low intravascular volume resulting in poor oxygen transportation, 8 which may necessitate administration of supplemented oxygen, and indeed supplementary oxygen will be simultaneously with the correction of the causative factors of hypoxaemia.

At a hospital level, the supplementary oxygen is needed at the time of operation for the correction and surgical treatment of the trauma. 3

Both hypoxaemia and hyperoxaemia may be harmful, so using O 2 should be use cautiously
1-3 space infection, and/or septic patient

Airway obstruction represent a serious and dangerous manifestation in some space infection in the head and neck region such as parapharyngeal spaces, lateral pharyngeal spaces, and obviously Ludwig's angina, with the hypoxia as the final predicted result.  

By using the principle of treating the underline cause, the main concern should be directed to the correction of this obstruction. Oxygen is a treatment for hypoxaemia, not breathlessness. nevertheless, still the supplementary oxygen has got a role in the management of such cases  

On the other hand, there is an important role for supplementary Oxygen, if this infection progress to septic shock  

Sepsis is a common reason for ICU’s admission  

2-Hyperbaric Oxygen;

HBO therapy is a therapy based on the inhalation of 100% pure oxygen intermittently in a completely closed pressure chamber, at pressures higher than 1 atmosphere, from ambient air, by mask or by endotracheal tube  

The pathophysiology of ORN is best illustrated by the "3 H" principle which describes the effect of radiation on tissue as presented by Marx  

Hyperbaric oxygen therapy (HBO) is an effective adjunctive therapy for chronic osteomyelitis and osteoradionecrosis and can also be used for the treatment of MRONJ  

2-1- Osteoradionecrosis (ORN)

is a dreaded complication of the use of radiation therapy in the treatment of head and neck cancer  

Ozone therapy was introduced in the list of approaches to treat MRONJ in 2012  

The incidence of osteonecrosis in oncology patients treated with high doses of radiation (1% to 15%).  

Hyperbaric Oxygen therapy (HBOT) for treatment of radiation -damaged tissues was introduced in the early 1970.  

There is a role of HBO in both treatment and prophylaxis of osteoradionecrosis(ORN)  

Although still considered controversial by some, hyperbaric oxygen (HBO) therapy used as an adjunctive therapy for ORN has been associated with improved success rates  

There is wide consensus on the use of prophylactic HBO in prophylaxis of mandibular osteoradionecrosis, still there is a lack of knowledge about the indications for HBO in ORN and, whether the stage of ORN also plays a role in the efficacy of HBO  

2-2 In Medication related necrosis

Medication-related osteonecrosis of the jaw (MRONJ, new nomenclature replacing bisphosphonate-related osteonecrosis of the jaw [BRONJ]) is one of the major complications after tooth ex- traction in patients using bisphosphonates (BPs)  

Microscopically, MRONJ as a condition that causes depletion of osteoclast activity and function, which is affect the bone turnover and wound healing  

HBO is not yet widely considered an efficient treatment for MRONJ as there are a lack of Randomized Control Trials (RCT) on its action.  

3-Ozone

Ozone (O$_3$), a gas discovered in the mid-nineteenth century is a molecule consisting of three atoms of oxygen in a dynamically unstable structure. It is an atmospheric gas (O$_3$) founded in the Earth’s stratosphere with excellent medicinal properties, and minimally invasive therapy, including antimicrobial activity, immunostimulant and antioxidative  

Medical O$_3$ ’s effectiveness has been well-documented, with minimal side effects, in treating the infection, by its ability to Inactivate bacteria, viruses, fungi, yeast and protozoa:  

It was suggested that the effects of ozone are cumulative, so the repeated therapies are recommended  

There is 3forms for the Ozone in the medical field: gaseous, water (ozonated water), and oil  

Ozone can accelerate Post extraction socket healing and more over can act as analgesic and as antibiotic with its antibacterial activity  

3-2- In osteonecrosis

There is a wide variation in recommendations and guidelines in international literature for the treatment of osteoradionecrosis. The benefits of using ozone as stimulation of local revascularization through the enhancement of angiogenesis and fibroblasts, there is promising result in treatment of osteoradionecrosis as well as the prophylaxis  

3-3- In medication related necrosis

Ozone therapy was introduced in the list of approaches to treat MRONJ in 2012  

The O$_2$ /O$_3$ therapy with and without the debridement with piezoelectric surgery represents a promising approach to improve the treatment of BRONJ and therefore the life quality of the patient  

It acts as Coadjunct therapy with promising result  

3-4 In Temporomandibular joint disorder

TMDs are commonly treated in a conservative fashion, accordingly emerging of ozone minimally invasive with its all properties as analgesic and antibacterial is let it more than welcoming for the treatment of TMD,  

It was found that Ozone gas injection for treatment of internal derangement of the TMJ has a better outcome in comparing with other therapy nonsteroidal anti-inflammatory drugs and muscle relaxants  

On the other hand, there is effectiveness of bio-oxidative ozone therapy in the TMD of muscular origin  

The O$_2$ /O$_3$ therapy has a low biological and economic impact thus representing a valuable therapeutic approach that could be consideredImplemented as the mainstream therapy for
Conclusion
Medical aspect in treatment of patients is being hand in hand with the surgical part in oral and maxillofacial surgery, before surgery the patient needs to be medicated as part of preparation for the surgery and then for optimal result, the wound healing is an important factor for satisfying surgical result.

Oxygen as a drug play important role before, during and after any surgical procedure.

Both Hyperbaric oxygen and Ozone have been used as adjunctive therapies before or after the surgical treatment of osteoradionecrosis and Medication related necrosis.

Hyperbaric oxygen and Ozone (oxygen with 3 atoms) constitute application of the modern science at the medical field assisting in healing in many cases.

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