Otolaryngology online journal

ISSN: 2250-0359 Volume 4 Issue 1.5 2014

# Coblation the physcis behind it

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Introduction:

The technology of using plasma to ablate biological tissue was first described by Woloszko and Gilbride [1]. By their pioneering work in this field they proved that radio frequency current could be passed through local regions of the body without discharge taking place. Radio frequency technology for medical use (for cutting, coagulation and tissue dessication) was popularized by Cushing and Bovie [2]. Cushing an eminent neurosurgeon found this technology excellent for his neurosurgical procedures. First use of this technology inside the operating room took place on october 1st 1926 at Peter Bent Brigham Hospital in Boston, Massachusetts. It was Dr Cushing who removed a troublesome intracranial tumor using this equipment.

Coblation is non-thermal volumetric tissue removal through molecular dissociation. This action is more or less similar to that of Excimer lasers. This technology uses the principle that when electric current is passed through a conducting fluid, a charged layer of particles known as the plasma is released. These charged particles has a tendency to accelerate through plasma, and gains energy to break the molecular bonds within the cells. This ultimately causes disintegration of cells molecule by molecule causing volumetric reduction of tissue.

Medical effects of plasma has spurred a evolution of new science “Plasma Medicine”. It is now evidently clear that Plasma not only has physical effects (cutting and coagulation) on the tissues but also other beneficial therapeutic effects too. Plasma not only coagulates blood vessels but also decontaminates surgical wound thereby facilitating better wound healing. Therapeutic application of plasma assumes that plasma discharges are ignited at atmospheric pressure.

Plasma Medicine:

This field of medicine can be subdivided into:

1. Plasma assisted modification of biorelevant surfaces

2. Plasma based decontamination and sterilization

3. Direct therapeutic application

Plasma assisted modification of biorelevant surfaces:

This technique is used to optimize the biofunctionality of implants, or to qualify polymer surfaces for cell culturing and tissue engineering. For this purpose gases that do not fragment into polymerisable intermediaries upon excitation should be used. Gases that do not fragment include air, nitrogen, argon, oxygen, nitrous oxide and helium. Exposure to such plasma leads to new chemical functionalities.

Plasma based decontamination and sterilization:

Not all surgical instruments can be effectively sterilized using currently available technologies. This is due to the fact that plastics cannot be effectively be sterilized by conventional means as it could get degraded on exposure to steam and heat. Plasma discharges have been found to be really useful in this scenario because of its low temperature action. The nature of plasma actions on bacteria extends from sublethan to lethal effects. Sublethal effects cause bacteriostatic changes, while lethal effects cause bacteriocidal changes.

Direct therapeutic application:

This is purely surgical application both in otolaryngology and orthopaedic surgeries. Plasma is used to ablate tissue with minimal bleeding.

A broad spectrum of plasma sources dedicated for biomedical applications have been developed. These include:

1. Plasma needle [3]

2. Atmospheric pressure plasma plume

3. Floating electrode dielectric barrier discharge

4. Atmospheric pressure glow discharge torch

5. Helium plasma jets

6. Dielectric barrier discharge

7. Nano second plasma gun

Figure showing plasma needle.  The glow is cold enough to be touched

Dielectric barrier discharge:

This is the technology used in therapeutic coblators.  This is characterised by the presence of atleast one isolating layer in the discharge gap [4] .

Image showing coblator wand with three electrodes separated by ceramic

For effective use of this technology for surgical procedures the plasma generated by the wand / electrode should be uniform.[5] The uniformity of plasma can be ensured by:

1. Increasing preionization of the gas thus ensuring generation of more avalanches

2. Shortening of voltage rise time

Therapeutic applications of plasma:

Plasma treatment is known to cause coagulation of large bleeding areas without inducing additional collateral tissue necrosis. Other methods causing coagulation act thermally producing a necrotic zone around the treated spot. Non thermal coagulation is caused due to release of Na and OH ions which causes release of thrombin.

Coblation technology is widely used in the field of otolaryngology for performing:

1. Tonsillectomy

2. Adenoidectomy

3. UPPP

4. Tongue base reduction

5. Turbinate reduction

6. Kashima procedure for bilateral abductor paralysis

7. Papilloma vocal cords

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