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Hot Techniques for Tonsillectomy

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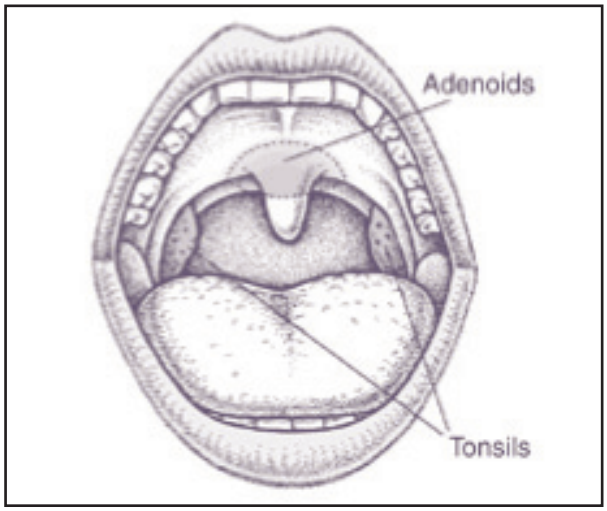
Summary

- ✓ **Some patients experience pain and bleeding after a standard or extracapsular tonsillectomy.**
- ✓ **Evidence suggests that none of the hot tonsillectomy techniques offers concurrent reductions in intra- and post-operative bleeding and pain, compared with traditional cold-steel dissection with packs or ties.**
- ✓ **Little information is available on the cost effectiveness of the hot techniques.**
- ✓ **Diathermy is likely to remain the most commonly practised hot tonsillectomy technique.**

The Technology

Standard or extracapsular tonsillectomy, which is typically performed under general anesthesia, involves surgically removing the palatine tonsil and capsule, and then sealing bleeding vessels (hemostasis) with ligatures (ties), sutures, or heat (diathermy).[1] In Canada, tonsillectomy is usually performed as day surgery.[2] The most common side effects are pain and bleeding (hemorrhage), but patients may also experience difficulty swallowing, nausea, vomiting, throat and ear pain, weight loss, dehydration, fever, and airway obstruction.[3-7]



Tonsils and adenoids

Image courtesy of Merck & Co., Inc.[9]

The incidence of primary hemorrhage (bleeding within the first 24 hours) is approximately 1%, and the rate for secondary hemorrhage (occurring between 24 hours and 10 days) is between 1% and 7%.[1] Transfusion or further surgery, particularly in children, may be required after primary hemorrhage. One in every 40,000 patients dies from bleeding after tonsillectomy.[1,8] In contrast, often only observation is required after secondary hemorrhage.

With hot tonsillectomy techniques, thermal energy is used to cut and coagulate tissue in an effort to reduce operative time and intraoperative bleeding.[3-6]

Electrosurgery

Monopolar and Bipolar Diathermy

In diathermy, an electric current from a radiofrequency generator passes through the tissue between two electrodes. The heat generated (between 400°C and 600°C) cuts the tissue, and simultaneously seals blood vessels.[10,11] In monopolar diathermy, the current passes from the surgical instrument (a standard electrocautery tip or microdissection needle) through the patient to an electrode placed on the leg. Because the surgical instrument has a small contact area, heating is confined to its tip.[12,13] In bipolar diathermy, the current passes through the tissue between electrodes located in the tips of a pair of forceps or scissors.[11]

Monopolar and Bipolar Radiofrequency Ablation (coblation, low temperature plasma excision, ionized field ablation)

Coblation tonsillectomy is a variation of bipolar electrosurgery that generates lower temperatures (40°C to 70°C), with the aim of minimizing thermal damage to surrounding tissues.[4] A series of electrodes on the tip of the coblation probe are bathed in a conducting saline solution that flows continuously

through an irrigation sheath. Radiofrequency energy ionizes the saline to form a localized plasma layer of sodium ions. The heat generated by these ions cuts tissue and seals small blood vessels.[12,14-16]

Argon plasma coagulation is a monopolar form of coblation. This non-contact technique uses a stream of ionized argon gas instead of saline as the medium for the electrical current. The current flows between the hand piece and the tissue, and is dispersed to a neutral electrode attached to the patient.[10,17]

Thermal Welding
Thermal welding uses the simultaneous application of heat and pressure to cut and coagulate tissue. Unlike diathermy, no electric current passes through the tissue. At the tip of the cautery forceps, a low voltage current activates a heating element. Tissue that is grasped using the forceps is vaporized (temperatures 300°C to 400°C), while the vessels are sealed by a combination of heat and the clamping pressure of the forceps.[18,19]

Ultrasonic or Harmonic Scalpel
The ultrasonic scalpel has a blade that vibrates at 55.5 kHz (55,500 cycles per second) over a distance of 80 µm to cut tissue. The heat generated in the tissue (between 50°C and 100°C) by the blade's movement coagulates the blood vessels.[12]

