Comparison Of Harmonic Scalpel, Coblation And Cold Dissection For Tonsillectomy In Adult

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Abstract

Objectives: To compare the safety and effectiveness of tonsillectomy with three different techniques. Design: A double-blinded randomized prospective clinical trial Setting and Participants: Totally120 patients with recurrent tonsillitis between April 2018 and April 2020 were included. Main Outcome Measures: Operative time, intra and post operative bleeding loss, pseudomembrane growth time, pseudomembrane shedding time, postoperative pain, and necrosis depth of specimens were compared of harmonic scalpel(HS), coblation and cold dissection(CD) tonsillectomy. Results: The operative time and intraoperative bleeding loss was significantly less in HS and coblation group than CD group($p < 0.05$). Pseudomembrane growth time and pseudomembrane shedding time were significantly longer in the HS group compared with the other groups($p < 0.05$). The postoperative pain levels were significantly higher on the first postoperative day in CD group($p < 0.05$), and significantly lower on the third and seventh postoperative day in coblation group($p < 0.05$). There was no significant difference among three techniques in terms of postoperative bleeding loss($p > 0.05$). The deepest necrosis depth in specimen was found in HS group($p > 0.05$), while in CD group, only edema was observed without necrosis. Conclusion: To compared with HS and CD, coblation is a faster, safer and more painless technique for tonsillectomy in adult.

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Conclusion: To compared with HS and CD, coblation is a faster, safer and more painless technique for tonsillectomy in adult.

Abbreviations: HS: harmonic scalpel; CD: cold dissection; VAS: visual analogue scale

Key point:

- This study showed that different tonsillectomy techniques have an effect on operation and determine the extent of postoperation pain and patients' recovery time.
- Analysis of research data showed that necrosis depth doesn't significantly correlate with postoperative pain. However,there was relation between necrosis depth and recovery time.
- By analyzing the causes of postoperative secondary bleeding, and after tonsillectomy care is extremely important
- HS and coblation tonsillectomy had significantly shorter operative time and less intraoperative bleeding.
- Coblation is a faster, safer and more painless technique for tonsillectomy in adult.

Introduction

Tonsillectomy is one of the most common procedure in Otorhinolaryngology, and it is recommended when the following standard is met: more than seven episodes in the prior year, or more than five episodes annually in the past 2 years, or more than three episode in the past 3 years(1). Although tonsillectomy is considered a simple procedure, how to further improve its safety, efficiency, painlessness and operability is still a concern. The efficacy of different tonsillectomy techniques is controversial.

HS uses ultrasonic waves to vibrate the knife head, vaporize the fluid in the tissue, denature and coagulate the protein in the cell, and produce hemostatic effect while cutting the tissue(2). Coblation uses the formation of a plasma thin layer in a plasma radio frequency electric field. The charged particles in the plasma thin layer are accelerated to dissociate the molecular bonds in the tissue and form carbohydrates and oxides. Under relatively low temperature conditions (40-70) to achieve the purpose of ablation and coagulation(3).

The aim of this study is to comapre postoperative pain score and postoperative bleeding loss of HS, coblation and CD tonsillectomy to select the surgical technique with the least complications and to explore the best tonsillectomy technique in adult in terms of operative time, intraoperative bleeding loss, pseudomembrane growth and shedding time, and necrosis depth of specimen.

Method

A double-blinded randomized clinical trial was conducted and included 120 patients aged 18 to 65 years with recurrent tonsillitis from April 2018 to April 2020 were recruited for tonsillectomy and randomly divided into 3 groups.

Ethical considerations

This study's approval was obtained by the Ethics Committee of "Blinded for review".According to the Chinese law and the guidelines of the research ethics committee, all patients gave informed consent of allowing randomization prior to operation.

Rondomization

Patients were divided into three groups randomly by using random number table prepared and managed by a nonblinded nurse. All information was stored separately and only was available for emergency situations.

Operative technique

All operations was performed by the same surgeon under general anesthesia. We performed 40 HS tonsillectomy using a high-intensity focused ultrasound machine(Johnson & Johnson,New Brunswick,USA) at the level of 5 in dissection and 3 in haemostasis, performed 40 coblation tonsillectomy using EVac Xtra HP type knife head connected to Coblate II Surgical System(ArthroCare Corp,Austin,USA) at the level of 7 in ablation and 3 in coagulation, and performed 40 CD tonsillectomy using sickle-shaped knives and bipolar electrocautery.

