Original Article

A pilot study to determine the feasibility of "hot" tonsillectomy with plasma-mediated ablation for recurrent acute tonsillitis

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Contributions: (I) Conception and design: All authors; (II) Administrative support: None; (III) Provision of study materials or patients: None; (IV) Collection and assembly of data: S Misra, BS Nandakumar; (V) Data analysis and interpretation: BS Nandakumar, S Misra; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

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Background: Current trends amongst otolaryngologists managing recurrent acute tonsillitis favour interval "cold" tonsillectomy over acute "hot" tonsillectomy. However, patients experience significant morbidity awaiting interval tonsillectomy, exacerbated by growing waitlist times in the context of COVID-19. The aim of this cross-sectional pilot study was to determine the feasibility of "hot" plasma-mediated ablation (PMA) tonsillectomy for acute recurrent tonsillitis.

Methods: A single-centre cross-sectional study with ethics approval was undertaken where patients over 16 years of age presenting with recurrent acute tonsillitis were offered PMA tonsillectomy. Patients who did not satisfy the Paradise criteria, were pregnant, had suspected tonsillar malignancy, bleeding diathesis, or significant comorbidities were excluded. Institutional electronic medical records and telephone follow-up at 1 month informed the following outcomes: post-tonsillectomy haemorrhage (PTH), operating time, length of stay, re-admission rate at 30 days, and post-operative infection. Statistical analysis of differences in operating time and length of stay for patients with and without peritonsillar abscess at time of surgery was performed using independent samples *t*-tests.

Results: Twenty patients were recruited, with an equal distribution of males and females. The mean age was 33.3±13.6 years, operating time was 37.5±15 minutes, and length of stay 3.4±1.3 days. There were no re-admissions or cases of PTH requiring return to hospital. Statistically significant difference was not found in operating time (P=0.305) and length of stay (P=0.104).

Conclusions: This pilot study concluded "hot" PMA tonsillectomy may be a feasible alternative to interval "cold" tonsillectomy that could reduce recurrent hospital admissions and waitlist times for patients with acute recurrent tonsillitis.

Keywords: Tonsillectomy; postoperative haemorrhage; tonsillitis; peritonsillar abscess; pharyngitis

Received: 08 August 2023; Accepted: 09 November 2023; Published online: 21 December 2023.
doi: 10.21037/ajo-23-37
View this article at: https://dx.doi.org/10.21037/ajo-23-37

Introduction

Tonsillectomy is typically performed for obstructive sleep apnoea (OSA) or recurrent tonsillitis. The benefits of surgery are well-established in the context of OSA, and OSA is increasingly the most common indication for surgery (1). Nevertheless, recurrent tonsillitis remains an important indication for tonsillectomy. When the Scottish Intercollegiate Guidelines Network (SIGN) introduced

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more stringent criteria for classifying the severity of sore throat and tonsillitis in 1999, the resultant decrease in tonsillectomies performed in Wales was associated with a concomitant increase in presentations with peritonsillar abscess and deep neck space infections in the ensuing 15-year period (2). A similar trend was seen in Scotland, where tonsillectomy rates fell 48% between 1993–2016, with a corresponding 500% increase in presentations with deep neck space infections (3).

There is significant morbidity experienced by patients awaiting elective tonsillectomy on the public healthcare system waiting list. Recurrent acute tonsillitis can cause debilitating odynophagia, necessitating repeated courses of antibiotics and prolonged absences from school and work, impacting quality of life (4). In our experience within the Australian healthcare system, patients may wait more than 12 months for elective tonsillectomy, with the recent COVID-19 pandemic causing further delays. Contrary to the notion that recurrent tonsillitis inevitably improves over time, early evidence has suggested that the vast majority of patients still meet the criteria for elective tonsillectomy after waiting many months for their surgery (5). In a cohort of 623 children who waited a mean time of 10.8 months for elective tonsillectomy, 81.4% of patients still warranted surgical intervention at subsequent pre-operative evaluation (6). Therefore, reducing the amount of time spent on the public healthcare system waiting list has the potential to reduce the morbidity experienced by patients with recurrent tonsillitis.

Elective tonsillectomy may be offered to patients with tonsillitis who meet the Paradise criteria (7). Elective tonsillectomy reduces the incidence of sore throat in children and adults, and the benefit may be greater in those with severe episodes (8-10). However, elective tonsillectomy does not address the burden of disease experienced by patients awaiting surgery who continue to suffer from recurrent acute tonsillitis.

