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Review Article

CRYOTHERAPY- A NOVEL TREATMENT MODALITY IN ORAL LESIONS

[1]SYED NAYEEMA, [2*]DR. M. SUBHA

Department of Oral Medicine and Radiology, Saveetha Dental College and hospital, 162, Poonamalle High Road, Velapanchavadi, Chennai-600077. Email: doctorsubha@gmail.com

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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 andapplications 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, then during Franco-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, seborrhoeic warts and solar kurtosis etc [3].Any biological tissue subjected to temperature below -20 degree centigrade will undergo cryogenic coagulation and necrosis [4].

Principles of cryothearpy[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 whichreduces 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 factorslike 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 cryothearpy

There are two systems and both require a cryogen. Liquid nitrogen(-191°), nitrous oxide (-81°), Carbondioxide ((-79°) 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 thermoelectric, evaporative and Joule Thomson effect. Used when depth orientation is required[2].

Factors influencing cryotherapy[10]

1. Type of apparatus

2. Coolant used
3. Temperature achieved
4. Duration
5. Number of cycles
6. Volume of tissue
7. Type of tissue

Cryo therapy in oral lesions[9,14]

1. Vascular malformations: The lesion resolves completely without scar in most cases. Two freeze thaw cycle for 1 ½ minute each is given.Nevus is emptied by compression using probe. Strawberry nevi which will have bleeding and ulcerations are managed effectively. Capillary nevi also respond well. Moderately fibrous lymphangioma is less responsive but when treated along with surgery it is effective.
2. Leukoplakia: Thick irregular plaques are planed with surgical blade the moistened with saline and then frozen. Two freeze thaw cycle for 1 ½ minute each is used[2]
3. Hyperplastic lesions: It acts as an alternative to excision or cautery. Papilary hyperplasia, fibrous epulis, viral wart and polyps can be treated.[2]
4. Mucous cyst: They respond without recurrence and scarring hence well accepted[15].
5. Facial pain: A reliable, prolonged nerve block can be achieved. Cryoanalgesics help in chronic facial pain[16].
6. Temperomandibular joint pain: Cryoneurotomy can be done when all conventional modalities of treatment fails[17].
7. Oral Cancer: Used for recurrent and persistent lesions and also for patients who are unfit for other treatment modalities. Also helps in management of radiation mucositis.

Healing after cryotherapy

The epithelial basal layer is severely damaged aftercryothearpy, whereas the parabasal and intermediate layers of epithelium are affected less. Re-epithelialization occurs within 7–12 days in the mouth and 10–20 days on the skin[5]. Bone gets devitalized by cryotherapy and the dead bone acts as a segmentfor future bone growth. Only cells in cortical bone may undergo death, cells deeper in the marrow cavity may survive to promote growth[5].Cartilages are not affected by cryotherapy. Freezing to -30ºC close to a developing tooth causes death of ameloblasts and odontoblasts, but the cellular components are replaced within two weeks. [18].

Advantages[19]

1. Minimal or no pain.
2. Less discomfort no hospitalization is required.
3. Predictable, low tissue damage.
4. Minimal or no scarring.
5. Can be an adjunctive therapy with surgery or radiation therapy in malignancy.
6. Safe, easy to perform, inexpensive.

Disadvantages[10]

1. Healing is slow.
2. In lesions of the tongue the procedure can limit its function.
3. Volume of lesion can be beyond capacity
4. Extensive lesions are difficult to treat.

Contraindications[10]

1. Cold urticarial, patient develop redness and swelling in the skin
2. Cryoglobulinemia, abnormal blood protein results in gel formation resulting in ischemia or gangrene
3. Raynaud's phenomena
4. Paroxysmal cold hemoglobinuria,hemoglobin is released from lysed red cells and is excreted in urine
5. Peripheral vascular disease
6. Patients undergoingimmunosuppressive therapy

CONCLUSION

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

1. Reade PC. Cryosurgery in clinical dental practise.Int Dent J 1979;29:1-11.
2. Leopard PJ. Cryosurgery and its applications in oral surgery. Br J of Oral Surg 1975;13:128-52.
3. Ravi Narula, BhavnaMalik.Indian Journal of Dental Sciences 2012;2(4):63-66.
4. Poswillo DE.A comparative study of effects of electrosurgery and cryosurgery in management of bening oral lesions. Br J of Oral Surg 1971;9:1-7.
5. CS Farah, NW Savage. Australian dental journal2006;52:9(1):2-5.
6. Orpwood RD. Cryosurgical apparatus. In: Bradley PF, ed , Cryosurgery of maxillofacial region. Vol.1.Boca Raton, Florida: CRC Press, 1986.
7. Salmassy DA, Pogrel MA. Liquid Nitrogen Cryosurgey and immediate bone grafting in the management of aggressive primary jaw lesions. J Oral MaxillofacSurg 1995:53:784-790.
8. Jackson A, Colver G, Dawber R. Cutaneous cryosurgery. Principles and clinical practice. London: Martin Dunitz:1992.
9. Kuflik EG, Gage AA. Cryosurgical treatment of skin cancer.Newyork: Igaku-Shoin: 1990.
10. Ashok Bansal, Shivani Jain, Shipra Gupta. IJDR2012: 23(2);297.
11. Sheperd J, Dawber RP. The historical and scientific basis of cryosurgery. ClinExpDermatol1982;7:321-8.
12. Gill W, Fraser J Da Costa J, Beazley R. The cryosurgical lesion. Am Surg 1970; 36:437-45.
13. Pogler MA. The use of liquid nitrogen cryotherapy in locally aggressive bone lesions.J oral and maxillofacSurg1993;51:269-273.
14. GrahamG.Cryosurgery for bening, premalignant and malignant lesions.In: Wheeland RG, editor. Cutaneous Surgery. Philedelphia:Saunders; 1994.
15. Toida M, Ishimaru JI, Hobo N. A simple cryosurgical method for treatment of oralmucosal cyst. J Oral and MaxillofacSurg1993;22:353-5.
16. Bradley PF, Fisher AD.The cryosurgery of bone. An experimental and clinical assessment. Br J Oral Surg 1974; 13:111-27.
17. Goss AN. Cryoneurotomy for interactable TMJ pain. Br J Oral MaxillfacSurg 1988;26:26-31.
18. Pogrel MA. The management of lesions of the jaw with liquid nitrogen cryotherapy.J Calif Dent Assoc1995; 23:54-57.
19. Ishida CE,Ramos-E-Silvia M. Cryosurgery in oral lesions.Int J Dermatol1998;37:283-5.