All patients were not given antibiotics, hemostatic drugs or other drugs after surgery. Patients were given a cold liquid diet in three days after the operation, and a cold semi-liquid diet in 14th postoperative day.

Examination methods

The removed tonsils immersed in 10% formalin solutionwere divided into parts passing through the upper and lower pole, and were fixed in a paraffin block by the same operator. The paraffin block-was made into 4-5 micron sections and stained with hematoxylin–eosin method. The pathological section was photographed by KF-PRO-120 digital pathology panoramic scanner(KFBIO,Yuyao,China), and the necrosis depth was measured by K-Viewer software(KFBIO,Yuyao,China).

Evaluation methods

All patients were hospitalized for seven days after surgery and telephoned for follow up. The operative time was recorded from cutting mucosa to finishing hemostasis. Postoperative pain was recorded through visual analogue scale (VAS) at 8 AM on the first, third, seventh and fourteenth postoperative days. Pain severity was scored from 0 to 10, which 0 means no pain and 10 means the most severe pain(4).

The pseudomembrane growth and shedding time were observed and recorded by the same observer at 8 AM every morning. The pseudomembrane growth time was recorded as tonsil fossa was completely covered by white fibrous membrane. The time when the white fiber membrane completely falls off is the pseudomembrane fall off time.

Intraoperative bleeding loss is calculated by fluid volume of suction bottle and the weigh of cotton ball pre and post the surgery. Record whether the patient has bleeding from the first day to the fourteenth day after surgery.

Statistical methods

Statistical Package for the Social Sciences version 26(SPSS 26.0,IBM Corp, Armonk, New York, USA) was used for data analysis. Before starting the analysis, the continuous variable were tested for normality (Shapiro-Wilk test) and homogeneity of variance test (Levene's test). The result shows that all continuous variables do not conform to normal distribution or homogeneity of variance. Kruskal-Wallis test was applied as parametric tests for comparison of data. A p value less than 0.05 was considered statistical significance. Frequency distribution is given for categorical variables and discrete variables, expressed as a percentage. Chi-square test were applied for categorical variables and discrete variables with 95% confidence level.

Results

120 patients all completed the 14-day follow-up. There are 40 patients in each group, including 20 males and 20 females. There was no statistically significant difference in the rate of age or gender between the three groups($p > 0.05$)(Table 1).

Pain score

The CD group(6.4(95 per cent CI, 6.11 to 6.59)) showed significantly higher pain scores than other two groups on the 1st postoperative days ($p < 0.05$), and no statistically significant difference was showed between HS group(5.7(95 per cent CI, 5.47 to 5.88)) and coblation group(5.7(95 per cent CI, 5.45 to 5.85)) ($p > 0.05$). Patients of cobation group(3.05(95 per cent CI, 2.80 to 3.30), 1.33(95 per cent CI, 1.17 to 1.48), respectively) showed significantly lower pain scores than HS group(3.75(95 per cent CI, 3.50 to 4.00), 1.60(95 per cent CI, 1.43 to 1.77), respectively) and CD group(4.08(95 per cent CI, 3.83 to 4.32), 1.70(95 per cent CI, 1.51 to 1.89), respectively) on the 3th and 7th postoperative days($p < 0.05$). There was no statistically significant difference in patients' pain scores among three groups on the 14th postoperative day($p > 0.05$) (Figure 1).

Postoperative bleeding

No case of primary bleeding was reported. Two cases of secondary bleeding occured in each group. Most patients occured secondary bleeding after eating hard food for about a week after surgery(Table 2).

Operative time

The operative time of CD group(57.3min) was significantly longer than other two groups($p < 0.05$). There was no statistically significant difference between HS group(20.9min) and coblation group(22.2min)($p > 0.05$)(Figure 2A).

Intraoperative bleeding

The mean intraoperative bleeding loss in CD group (70.5ml) was significantly more than that in HS group(3.5ml) and coblatin group(5.9ml)($p < 0.01$). The Intraoperative bleeding loss of HS group and coblation group showed no statistically significant difference($p > 0.05$)(Figure 2B).