Immediate tonsillectomy when a patient presents to hospital with acute tonsillitis or peritonsillar abscess, so called "hot tonsillectomy" or "tonsillectomy à chaud", is not common practice in the modern era. Opponents argue that surgery in the context of acute inflammation may carry a higher risk of pain, bleeding, or infection. Classically, these risks have guided surgeons to offer interval "cold" tonsillectomy in the elective setting once the acute tonsillitis episode and its associated operative risk settles. However, "hot tonsillectomy" in the presence of a peritonsillar abscess has been described as early as 1921 (11). Recovery time was reported to be identical to tonsillectomy in the absence of infection. Furthermore, there was complete removal of all abscess collections, rapid improvement in sepsis, and definitive "cure" without the need for multiple drainage procedures or operations. Limited studies examining conventional tonsillectomy techniques have suggested that greater consideration should be given to performing a "hot tonsillectomy", reporting no difference in blood loss, duration of hospital admission, or rates of post-operative complications such as bleeding (12-14).

The outcomes for patients undergoing "hot" tonsillectomy using a plasma-mediated ablation (PMA) technique has not been examined. PMA relies on breaking the dielectric bonds of sodium chloride, creating a plasma field of sodium ions in which ablation of tissue occurs at lower temperatures than Bovie electrocautery whilst maintaining hemostasis. Given its reduced thermal injury, PMA is often referred to as cold ablation or Coblation (ArthroCare ENT, Austin, TX, USA) (15). In addition to limiting depth of destruction and injury to surrounding structures, PMA also reduces risk of airway fires (16). When compared to conventional tonsillectomy techniques, PMA tonsillectomy can result in less post-operative pain, less intra-operative blood loss, shorter operation time, and early resumption of normal diet (17-20). These are key considerations for surgery in the context of acute inflammation. Safely performing a "hot" tonsillectomy in this setting has the potential to reduce the burden of disease associated with long public waitlists, in addition to shortening hospital admission times. This could potentially represent a paradigm shift similar to laparoscopic appendicectomy or cholecystectomy which are also performed during the acute infection. The aim of our study was to determine the outcomes of "hot" tonsillectomy using PMA for adults admitted to hospital with recurrent acute tonsillitis requiring intravenous antibiotics and rehydration. We present this article in accordance with the STROBE reporting checklist (available at https://www.theajo.com/article/view/10.21037/ajo-23-37/rc).

Methods

Study setting and design

This pilot study was a single-centre cross-sectional study which recruited and collected data from patients with recurrent acute tonsillitis who were admitted to Canterbury Hospital via the Emergency Department (ED) between October 2016 and August 2022. The study was conducted

in accordance with the Declaration of Helsinki (as revised in 2013). Ethics approval was granted by the Research Ethics and Governance Information System (REGIS) which is responsible for human research projects within NSW Health facilities (2020/ETH00306). The trial was registered with the Australian New Zealand Clinical Trials Registry (Trial ID ACTRN12620000660987p), with the aim of recruiting 20 patients for this pilot study (21), and informed consent was taken from all individual participants.

Patients and recruitment

Patients with recurrent acute tonsillitis, with or without peritonsillar abscess, were recruited from the ED of Canterbury Hospital in Sydney, Australia. All patients received an information brochure regarding the study and were consented for participation in the study by a designated ENT medical officer. This included a discussion regarding potential risks and benefits of surgery in the setting of acute infection.

Patients were included if they were over 16 years of age and admitted to hospital with recurrent acute tonsillitis, with or without peritonsillar abscess. Patients were required to satisfy the Paradise criteria for tonsillectomy, having suffered seven episodes in the previous year, five episodes per year for the previous 2 years, or three episodes per year for the previous 3 years. An episode of infection was defined as sore throat in combination with either fever greater than 38.3 degrees Celsius, tonsillar inflammation or exudate, culture positive for Group A β-haemolytic Streptococcus, or cervical lymphadenopathy. These episodes of tonsillitis were typically previously diagnosed by community medical practitioners or ED physicians.

Patients were excluded if they were pregnant, had OSA as the only indication for surgery, were admitted for suspected tonsillar malignancy, were unable to provide an accurate history of tonsillitis episodes, or were unable to provide consent or understand the study objectives. Furthermore, patients were excluded if they suffered from a coagulopathy or bleeding diathesis, or if they had significant medical co-morbidities which placed them in the American Society of Anesthesiologists Classification III or higher (ASA III–VI).

