Use of coblation in otolaryngology, head and neck surgery

Coblation is a relatively new, low-temperature electrosurgery technique that has established its place in various surgical fields. This article summarizes the published work on the use of coblation in the field of otorhinolaryngology.

Coblation ('controlled ablation') is a bipolar radiofrequency electrosurgery technique of tissue removal. Its mechanism of action involves electric molecular dissociation of a conductive fluid (e.g. normal saline). When electrical current is applied to this fluid, it turns into a charged layer of particles, called a plasma layer. Charged particles accelerate through the plasma and gain sufficient energy to break the molecular bonds within the cells. This causes the cells to disintegrate molecule by molecule, so that the tissue is volumetrically removed. A continuous mode of operation is used to allow for coagulation of smaller blood vessels (unlike a laser), and when used in bipolar mode, it can be used to produce haemostasis in larger vessels as well as shrinkage of collagen.

Coblation uses a relatively low-temperature plasma (classically around 60–70°C), unlike other types of electrosurgeries where temperatures above 100°C are reached. Because of the low temperature, the risk of thermal damage to surrounding tissues is significantly reduced (Woloszko et al, 2002; Benninger and Walner, 2007).

Coblation was first used in orthopaedics for arthroscopic cartilage removal and subsequently for reduction of intervertebral disc prolapses. It was first used in otorhinolaryngology for tonsillectomy and has since been used for a wide spectrum of otolaryngological procedures. This article summarizes published work on coblation in otorhinolaryngology and outlines some potential future uses of the technology in otolaryngology.

Tonsil surgery

Dissection tonsillectomy

Tonsillectomy is the most common surgical procedure performed worldwide. Coblation is established as an effective technique for tonsillectomy and this constitutes the majority of published work on coblation use in otorhinolaryngology. Although monopolar cautery has been predominantly used for tonsillectomy over the last 15 years, the use of coblation has significantly increased in recent years.

Post-tonsillectomy haemorrhage and pain are the two key issues that contribute to the morbidity associated with tonsillectomy.

Pain

Postoperative pain remains a major morbidity after tonsillectomy and is an important reason for hospital readmission. Patients undergoing coblation tonsillectomy have a better postoperative course as they need less analgesia, discontinue narcotic analgesics earlier and are able to return to normal diet earlier than patients undergoing tonsillectomy by traditional means (Benninger and Walner, 2007; Wang et al, 2009).

A number of studies have compared coblation tonsillectomy to other tonsillectomy techniques with regards to postoperative pain. The majority of these have found that there is significant reduction in postoperative pain with coblation tonsillectomy compared to harmonic scalpel, monopolar electrosurgery and microdebrider (Stoker et al, 2004; Parsons et al, 2006; Magdy et al, 2008). However, when compared to cold steel dissection technique results have been conflicting. Some studies have shown no significant difference in pain scores but also highlighted the need for less potent analgesics in the coblation group (Polites et al, 2006; Parker et al, 2009) while others have found it to be associated with less postoperative pain and less analgesic use in the early postoperative period (Stoker et al, 2004; Polites et al, 2006; Zhong et al, 2006; Wang et al, 2009). A review article concluded that, compared to other tonsillectomy techniques, coblation tonsillectomy is associated with less painful recovery and decreased narcotic use (Shah and Dunham, 2007).

Haemorrhage

Primary (within 24 hours) and secondary (after 24 hours) haemorrhage is the most significant complication associated with tonsillectomy.

While most studies agree that intraoperative blood loss is significantly less with coblation (Shapiro and Bhattacharyya, 2007; Wang et al, 2009), there is controversy regarding primary haemorrhage rates. It cannot be

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ignored that the National Prospective Tonsillectomy Audit found a statistically significant risk of postoperative haemorrhage with coblation (Royal College of Surgeons of England, 2005). However, this audit only included a relatively small number of coblation cases and others have claimed that this may have affected the final bleeding rates (Clark et al, 2006). There are now many published studies which have demonstrated that a learning curve exists and that experienced coblation surgeons have haemorrhage rates much lower that those reported in the National Prospective Tonsillectomy Audit (Belloso et al, 2003; Divi and Benninger, 2005; Clark et al, 2006; Carney et al, 2008a).

In view of the National Prospective Tonsillectomy Audit findings and the demonstrated learning curve, adequate training and mentoring schemes (such as that now introduced in the UK) are essential for patient safety.

The use of a disposable instrument such as a coblation wand certainly increases some aspects of theatre costs. In the authors' department, coblation tonsillectomy saves approximately 15 minutes of theatre time per patient. At an estimated cost of AU$22 per minute, this saving more than compensates for the cost of the wand. In addition, the speed of day surgery has increased, providing further financial savings to the authors' hospital. The cost–benefit figures obviously need to be adjusted to suit individual health-care systems and doctors' practices.