Laser
The carbon dioxide laser, potassium titanyl phosphate (KTP) laser, and contact diode laser are the most commonly used in tonsillectomies. Energy is delivered through a flexible optical fibre that is used as a scalpel to dissect tissue and coagulate vessels.[20,21]

Regulatory Status

Monopolar and bipolar diathermy have been used in tonsillectomy for decades. Several companies manufacture the instruments. Lasers and ultrasonic scalpels, which have been used in other procedures for many years, have recently been applied in tonsillectomy. All the hot tonsillectomy technologies described here are licensed by Health Canada, and the US Food and Drug Administration.[22,23]

Patient Group

Tonsils are small masses of lymph tissue at the back of the throat. They produce antibodies and help fight infections. The two main reasons for removing the tonsils are recurrent infection (tonsillitis) that does not respond to antibiotics, or enlarged tonsils that cause breathing, swallowing, or speech difficulties; severe snoring; or obstructive sleep apnea (blockage of breathing).[8,12,24]

Most tonsillectomies are performed in children <15 years old.[13] In 1998, 19 in 10,000 Canadian children <20 years old underwent tonsillectomy.[25] By 2003, 42,000 tonsillectomies were performed annually.[26]

Current Practice

Traditionally, the tonsils are removed through cold-steel tonsillectomy. In this procedure, a combination of blunt and sharp dissecting instruments is used to separate the tonsil and capsule from the surrounding tissue; and a snare is used to sever the base of the tonsil. Bleeding is controlled with packs, absorbable ties, or suction cautery.[6,12] Diathermy has recently become popular, because of the belief that intraoperative bleeding is reduced.[4] Consequently, most tonsillectomies are now performed using cold-steel dissection, or monopolar diathermy.[12,27]

The Evidence

For studies that reported on overlapping patient groups, only the paper reporting the most comprehensive data set was used.

Electrosurgery
A systematic review (SR) of electrosurgery tonsillectomy in adults and children found that operative time was shortest for monopolar diathermy (15.5 minutes), and longest for coblation (24.5 minutes).[13] Generally, patients took approximately two days longer to return to a normal diet after diathermy, compared with cold-steel dissection. Patients returned to a normal diet after a similar or a shorter time with coblation compared to diathermy. The mean number of days taken

to return to normal activity was similar for coblation, diathermy, and cold-steel dissection.[13] Many of the randomized controlled trials (RCTs) included in the SR failed to adequately report the treatment allocation methods, or to use outcome assessors that were blinded to treatment allocation. Inadequate reporting also occurred in the non-randomized comparative studies.

Two RCTs assessed argon plasma coagulation tonsillectomy.[17,28] One RCT of 201 patients found no difference between argon plasma coagulation and cold-steel dissection (with packs or ties) with respect to pain during the 10-day follow-up, but the operative time was significantly shorter with argon coagulation.[17] The other RCT (n=40) found that operative time and pain <2 weeks after the procedure were similar for patients undergoing argon plasma coagulation, and patients who had undergone cold-steel dissection or bipolar diathermy.[28]

Thermal Welding

No identified RCTs assessed thermal welding in children, but the technique was used in adults in two RCTs.[18,19] The mean operative time was significantly shorter, and the pain was lower <2 weeks after thermal welding, compared to cold-steel dissection with packs or ties.[19] The other study found no difference in operative time between thermal welding and bipolar diathermy. Patients in the thermal-welding group had less postoperative pain during the two-week follow-up, and returned to a normal diet more quickly.[18]

Ultrasonic Scalpel

One SR found five RCTs and four non-randomized comparative studies about the use of the ultrasonic scalpel in children and adults.[29] The pain scores <7 days after surgery were similar for the ultrasonic-scalpel tonsillectomy, diathermy, and cold-steel dissection. Two weeks after surgery, the pain was significantly worse after the ultrasonic-scalpel technique, compared with cold-steel dissection, but was better compared with diathermy. The time that it took for patients who had ultrasonic-scalpel tonsillectomy to return to a normal diet or appetite was similar or shorter, compared with cold-steel dissection or diathermy.

The SR concluded that the evidence base for this procedure was small, and generally of a low quality. The outcomes in the studies were poorly assessed and reported, and most of the RCTs were small.[29]

Laser

A SR found four RCTs, two non-randomized comparative studies, and one case series of laser tonsillectomy in adults and children. Most used the KTP laser.[21] The pain within 24 hours was lower after laser tonsillectomy than after cold-steel dissection, but was subsequently greater <2 weeks postoperatively. One study found that pain was consistently lower in the contact-diode laser group compared with the diathermy group. Three studies found that wound healing was slower after laser tonsillectomy, compared with cold-steel dissection.[21]