Management protocol

All patients received appropriate medical management in the form of analgesia, intravenous fluids, intravenous antibiotics (benzylpenicillin or suitable alternative in the case of penicillin allergy), and corticosteroid therapy (dexamethasone). Patients were subsequently offered bilateral PMA tonsillectomy under the care of an ENT surgeon with over 20 years of experience (A.C.) in accordance with the study protocol. Refusal to participate in the clinical trial did not compromise medical management. Surgery was performed under general anaesthesia with a standard tonsillectomy set-up using an EVAC 70 XTRA Coblation Wand with coblation-coagulation setting at seven-four. Tonsils were removed in their entirety using an extracapsular dissection technique which exposes the underlying muscle bed and vasculature, along with any peritonsillar abscess if present. Haemostasis was achieved by any means necessary including PMA, bipolar cautery or suture ligation.

Outcomes of interest

The outcomes of interest were primary or secondary post-tonsillectomy haemorrhage (PTH) requiring return to hospital or theatre, operating time, time taken to tolerate adequate oral intake, analgesia requirements, length of hospital stay, re-admission rate at 30 days, and post-operative infection within 3 weeks. One patient's operating time data was missing and a single author (S.M.) reviewed both electronic and paper records to obtain this absent data.

Data collection and statistical analysis

Data was collected using the institutional electronic medical records system known as PowerChart. In addition to the outcomes of interest, pertinent operative findings were noted such as the presence of peritonsillar abscesses. Duration of admission was defined as the time from commencing medical management to discharge post-operatively. Patients were followed up via telephone call at least 1 month post-operatively to review the progress of their recovery and determine the presence of post-operative complications. Data was stored securely in a Research Electronic Data Capture (REDCap) database in accordance with our ethics approval.

Statistical analysis was performed using SPSS 29 (SPSS Incorporated, Chicago, IL, USA). Differences in operating time and length of stay for patients with and without peritonsillar abscess at time of surgery were tested using two-tailed independent samples *t*-tests, with a statistically significant P value defined as less than 0.05. To determine if baseline data (age, sex, number of tonsillitis episodes, and number of admissions for tonsillitis) were confounding

Table 1 Patient characteristics

Characteristics	Patients (n=20), n [%]
Sex	
Male	10 [50]
Female	10 [50]
Age	
18–30 years	10 [50]
31–50 years	8 [40]
51–70 years	1 [5]
71–90 years	1 [5]
Co-morbidities	
Diabetes	1 [5]
Hypertension	2 [10]
Hypercholesterolaemia	1 [5]
Fibromyalgia	2 [10]
Epilepsy	1 [5]
Depression	1 [5]
Cancer (not of the head or neck)	1 [5]
None	13 [65]
Number of tonsillitis episodes prior to intervention	
0–12 months	
0–5 episodes	16 [80]
6–10 episodes	2 [10]
>10 episodes	2 [10]
13–24 months	
0–5 episodes	16 [80]
6–10 episodes	2 [10]
>10 episodes	2 [10]
25–36 months	
0–5 episodes	16 [80]
6–10 episodes	2 [10]
>10 episodes	2 [10]
Tonsillitis episodes requiring admission prior to intervention	
0–12 months	
0	12 [60]
1–2	5 [25]
3–4	3 [15]
13–24 months	
0	15 [75]
1–2	3 [15]
3–4	2 [10]
Peritonsillar abscess at time of intervention	
Present	13 [65]
Absent	7 [35]

factors, a one-way analysis of covariance (ANCOVA) test was conducted.

Results

A total of 20 patients underwent bilateral PMA tonsillectomy as part of their treatment for acute recurrent tonsillitis over a 6-year period. Their demographic information, history of tonsillitis episodes, and presence or absence of concurrent peritonsillar abscess are shown in *Table 1*.

Post-operative complications

No patients (n=0) in the cohort experienced a primary or secondary PTH requiring re-admission or return to theatre. At follow-up, three patients (n=3, 15%) reported a single episode of blood-stained saliva greater than 24 hours post-operatively and did not require admission or significant intervention. No patients (n=0) had an infection in the immediate post-operative recovery period or reported infection at follow-up requiring antibiotics.

Operating time

Average operating time for PMA tonsillectomy was calculated as 37.47±15.02 min with a range of 20 to 79 minutes. It is important to note 13 patients had peritonsillar abscesses that were concurrently drained during the primary operation (n=13, 65%). One patient's records with regards to operating time was missing. After a single author (S.M.) thoroughly searched paper and electronic records unsuccessfully, a complete-case analysis was conducted whereby this patient's data was selectively excluded from average operating time and further statistical analysis.