Subtotal tonsil reduction ('tonsillotomy')

Partial tonsil surgery has made a resurgence largely through the use of a microdebrider (PITA technique – powered intracapsular tonsillectomy and adenoidectomy) although coblation has now established itself as an effective bloodless alternative (*Figures 1–3*). This technique is particularly effective in cases of obstructive sleep-disordered breathing in children (Friedman et al, 2003). Evidence clearly demonstrates that subtotal tonsil surgery significantly reduces postoperative pain and bleeding rates compared to full tonsillectomy (Wood et al, 2011).

Figure 1. Subtotal tonsil reduction showing preoperative appearance of tonsils.

Adenoids

Adenoidectomy has traditionally been performed using a blind curettage technique. Although this is usually quick and safe, there are documented complications with this technique. Eustachian tube damage and trauma to the nasal septum have been reported and it is often difficult to remove all the adenoid tissue adjacent to the Eustachian tube and in the posterior choana. Significant bleeding can also occur. Coblation adenoidectomy is now widely performed with the aid of laryngeal mirrors and occasionally rigid endoscopes, which makes the procedure more precise with effective haemostasis (*Figure 4*). It also makes it possible to achieve partial adenoidectomy in cases where submucosal cleft palate exists, thus avoiding the risk of palatal incompetence, something that is not possible with the classical curettage technique. All adenoid tissue in the posterior

Figure 2. Subtotal tonsil reduction with coblation.

Figure 3. Subtotal tonsil reduction showing postoperative appearance of tonsils.

choana and immediately adjacent to the Eustachian tube can be removed without causing injury to adjacent tissues (Timms and Ghosh, 2005). In the authors' experience, recovery is identical to a curettage technique, with no need for antibiotics and no evidence of nasopharyngeal crusting.

Obstructive sleep apnoea

In the vast majority of cases, obstructive sleep apnoea is a multilevel problem with the velopharynx and the hypopharynx being the most widely documented sites of obstruction. A wide variety of techniques have been developed to surgically correct pharyngeal obstruction but all of them are associated with significant morbidity.

Palate

Coblation is being widely used for the volumetric reduction of soft palate in cases of sleep-disordered breathing. The most commonly performed procedure is uvulopalatopharyngoplasty, with several modifications of the standard uvulopalatopharyngoplasty now having been described. These modifications have several advantages and plain uvulopalatopharyngoplasty is no longer regarded as standard of care. Many studies have found a statistically significant decrease in the intensity of snoring and improvement in the quality of life with coblation treatment of the palate. Radiofrequency-assisted uvulopalatopharyngoplasty is less painful and associated with lower morbidity than other techniques (Van den Broek et al, 2008).

Coblation-assisted upper airway procedure is a more recently described technique, which is particularly useful in cases of sleep-related breathing disorder where obstruction is at the upper pharyngeal level. It is claimed to be as effective as uvulopalatopharyngoplasty without causing fibrosis or scarring. It has emerged as a safe, well-tolerated procedure, which gives good results and can be performed as an outpatient procedure at some centres (Tvinnereim et al, 2007). Whether coblation-assisted upper airway procedure is as powerful a procedure as uvulopalatopharyngoplasty variant remains to be seen.

Tongue base

Radiofrequency tongue base reduction, either alone or combined with an uvulopalatopharyngoplasty variant, is as effective as continuous positive airway pressure in cases of mild to moderate obstructive sleep apnoea with the additional advantage of having no compliance issues (Ceylan et al, 2009).

Ultrasound-guided submucosal tongue base excision with coblation (submucosal lingualplasty) has shown good results in sleep apnoea patients with retrolingual collapse.

The retrolingual airway reduction leading to sleep-disordered breathing can also be managed with minimally invasive coblation techniques. Coblation channelling of the tongue is an effective technique, which avoids the risk of damage to the hypoglossal nerve or the lingual artery (Friedman et al, 2008). The feasibility of coblation channelling in the safe area of the tongue, thereby avoiding the neurovascular bundle, has been explicitly demonstrated in animal studies (Salinas and Barrera, 2010) and in over 2000 human cases (Professor Q Zhang, unpublished, 2010). Data on the first 60 cases performed in Australia are currently being analysed with provisional results reinforcing the Chinese experience that over 80% patients with mild and moderate sleep apnoea can be 'cured' with this technique (AS Carney, S Mackay, S Robinson, unpublished, 2009) (*Figure 5*).

Nose

Turbinate surgery is a useful surgical technique to relieve symptoms of nasal obstruction when medical therapy has failed.

