Chemical Ablation of the Submucosal Tissue in Volumetric Reduction of Inferior Turbinate

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Throughout the years, minimally invasive methods have gained ground when considering the surgical field. Most of all, these techniques are used in tissue ablation as they associate less operative and postoperative bleeding, high rate of recovery, as well as minimal scaring. One of these minimally invasive methods refers to the use of chemical ablation or coblation when regarding tissues ablation, thus using a chemical reaction based technique despite the regular use of mechanical or thermal interactions in order to achieve tissue ablation. Widely used in the area of ENT surgery, coblation could easily be defined as an extremely effective technique in dealing with the submucosal tissue in volumetric reduction of inferior turbinate. Different length and angulation probes ensure the applicability of this technique to better correlate with any anatomical variants and local features of the targeted structures to be ablated. Although the duration of surgery by using this method is slightly higher than with the use of other inferior tubinate volumetric reduction techniques such as radiofrequency or use of the shaver, the low degree of postoperative discomfort and the good local hemostasis provided by this technique are markers that support its elective use if it is available for the surgeon.

Keywords: chemical ablation, inferior turbinate volumetric reduction, coblation, controlled ablation, minimally invasive

In the past 10 years ENT surgery has embraced the technological revolution of the surgical area widely using minimally invasive techniques and highly adapting them for every inch of the head and neck department without second guessing.

Whether the discussion marks tonsillectomy, adenoidectomy, ablation of certain tumors or the submucosal tissue in volumetric reduction of inferior turbinate, tissue ablation is targeted as the basic principle and requires the adoption of a method by which it can be efficiently achieved without significant side effects[1].

The classical approach used cold instruments that could lead to high risk of bleeding or postoperative discomfort, as well as an associated degree of local edema, pain and, furthermore, scaring due to the use of different techniques of hemostasis such as the use of cautery that is based on a thermic local reaction or even considering the idea abusive and intempestive use of local packing in massive antero-posterior bleeding.

Thus, empirically mentioning, another side-effect needed to be considered is the possible traumatic experience of the patient gained through long recovery periods correlated with the need for analgesia [2].

Minimally invasive methods have developed among various surgical adapted skills a wide variety of instruments that ensure the adaptability of the technique and fitting it to a required intervention. The purpose is to create an instrument that achieves instant hemostasis, with minimal or no surrounding tissue damage, while efficiently defining tissue ablation. In the past few years a certain technology trying to hold the described features has been developed and is based on a chemical reaction with the tissue needed to be ablated, coblation [3].

ArthroCare Company created this technology and at the beginning it was designed for surgical branches such as gynecology, urology and orthopedics. Soon after the producing company designed coblation probes suitable for other surgical areas, such as ENT, and they immediately started being on a high scale used due to their efficient controlled ablation and hemostasis, both effects being achieved at low temperatures as well as defining the same surgical action [4].

Adenoidectomies and tonsillectomies were the first to be targeted by the use of controlled ablation in the ENT field, but shortly the submucosal tissue in volumetric reduction of inferior turbinate, during functional interventions, became of interest to be chemically ablated using the mentioned method.

Several studies evaluating the benefits of this method highlight it be a superior and trustworthy practice with a decreased degree of postoperative bleeding, pain and discomfort in comparison to other acknowledged methods [5].

Regarding its use for the ablation of submucosal tissue in volumetric reduction of inferior turbinate a shorter recovery period is described as well as the lack of nasal packing usage [6].

Controlled ablation was also used with success for selected cases of benign and malignant tumors, due to its simultaneous hemostatic and ablative role, but further studies need to be developed in other to assess the superiority of methods in term of postoperative recurrence. Nevertheless, this area of interest is still open to research in order to establish the *when's* and *how much's* of the discussed technology.

It is also worth mentioning the role of controlled ablation in sleep surgery management, as it can help in safely achieving several types of interventions from this area, with low degree of bleeding, at low temperatures and a short recovery period [7].

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The use of coblation in the ENT practice has become an appreciated alternative, although it associates higher equipment costs and may take longer than some other used methods, but its already proven advantaged ensured an extension of the indications for use of this method throughout the past few years.

Experimental part

Coblation or controlled ablation is a technique of surgical tissue dissolution using a radiofrequency plasma based device with the help of a conductive saline solution.

At the time the current from the generator is transmitted within the coblation probe it passes the saline solution and so chloride and sodium ions are obtained. These ions have an energy that is enough to determine the appearance of a plasma field which will disrupt the molecular links of the organic matter and determine the ablation of the interested tissue. A lower energy than the one previous needed also determines the formation of a plasma coverage but in this case the suitable purpose for its use is for coagulation.

