CRYOTHERAPY- A NOVEL TREATMENT MODALITY IN ORAL LESIONS

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ABSTRACT

Cryotherapy is the deliberate destruction of tissue by application of extreme cold. It is well accepted by patients due to lack of discomfort, the absence of bleeding and minimal to no scarring after healing. It has numerous applications in the field of oral medicine and oral pathology. It is of great use in patients for whom surgery is contra-indicated due to either age or medical history. This article gives a brief outline on the physical principles, mechanism of action and applications of cryotherapy in the treatment of oral lesions.

Keywords: Cryotherapy, Oral lesions, Oral medicine, Cryogens.

INTRODUCTION

Cryotherapy is derived from the Greek word “kryos” means frost [1] hence cryosurgery is local destruction of tissue by freezing. Local application of low temperature was first used by Egyptians for pain relief when during French American war for amputated limbs[2]. James Arnott (1851) was the first to report and demonstrate this freezing therapy by using a mixture of salt and ice in malignant disease[3]. Initially its use was limited to oral cavity and lips then expanded over benign skin growth like viral warts, skin tags, verrucae, seborrheic warts and solar keratoses etc [5]. Any biological tissue subjected to temperature below -20 degree centigrade will undergo cryogenic coagulation and necrosis [4].

Principles of cryotherapy[5]

The physical principle behind cryotherapy is based on Joule-Thompson expansion which enables substances to undergo a drop in temperature when moved from a high pressure area to a lower pressure area[6]. When nitrous oxide is released from the high pressure inside the cryoprobe to the lower pressure cryotip, there will be drop in temperature which results in freezing of the tissues. Cryotherapy is a multistep process involving rapid cooling, slow thawing and repetition of the freezing process to enhance tissue destruction[7]. The biophysical changes in tissue due to cooling are vasoconstriction which reduces bleeding, decreases secondary hypoxic injury, inflammation, fluid retention due to inflammation thereby reducing edema and increases pain threshold. When tissue temperature is reduced and maintained in the same temperature for more than 15 minutes it causes cold induced vasodilatation followed by initial vasoconstriction. The vasodilatation is due to release of substance “H” a substance similar to histamine this is again followed by vasoconstriction which is attributed to flow of warm blood in the area. This cycle keeps repeating continuously and is known as “hunting response”. The peripheral nerves will undergo an impeded or blocked synaptic transmission due to altered transmembrane ionic flow which results in altered conduction velocity and synaptic activity. Cold facilitates alpha-motorneuron activity and decreases gamma-motorneuron firing and this property reduces spasticity temporarily.

Mechanism of tissue death[8,9]

Tissue death during cryosurgery depends on various factors like apparatus used, physical nature of tissue being treated, distance of cryoprobe, rate and degree of cooling [10]. There can be direct or indirect effect on the tissue.

Direct effect

1. Ice crystal formation: Rapid cooling causes formation of ice crystals from intracellular and extracellular fluid resulting in physical disruption of cell [8,9].

2. Cellular dehydration and electrolyte disruption: Initially during freezing the extracellular fluid alone forms ice which is limited by intracellular fluid and there is increase concentration of electrolyte in the extracellular fluid this causes movement of intracellular fluid to extracellular spaces where they again form ice crystals. This results in dehydration of cell, cell shrinkage, intracellular increase in electrolyte which is toxic to the cell and all together causes cell death.

3. Thermal shock: Damage of cell membrane due to freezing occurs and this alters cell permeability leading to cell death.

4. Enzyme inhibition: Each enzyme requires particular temperature for their functioning which when altered prevents their function.

5. Effect on proteins: During the phase after cooling when the cells return to normal temperature imbibes more water as it has high concentration of electrolyte which result in swelling and rupture[11].

Indirect effect

1. Vascular effect: Ischemic necrosis results due to vascular thrombus and micro-thrombusformation[12].

2. Immunological effect: Massive release of pathological cell antigen occurs making them susceptible for host surveillance mechanism.

Cryolesion dimension

Cryolesion dimensions are dependent upon three variables: the temperature of the cryo tip, the period of contact and the area of contact between the tip and tissue[6]. Temperature of the probe tip contributes to the size of the freeze-ball and velocity of freezing within cells.

Methods of cryotherapy

There are two systems and both require a cryogen. Liquid nitrogen(-191°C), nitrous oxide (-81°C). Carbon dioxide (-79°C) are the commonly used cryogens.

1. Open system: It involves direct application of liquid nitrogen and carbon dioxide by cotton pellets or as spray, the heat is released by vaporization due to drop in temperature. Used when no control over depth is required [7,13].

2. Closed system: This is based on three principles thermo electric, evaporative and Joule Thomson effect. Used when depth orientation is required [2].

Factors influencing cryotherapy[10]

1. Type of apparatus
Cryotherapy is an effective treatment method for a variety of lesions of the head and neck region. It is advantageous over surgery and is well accepted by patients. It can be used right from infants to elderly. It is inexpensive, safe and less painful. Many a times it is used when the conventional therapy either fails or is contraindicated. But unless the physician is confirmed of the diagnosis and volume of lesion it is not advisable to use it.

REFERENCES