Turbinate surgery can be performed using submucosal ablation techniques, by external reduction or by the re-sculpting of turbinate tissue, with removal of some or all of the inferior turbinate bone (turbinatoplasty). Coblation can achieve submucosal ablation using bayonet-type wands (*Figure 6*) and can also be used to perform the more aggressive turbinatoplasty using traditional larger wands.

Figure 4. Coblation adenoidectomy.

Figure 5. Tongue base channelling for obstructive sleep apnoea.

A study comparing the long-term effects of laser-assisted turbinoplasty with those of coblation turbinoplasty showed that initially the improvement of symptoms score was similar between the two groups but progressively the improvement rates for laser-assisted turbinoplasty decreased while those for coblation-assisted turbinoplasty remained stable (Tani et al, 2008). However, another study found that both microdebriders and coblation achieve significant improvement in nasal obstruction during the first 12 months after surgery although the benefits of microdebriders seems to last longer than coblation after this period (Lee and Lee, 2006).

Coblation is particularly useful when radical turbinoplasty is indicated in patients with obstructive sleep apnoea when it is desirable to avoid nasal packing under all conditions and also for patients with haematological disorders (e.g. Von Willebrand disease) or on anticoagulants.

Coblation has also been found to be extremely useful in patients with hereditary haemorrhagic telangiectasia. It provides excellent ablation of the lesions as well as haemostasis simultaneously with a single instrument (Joshi et al, 2011). It is especially useful for dealing with the larger arteriovenous malformation-type lesions seen in some patients of hereditary haemorrhagic telangiectasia.

The resection of nasal and anterior skull base tumours (e.g. angiofibroma) is often associated with significant bleeding. Many surgeons now use coblation technology to assist with part or all of the tumour resection when an endoscopic approach is used (Eloy et al, 2009).

Larynx

Coblation is being increasingly used to treat a multitude of laryngeal disorders such as anterior and posterior glottic webs, arytenoid granulomata, posterior cordotomy and internal laryngoceles. Excellent haemostasis, minimal damage to underlying tissue and the minimal risk of airway fires make it a very useful instrument for upper airway lesions.

Figure 6. Inferior turbinate channelling with coblation.

Coblation is useful in cases of laryngeal papillomatosis and granulomata where it provides good access, a bloodless field and longer treatment intervals. Coblation wands are particularly useful in reaching the difficult to access areas of the larynx (Carney et al, 2010) (*Figure 7*).

Trachea

Lasers, which are of proven use in laryngeal surgery, become difficult and dangerous instruments to use below level of vocal cords. The risk of airway fires and carbon dioxide retention rises significantly. Since the laser fires in a straight line, lesions outside the direct line of sight become impossible to access. Coblation on the other hand is an ideal option in these situations. Access is not limited by line of sight, bleeding can be controlled simultaneously and there is no risk of airway fire. In cases of tracheal recurrent respiratory papillomatosis where repeated surgeries are necessary, coblation is quickly becoming the instrument of choice, reducing the risk of surgery and causing minimal postoperative scarring and fibrosis (Carney et al, 2010). Subglottic and tracheal stenosis can also be treated easily with coblation, with early results showing almost no recurrence of scar tissue (AS Carney, unpublished data, 2009–10).

Malignancy

Coblation, with its advantages of providing a bloodless surgical field, is becoming an attractive tool for resection of oropharyngeal malignancy. Initial published series have shown that coblation-assisted surgery is faster and cheaper with the ability to achieve better haemostasis and the option for working around corners (*Figure 8*). The disadvantage is that since a coblation wand ablates a margin around the resection, more tissue has to be excised to ensure oncological clearance (Carney et al, 2008b). Long-term studies are needed to look at the recurrence rate with this technique.

Figure 7. Coblation use in laryngeal surgery.

Figure 8. Resection of oropharyngeal malignancy with coblation.

Conclusions

Radiofrequency coblation is a new technology which has proven benefits in many areas of otolaryngology. Surgeons are now expanding the indications for coblation use to include the resection of nasal and head and neck malignancies. Coblation is ideal for laryngeal and tracheal airway surgery. There are certain limitations, which need to be recognized. The technique has a demonstrated learning curve and current wands are not ideal for all locations. More long-term prospective research is needed to provide high-level evidence supporting the use of coblation in all areas of otolaryngology. BJHM

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KEY POINTS

- Coblation use is associated with significantly less thermal tissue damage.
- Coblation tonsillectomy is a quicker and less painful procedure with no increase in the rate of post-tonsillectomy bleeding in experienced hands.
- Proper supervision and training is essential to ensure good outcomes with coblation as a learning curve clearly exists.