Depending on the amount of energy produced by the generator (100-500 kHz), the coblation wand can be used for coagulation, ablation or tissue reduction purposes. As the amount of energy increases, plasma field is obtained but even so minimum tissue necrosis is determined in case of tissue ablation. Local temperature maintains itself low and varies between 40-70 degrees Celsius. The plasma field generates H and OH ions that determine protein degradation thus having a destructive action and explaining the base principle behind controlled ablation method.

The coblation method is defined by several stages as following: a decrease in heat emission and an increase of surface temperature, pulsation of the vapor film as tissue ablation is performed, followed by a decrease in amplitude of electrode's currents with dispersion of energy on the electrode's surface and the dissipation of heat as elements recombine[8]. Thus, minimum damage to the surroundings of the ablated tissue is obtained.

Studies comparing coblation with techniques using radiofrequency such as electrocautery and other electrosurgical devices showed that controlled ablation gains its superiority and good outcomes by functioning at lower temperatures, having a greater precision and maintaining the tissue's quality all throughout the procedure [9].

As from our clinic's experience, Prof. Dr. D. Hociota Institute of Phonoaudiology and Functional ENT Surgery, we have been successfully using this technology for several kind of surgical procedures, but we have shown a great interest in making use of it when taking into discussion the surgical approach of the inferior turbinates (fig. 1).

We gathered here informations with the purpose of presenting our experience in this field of interest, highlighting both the advantages and limitations of the method.

Functional inferior turbinate surgery using controlled ablation can imply either performing a submucosal turbinectomy or a volumetric reduction of the inferior turbinate, depending on the type of coblation instruments used.

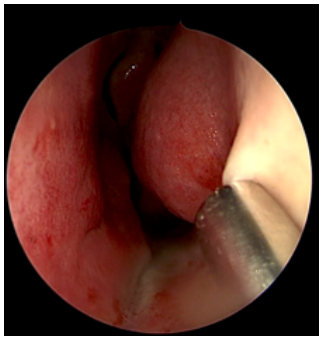

Fig. 1. Nasal Inferior turbinate hypertrophy

Submucosal turbinectomy defines volumetric reduction of the inferior turbinates by vaporizing the submucosal vascular network of the lower nasal turbinate using coblation wands. It is indicated in mucosal hypertrophy of the nasal inferior turbinate and the method is not efficient if the bony part of the turbinate is the hypertrophic one.

This procedure can be performed within under general anesthesia, within more complex surgical interventions or under local anesthesia with sedation.

This technique implies inserting, under endoscopic control, a coblation probe inside the inferior turbinate up to the level of the tail of the turbinate, also visualizing the torus of the auditory tube and the pharyngeal aperture of the Eustachian tube, with the possibility of always checking the depth at which it is inserted inside the lower turbinate (fig. 2.)

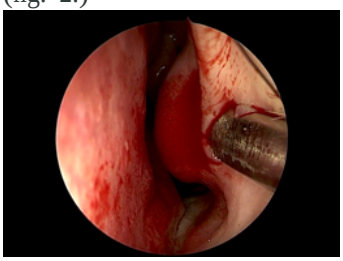

Fig. 2. Inserting the coblation probe inside de inferior turbinate

The coblation probe is activated for approximately 10 s pressing the *ABLATE* mode, resulting in vaporization of a volume of the submucosa inside the lower nasal turbinate. This procedure can be repeated in sequences of 10 s until achieving the desired volumetric reduction, always evaluated by the surgeon through the use of endoscopic rods. For good quality hemostasis, without changing the position of the probe, the surgeon should activate the *COAG* mode for 5-10 s. The position of the probe changes by withdrawing it from the tissue over a distance equal to the length of a probe marker. The volumetric reduction procedure of submucosal lower nasal turbinate should be repeated all over the length of the cornet using the alternate sequence *ABLATE/COAG.*

At the end of the procedure, the inlet made by the probe on the lower nasal turbinate should be sealed by activating the probe on *COAG* mode. The whole procedure can be resumed using a superior and/or inferior trajectory besides the median trajectory initially used.

If the integrity of the inferior nasal turbinate mucosa is not affected and the vaporization of the tissue is strictly submucosal, there is a minimal bleeding, therefore nasal packing is not necessary (fig. 3.)