Oral intake and analgesia

On post operative day one, all (n=20, 100%) patients tolerated an oral diet. Of the 20 patients, most (n=16, 80%) were started on a course of paracetamol and oxycodone immediately post operatively. Two patients (10%) received ibuprofen in addition to paracetamol and oxycodone, whilst two others received celecoxib instead of ibuprofen (10%). No analgesic escalation plans were required.

Admission and follow-up

Average length of hospital stay from time of admission

Table 2 Impact of peritonsillar abscess on operating time and length of stay

Variable	Peritonsillar abscess (n=20)		P value	P value (controlling for baseline data)
	With (n=13)	Without (n=7)		
Operating time, min (n=19)	40.25±17.43	32.71±8.81	0.305	0.086
Length of stay, day (n=20)	3±1.08	4±1.53	0.104	0.078

Data are presented as mean ± standard deviation.

to discharge was calculated as 3.35±1.3 days with a range of 2 to 6 days. No patients (n=0) required re-admission to hospital for management related to their tonsillitis or tonsillectomy at 30 days following their operation. Follow-up was conducted on average 748.95±683.93 days post-operatively ranging from day 25 to 1,744 with a median of 567.5 days.

Statistical analysis

No significant statistical difference was found between patients with or without peritonsillar abscess at time of surgery when comparing their operating time (P=0.305) and length of stay (P=0.104) (*Table 2*). Controlling for baseline data, there remained no significant difference in operating time (P=0.086) and length of stay (P=0.078) for patients with or without a peritonsillar abscess at the time of surgery.

Discussion

This 20-patient cross-sectional pilot study of PMA tonsillectomy for acute tonsillitis with or without peritonsillar abscess resulted in no primary or secondary PTHs or infections requiring admission to hospital or return to theatre at time of follow-up. All patients tolerated an oral diet the day after their operation without requiring escalation of analgesia beyond a combination of paracetamol with a cyclo-oxygenase (COX) inhibitor and/or oxycodone. No statistically significant difference in operating time or length of stay was found for patients with or without peritonsillar abscess at time of surgery, however given the size of our pilot study, statistical power was limited.

PTH is commonly cited as a major deterrent in "hot" tonsillectomy as acute inflammation may increase risk of haemorrhage (14,22). However, the literature does not show this unanimously and our study did not produce significant PTH. A recent meta-analysis of three randomised and two non-randomised trials comprising 232 patients demonstrated no statistically significant difference in PTH rate between immediate and interval tonsillectomy (4.7% and 5.4% respectively) (23). Furthermore, Windfuhr and Chen demonstrated similar PTH rates of 2.9% compared to 2.8% for those undergoing immediate and elective tonsillectomy respectively (24). Contrastingly, Giger *et al.* found a 13% PTH rate for immediate tonsillectomy (25). However, their study did not have a comparison interval tonsillectomy group, and more than two-thirds of the PTH group presented with contralateral bleeding rather than haemorrhage from the side that was originally infected.

Of our cohort's three patients that retrospectively reported self-resolving blood-stained saliva, one was prescribed ibuprofen which is a non-steroidal anti-inflammatory drug (NSAID) which non-selectively inhibits the COX pathways. Inhibition of COX-1 causes reduced platelet aggregation, theoretically promoting bleeding. Contrastingly, COX-2 selective inhibitors such as celecoxib potentially avoid this complication. Whilst some systematic reviews and a Cochrane review have demonstrated NSAIDs lead to higher rates of PTH (26-29), Riggin *et al.*'s systematic review found no increased risk of PTH with NSAIDs compared to opioids or placebo after tonsillectomy (30). A common theme in those reviews that showed higher PTH rates with NSAIDs was to not include or delineate selective COX-2 inhibitors from non-selective NSAIDs (28,29). Interestingly, when ibuprofen was compared to celecoxib in Kwok *et al.*'s study, ibuprofen was found to confer a two-fold increased odds of PTH (27). Furthermore, Riggin *et al.* identify inclusion criteria (only including randomised control trials) and the application of lack of quality measures as reasons for their differing conclusion (30). More recently, Giordano *et al.* demonstrated high dose celecoxib was safe for use in children aged 3 to 11 in a randomised double blinded trial and did not lead to higher PTH rates compared to placebo (31). Whilst the size of our cohort precludes wider conclusions being drawn, further randomised controlled trials and systematic reviews of high-quality studies are required to delineate the safety of non-selective NSAIDs and COX-2 selective inhibitors.