Adverse Effects

Electrosurgery

A SR analyzed data from 50 primary studies, and three population-based registry reports.[13] The primary hemorrhage rates were lowest for bipolar diathermy, and cold-steel dissection with diathermy, and highest for monopolar diathermy, and cold-steel dissection with packs or ties. The meta-analysis showed that bipolar diathermy had lower odds of primary hemorrhage, compared to cold-steel dissection with packs or ties. The rate of secondary hemorrhage was lowest for cold-steel dissection with packs or ties, and highest for monopolar and bipolar diathermy. In the meta-analysis, diathermy, coblation, and cold-steel dissection with diathermy had higher rates of secondary hemorrhage, compared with cold-steel dissection. Diathermy tonsillectomy caused less intraoperative bleeding than cold-steel dissection using packs and ties, or diathermy to control bleeding. Because the length of follow-up was inadequate in most of the studies, some cases of secondary hemorrhage may not have been noted.[13]

For argon plasma coagulation, the rates of postoperative hemorrhage were similar to those of cold-steel dissection.[17] The mean intraoperative blood loss was significantly lower, compared with cold-steel dissection or bipolar diathermy.[17,28]

Thermal Welding

The mean intraoperative blood loss was lower after thermal welding, compared with cold-steel dissection with packs or ties. The rates of postoperative hemorrhage were similar.[19] Another study found no difference between thermal welding and bipolar diathermy in mean intraoperative blood loss or postoperative hemorrhage.[18]

Ultrasonic Scalpel

Primary hemorrhage rates were lower with ultrasonic-scalpel tonsillectomy, compared with cold-steel dissection or diathermy. In most studies, additional techniques were used to control bleeding. There was a greater risk of secondary hemorrhage after ultrasonic-scalpel tonsillectomy, compared with cold-steel dissection. The follow-up period in more than half of the studies was too short or not stated, so the rates of secondary hemorrhage may be underestimated.[29]

Laser

The mean intraoperative blood loss was lower with KTP-laser tonsillectomy, compared with cold-steel dissection, but there was a slight increase in postoperative hemorrhage rates. Some studies used other techniques to control bleeding. One patient in the case series sustained a burn to the tongue.[21]

Administration and Cost

Two cost comparisons were identified.[30,31] One found that the cost of electrosurgical adenotonsillectomy was 19% lower than that of cold-steel dissection, mainly because of a shorter operative time.[30] The other showed that operating-room charges were higher (1.3%) for ultrasonic-scalpel tonsillectomy, compared with diathermy.[31] The effect of differences in postoperative outcomes between the procedures on overall cost was not assessed. Also, the initial capital investment required for buying the equipment, which differs significantly among the techniques, was not considered. The equipment cost for cold-steel dissection, which involves standard surgical instruments, is lower than that of any of the hot techniques.

Concurrent Developments

Debate continues about which technique is best, and about whether tonsillectomy is better than non-surgical treatments such as antibiotics and analgesia.[32]

Intracapsular or subtotal tonsillectomy (tonsillotomy), in which most of the tonsil tissue is removed but the capsule is left intact, has been explored as an alternative to extracapsular tonsillectomy, particularly for children with enlarged tonsils.[21] It purportedly reduces postoperative pain and speeds recovery, but there is a risk of tonsil re-growth and the return of symptoms.[12,15] Lasers and coblation are increasingly being used for tonsillotomy, which may indicate a change in the pattern of their use.[21]

Rate of Technology Diffusion

Although tonsillectomy rates have recently declined, it is still the most common major surgical procedure performed in children.[8,33] Diathermy is the most established of the hot tonsillectomy techniques. The more expensive techniques, such as coblation and ultrasonic-scalpel tonsillectomy, are not widely used.[13,34] The rate of uptake of the newer techniques likely depends on surgeons' preference, operative time, and the clinical implications of the associated postoperative morbidity, particularly hemorrhage.[13,34] If no differences in safety and effectiveness exist among the hot techniques, cost will be a major determinant of their uptake. Recent concerns about the transmission of new variant Creutzfeldt-Jakob disease[35] may also affect the diffusion of technologies with reusable surgical instruments or costly single-use components.

Implementation Issues

None of the hot tonsillectomy techniques achieves concurrent reductions in intraoperative blood loss, postoperative hemorrhage, and pain, compared with traditional cold-steel dissection with packs or ties. These results can be affected by differences in adjunctive treatments that patients receive, such as steroids, antibiotics, and pain relievers. Diathermy and cold-steel dissection are the most widely practised tonsillectomy techniques, which, based on the evidence presented here, is unlikely to change in the near future.

The evidence base for some of the techniques, such as thermal welding and argon plasma coagulation, is small, but is likely to expand, as the procedures are refined. Hot techniques, particularly those that generate high tissue temperatures, can damage surrounding tissue, and increase the likelihood of

delayed healing, secondary hemorrhage, pain, and infection.[4,36] Surgeons using hot tonsillectomy techniques should be trained to ensure that trauma to surrounding tissue is minimized.[3,7]

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