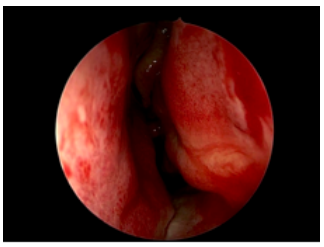

Fig. 3. Submucosal turbinectomy with no need of nasal packing after the procedure

Volumetric reduction of the inferior turbinate refers to vaporizing the mucosal and submucosal tissue of the lower nasal turbinate using coblation probes. It is indicated in mucosal hypertrophy of the nasal inferior turbinate that could not be reduced by anterior submucosal turbinectomy and, as the previous one, this method also is not efficient if the bony part of the turbinate is the hypertrophic one.

The coblation probes used for this procedures have integrated irrigation with normal saline that decreases the

thermic effect on the surrounding tissue, integrated aspiration system, perform a bipolar type coagulation with a thermic effect lower than the monopolar type of coagulation, all probes are flexible and the surgeon can adjust the form and angulation and, furthermore, the system is user friendly as it recognizes when we insert the jack of the coblation probe into the generator, it will be recognized by the system, the generator automatically selecting the specific parameters *ABLATE/COAG* for each individual probe. The surgeon can later change the basic parameters adapting to the needs of the surgical moment.

The suction channel may be obstructed by tissue within the dissection / vaporization maneuvers, decreasing the ablative efficacy of the probe and requiring cleanness by using the ABLATE mode.

This procedure can be performed under general anesthesia, within more complex surgical interventions or under local anesthesia with sedation.

After endoscopic evaluation the nasal cavity, especially the volume of the inferior turbinate, the torus of the auditory tube and the pharyngeal aperture of the Eustachian tube, local hydroanesthetic infiltration is performed and the coblation probe is placed on the surface of the lower turbinate, from posterior to anterior.

Using the *ABLATE* mode the desired volume of mucosal and submucosal tissue is removed being subsequently vaporized by the created plasma cloud, and the blood and the serum are aspirated by the coblation probe. Haemostasis is performed by activating the probe on the *COAG* mode.

Because bleeding is very well controlled with the help of coblation the patient does not require later nasal packing as the procedure can be performed within a one day admission in the hospital (fig. 4.)

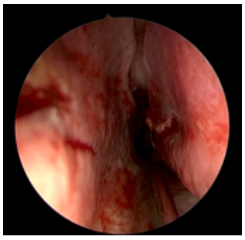

Fig. 4. Volumetric reduction of the inferior turbinate with no need of nasal packing after the procedure

Results and discussions

This method, used in several types of surgeries, covering almost all of the ENT procedures, has minimal effects on the surrounding tissue and seems to be a trustworthy option for tissue ablation as it has several benefits in comparison to other techniques that use similar principles.

First of all, the effect it has on the surrounding tissue is less aggressive regardless of other methods using mechanical or local burns for excision. Therefore, the tissue restores its normal status faster and when taking into discussion nasal surgery, this aspect is very important as the mucosa resumes its functions quickly and without any further damage.

The low temperature used when performing controlled ablation, due to its chemical dissolution in saline solution that only determines a 40-70 degree Celsius local temperature, represents the fundamental factor for minimal local scarring, therefore minimal postoperative bleeding.

Taking into consideration the thickness of the plasma field (100-200 mm) only enhances the idea mentioned above of minimal damage to the surrounding tissue. Furthermore, the smoke-free method makes it easier to improve visibility while using endocopy as guidance into the surgical field and ensures the surgeon's comfort during the procedure.

Despite all its mentioned advantages, this method could never be used for an important intra-/postoperative bleeding unlike conventional electrocautery [10].

It is worth mentioning that this is an expensive method due to the fact that the coblation probes are of single-use.

Furthermore, any functional intervention, despite its initial apparent low degree of difficulty, should always confide in the extensive learning curve that the surgeon has already performed in order for him to be prepared for any possible complications that may occur during an alternative method such as this one and immediately convert to a classical or more aggressive approach for better outcome and minimal postoperative risks.

Conclusions

Controlled ablation when discussing interventions such as volumetric reduction of the inferior nasal turbinate seems to be a reliable method with good outcome and minimal local damage and it can be mentioned as a top choice for such interventions as it is easy to perform.

Low temperature and poor traumatization of the surrounding tissue end up as good wound healing, minimal scarring, low degree of pain, high quality and less time for recovery as well as rapid mucosal function retrieval due to minimal risk of local necrosis during the procedure [11].

Our experience regarding the use of coblation and its good outcomes as a minimally invasive ablation procedure make us rank the method as a top choice not only when taking into discussion the volumetric reduction of the lower nasal turbinate but also when discussing some other surgical intervention from the ENT field, such as tonsillectomies, adenoidectomies and even for several selected cases of benign or malignant tumors that needed minimal tissue ablation, either for palliative or curative purpose [12,13].

Further studies should be performed to establish the real limitations of this technology and asses its full potential.

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