The Role of Hypertonic Saline in Monopolar Tonsillectomy in Pediatric Patients

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Abstract Looking for a simple and inexpensive method to reduce patients' pain during tonsillectomy. Bilateral tonsillectomy patients were enrolled and placed into different groups based on their admission numbers. Patients with odd numbers had electrical tonsillectomy on the right side with hypertonic saline injection into peritonsillar gap (group A) or electrical tonsillectomy on the left side without hypertonic saline injection (group B). Those with even numbers had electrical tonsillectomy on the left side with hypertonic saline injection into peritonsillar gap (group A) or electrical tonsillectomy on the right side without hypertonic saline injection (group B). Pain, operative bleeding, post-operation bleeding and operation time were evaluated. Injecting hypertonic saline into peritonsillar gap reduced pain caused by electrical tonsillectomy but did not impact operation or postoperative bleeding and operation time. While simple and economic, monopolar electrical tonsillectomy with the help of hypertonic saline injected into peritonsillar gap can effectively relieve patients from pain compared with surgeries without hypertonic saline injection.

Keywords Hypertonic saline · Monopolar tonsillectomy · Operation bleeding · Post-operation bleeding

Introduction

Tonsillectomy is one of the most commonly used operations for treating chronic tonsillitis and/or tonsillar hypertrophy. Over the years, various surgical approaches, including diathermy, laser, plasma excision, radiofrequency ablation and harmonic scalpel, have been developed besides cold knife dissection tonsillectomy. However, none of the new techniques has been clearly shown to be better than the others and no single technique can be recommended as an standard method [1]. Monopolar diathermy is a relatively simple and less expensive method among these hot techniques. It reduces operating time, minimizes per-/post-operative risk of bleeding compared with cold knife dissection. A systematic review of the literature found that electrical dissection increases surgical pain comparing to sharp dissection in tonsillectomy, which was mostly caused by thermal damage. It is rarely reported on how to reduce thermal damage, which is the key for postoperative comfort of the patient.

Our study investigated the difference of clinical outcomes of monopolar dissection diathermy with or without injection of hypertonic saline into peritonsillar gap.

Methods

All the procedures have been approved by the institution review board of Rizhao City Hospital.

Sixty tonsillectomy patients were recruited to the study from January to December of 2010, with parental consent. They are 4–9 years old (mean 5.6 years). There were 32 boys and 28 girls, of which 21 had chronic tonsillitis (one of them with chronic nephritis) and 39 were complicated with adenoidal hypertrophy (Table 1).

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Table 1 Characteristics of patients

Admission #	Age	Sex	Concurrent condition
1	4	F	T+A
2	6	F	T+A
3	9	M	T
4	5	F	T+A
5	4	M	T+A
6	5	M	T
7	4	M	T+A
8	6	F	T
9	7	F	T+A
10	5	M	T+A
11	6	M	T+A
12	5	F	T
13	4	M	T+A
14	5	F	T+A
15	8	M	T
16	4	M	T+A
17	7	F	T
18	8	F	T
19	5	M	T+A
20	6	F	T+A
21	4	M	T+A
22	5	M	T
23	7	F	T
24	5	F	T+A
25	6	F	T+A
26	4	M	T
27	4	F	T+A
28	6	M	T
29	5	M	T+A
30	5	F	T+A
31	7	M	T+A
32	6	M	T+A
33	5	M	T
34	7	M	T+A
35	6	F	T+A
36	4	F	T+A
37	6	M	T+A
38	5	F	T+A
39	4	M	T
40	9	F	T
41	5	F	T+A
42	6	M	T
43	9	F	T+A
44	4	M	T+A
45	5	F	T+A
46	7	F	T
47	4	M	T+A
48	5	F	T

Table 1 continued

Admission #	Age	Sex	Concurrent condition
49	5	M	T+A
50	8	M	T+A
51	4	F	T+A
52	5	M	T
53	5	M	T
54	8	F	T+A
55	4	M	T+A
56	9	M	T+N
57	5	M	T+A
58	4	F	T
59	6	M	T+A
60	5	F	T+A

T Tonsillitis, *A* adenoidal hypertrophy, *N* nephritis

The patients were assigned to groups receiving hypertonic saline (80 ml 0.9 % hypertonic saline + 20 ml 10 % hypertonic saline) injection or without injection based on their admission numbers. Patients with odd numbers had electrical tonsillectomy on the right side with hypertonic saline injection into peritonsillar gap (group A) or electrical tonsillectomy on the left side without hypertonic saline injection (group B). Those with even numbers had electrical tonsillectomy on the left side with hypertonic saline injection into peritonsillar gap (group A) or electrical tonsillectomy on the right side without hypertonic saline injection (group B).