The pseudomembrane growth and shedding time

The pseudomembrane growth and shedding time in the HS group were significantly longer than the other two groups($p < 0.05$). Although there was no statistically significant difference, the pseudomembrane growth and shedding time in the CD group were longer than the coblation group(Figure 3A,3B).

Necrosis depth

The depth of scar tissue produced by thermal injury is used as the standard for the necrosis depth during tonsillectomy. The mean necrosis depth in HS group was 767.5μm. In coblation group, the mean necrosis depth was 447.1μm. In CD group, there was a little inflammatory cell infiltration in the tonsil tissue without thermal injury, but the interstitial edema was severe, and small blood vessels were dilated(Figure 4). The necrosis depth was statistically different between three groups($p < 0.05$)

Discussion

Tonsillectomy is one of the most common operations in otolaryngology and the number is increasing per year over recent decades(5). In the past century, a variety of modern techniques have emerged to replace traditional CD tonsillectomy to make the surgery more fast, safe, and efficient.

Postoperative pain is the main factor affecting patients' quality of life of in the short-term. Although the VAS score of the CD group was significantly higher than other two groups on the1st postoperative day, the VAS score of the HS group was higher than the other two groups on the 3rd and 7th postoperative day, and the VAS score of coblation group was lower throughout the recovery period. We believe that coblation tonsillectomy has lower postoperative pain compared with HS and CD tonsillectomy. There are many factors that affect the level of postoperative pain in patients. Ragabet al. reported that higher VAS scores in CD group on the first day after surgery may be related to more intraoperative bleeding resulting in unclear operation fields and longer operation time(6). Postoperative pain is mainly caused by inflammation, tissue damage and stimulation of mucous membranes, muscles, and nerve endings by mechanical movements such as swallowing. HS tonsillectomy has more severe thermal damage, leading to more obvious inflammation and a slower recovery rate. Coblation tonsillectomy reduces both intraoperative mechanical and thermal injury, which leads to lesspostoperative pain. Mitic et al. reported that coblation tonsillectomy has less postoperative pain than CD tonsillectomy(7). Polites et al. reported that the application of coblation tonsillectomy on only the first three days after surgery has less postoperative pain than CD tonsillectomy(8).

According to the results of our study, two cases of secondary bleeding occured in each group. It is worth noting that the mean time to occur secondary bleeding was 7.8th days after surgery in the three groups. As epithelial cells grow inward from the wound edge, the epithelial contracture causes the fibrinous clot to separate and expose the granulation tissue on the 7th day after surgery(9). Meantime, as patient's pain getting greatly reduced, patients are eager to return to a normal diet, subconscious mechanical stretching is more likely to cause secondary bleeding. The stimulation of repeated inflammation can cause necrosis and fibrosis of the surrounding tissues to make the tonsils adhere to the surrounding tissues(10, 11), and because of the large diameter of blood vessels in the lower tonsils, bleeding is more dangerous if they occur. In order to avoid severe bleeding, we suggest that active postoperative care and surgical proficiency are very important, the tonsils should be carefully separated along the capsule, especially the lower pole of the tonsils.

To compared with CD tonsillectomy, both HS tonsillectomy and coblation tonsillectomy can significantly reduce operative time and intraoperative bleeding loss, which is also recognized by many other scholars(6, 12, 13).

Pseudomembrane is a fibrin clot that includes inflammatory cells and bacteria(14). HS tonsillectomy has high thermal damage to the tissue. The heat energy denatures the collagen in the tissue, and the pseudomembrane is thicker, which makes the pseudo-membrane grow and fall off time for a longer time(15).

Our study shows that HS tonsillectomy has stronger thermal damage to tonsil tissue, while CD tonsillectomy has no thermal damage. The necrosis depth is not related to postoperative pain and postoperative bleeding rate. Boğrul et al. reported that necrosis depth was positively correlated with the degree of postoperative pain(16). However, we believe that the necrosis depth is related to the healing time of surgery.

Conclusion

Coblation tonsillectomy have obvious advantages in respect of operation time, intraoperative bleeding loss,postoperative pain and healing time. We suggest that postoperative care and surgical proficiency are crucial factors affecting postoperative secondary bleeding. Although it has not been proved that the necrosis depth is related to postoperative pain, the results showed that the necrosis depth was negatively correlated with the healing time.

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