Cost-effectiveness is crucial to health economics, and with peritonsillar abscess admissions costing the healthcare system approximately $150 million per year in the United States alone, the ability to prevent recurrent admissions is crucial (14). Our single-institution data demonstrated a total of 29 admissions to hospital for tonsillitis across all patients in the 2 years prior to their "hot" tonsillectomy, with zero re-admissions at follow-up. Although recurrence rates of peritonsillar abscess vary from 5–22%, Wang *et al.*'s nationwide cohort demonstrated a recurrence rate of 5.15% with number of tonsillitis episodes being a significant risk factor (32). In 2002 figures, Bhattacharyya and Kepnes demonstrated a total economic cost saving of $1,275.82/year after tonsillectomy with an average break-even point of 2.3 years following tonsillectomy for chronic tonsillitis (33). Thus, when compared to recurrent admissions for tonsillitis, having a safe "hot" tonsillectomy option such as PMA may be more cost-effective, and is a potential avenue for future research.

Our pilot study is subject to limitations inherent to its design. A small sample size limits appropriately powered statistical analysis which hinders definitive conclusions being drawn, especially with regards to the impact that peritonsillar abscess may have on operating time and length of stay. Using a validated pain-scale post-operatively and documenting intra-operative blood loss and operative difficulty would have added more outcomes to compare with interval tonsillectomy to provide greater justification for "hot" tonsillectomy. Furthermore, we did not record the number of potentially eligible patients that were selected for inclusion but eventually excluded, which limits analysis of why a 6-year period was required to recruit 20 patients. A greater awareness of this study protocol amongst rotating ED doctors may potentially have led to more referrals to ENT doctors for consideration of "hot" tonsillectomy for tonsillitis.

Multiple studies have demonstrated conflicting evidence for whether PMA is superior or inferior to more traditional techniques in reducing PTH for elective tonsillectomy (34). Although a 2008 audit of Australian surgeon experience with PMA demonstrated a learning curve that implies surgeon experience is a factor in PTH for PMA (35), other large-scale data do not demonstrate surgeon experience is a significant factor in PTH following PMA (36,37). A recent meta-analysis by Ahmad *et al.* demonstrated lower rates of PTH with PMA compared to traditional techniques, however, a Cochrane review by Pynnonen *et al.* demonstrated low-quality evidence to suggest PMA techniques may confer a slightly higher risk of PTH (17,38). Irrespective, no large-cohort study to date has investigated the impact of the PMA technique on "hot" tonsillectomy and remains an avenue for future research.

Conclusions

In this pilot study of PMA "hot" tonsillectomy, we concluded the PMA technique may be a safe and feasible method when treating patients with recurrent acute tonsillitis immediately. Larger cohort studies or randomised controlled trials are required to draw stronger conclusions about PTH rates and cost-effectiveness to the healthcare system of PMA "hot" tonsillectomy when compared to the current paradigm of interval tonsillectomy.

Acknowledgments

The authors would like to sincerely thank Dr. Antonia Watson and Dr. Nusrat Mohammad from the Department of Surgery at Canterbury Hospital in Sydney, Australia, for their contribution in data collection. Our abstract was accepted for poster presentation at the Royal Australasian College of Surgeons 91st Annual Scientific Conference (held in Adelaide, Australia, taking place between the 1st to 5th of May 2023) and has been published in the *ANZ Journal of Surgery* conference proceedings.
Funding: None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://www.theajo.com/article/view/10.21037/ajo-23-37/rc

Data Sharing Statement: Available at https://www.theajo.com/article/view/10.21037/ajo-23-37/dss

Peer Review File: Available at https://www.theajo.com/article/view/10.21037/ajo-23-37/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://www.theajo.com/article/view/10.21037/ajo-23-37/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related

to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Research Ethics and Governance Information System (REGIS) (2020/ETH00306). The trial was registered with the Australian New Zealand Clinical Trials Registry (Trial ID ACTRN12620000660987p), and informed consent was taken from all individual participants.

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doi: 10.21037/ajo-23-37
Cite this article as: Nandakumar BS, Misra S, Wright D, Cheng A. A pilot study to determine the feasibility of "hot" tonsillectomy with plasma-mediated ablation for recurrent acute tonsillitis. Aust J Otolaryngol 2023;6:27.