All cases were performed under endotracheal general anesthesia by the same surgeon. Patients were supine and their mouths were kept open with a Davis mouth gag to expose the tonsils. A tongue retractor of suitable size was used depending on the age of the patient. Before operation, 1–2 ml hypertonic saline was injected into peritonsillar gap at one side. Adenoidectomy was performed and packed followed by electrical tonsillectomy using a German Aesculap 300 with the cutting current being set at 40 w with coagulation at 20 w. The upper pole of the tonsil was grasped with an Allis clamp and drawn toward midline. The tonsillar membrane was opened along the free margin of palatoglossal arch. A straight clamp dissector was used to free the upper tonsillar pole, which was then pulled down to midline. An assistant retracted the palatoglossal arch away from the tonsil. The tonsillar membrane was exposed and the whole tonsil was removed with electrical coagulation in an top down fashion. Intra-operative hemostasis was achieved with electrical coagulation. Stubborn bleeding at the inferior tonsillar pole was controlled by suture ligation. Surgical time was measured from the start of one-side operation to complete hemostasis after tonsil removal. Intra-operative bleeding was estimated by

gauze weight and suction volume. Postoperative pain was assessed using analog visual scales, with 0 for no pain and 10 for the worst pain. Pain scores were collected at 8:00 am everyday on postoperative day 1, 3, 5, and 8. Patients were followed up in 4 weeks to examine tonsillar bed healing (Table 2).

Statistics

Statistical analysis was performed using SPSS 12.0 software. *P* values of less than 0.05 were considered statistically significant.

Results

The surgical time, intra-operative bleeding, and postoperative pain of the two groups were analyzed (Table 2). The operation time (6.13 ± 1.87 min vs. 7.68 ± 2.04 min) and surgical bleeding (11.92 ± 0.250 ml vs. 12.07 ± 1.77 ml) were both reduced with the injection of hypertonic saline but the differences were not significant ($P > 0.05$ in both cases). However, patients received injection of hypertonic saline experienced markedly less post-surgical pain ($P < 0.01$). Postoperative tonsil bleeding occurred in six cases (seven sides). There were three cases of primary hemorrhage in group B (3/60) and two cases of primary bleeding for group A (2/60) ($P > 0.05$). There was one case who had chronic nephritis (two sides) of secondary bleeding due to operation cavity ooze bleeding and widespread electric setting. Primary hemorrhage was treated with suture ligation under general anesthesia and secondary bleeding received conservative treatment. At 4-week follow-up all patients healed completely.

Discussion

Tonsillectomy, with a history over thousand years, is one of the most common surgeries in Otorhinolaryngology [3]. Cold dissection (CD) and electrodissection are the two mostly used techniques. The main goal of this study was to establish a method that can reduce operative time, per/postoperative risk of bleeding, postoperative pain, and the

number of complications [4–7]. Traditional techniques of CD and snare are easy to perform but perioperative bleeding is hard to control, especially in pediatric patients. Hot tonsillectomy techniques with diathermy can reduce the intra-operative bleeding and surgical time [8] but increases postoperative pain in comparison to sharp dissection [2]. Pizzuto et al. [9] suggested there was not any difference in the healing time of tonsillar fossae between electrosurgical and classical dissection tonsillectomy, whereas other authors have stated that healing of the tonsillar fossa occurred much sooner with the CD method [10, 11]. Without the thermal damage, electrodissection is superior to CD method. How to reduce thermal damage is the key for postoperative comfort of the patient.

Our data showed that injecting hypertonic saline into peritonsillar gap could significantly reduce postoperative pain. The hypertonic saline injection could work in several ways to achieve such an effect. (1) Pushing tonsil away from lateral pharyngeal wall to minimize the injury to lateral pharyngeal wall muscle; (2) Reducing electrocautery-caused damage to lateral pharyngeal wall vessels to avoid fatal hemorrhage; (3) Absorbing part of the heat produced by the electrocautery technique and reducing the thermal damage of lateral pharyngeal wall; (4) hypertonic saline increased the conductivity of the organ to improve the electrocautery efficiency, making it possible to use less power to achieve normal cutting effect.

The electrocautery technique we used in this study offered us the ability to have a clear surgical field with adequate visualization of blood vessels, which enabled us to cauterize small vessels and ligate the large ones before cutting or dissecting, thereby providing a simultaneous hemostasis. A clear visualization of the surgical field also made it possible to dissect the tonsils without damaging the muscle layer.

Degradation of tissue and cell can occur with heat transformed from the electrical current. Irreversible damage can happen when the temperature is higher than 55°C (Artz 1979). Recent studies reported that 57°C may be the threshold as heat-sensitive enzymes have been shown to degrade when temperature reaches this threshold. Thermal injury includes a primary (acute) and a secondary processes, which include vascular bed contraction, thrombosis, ischemia, and inflammation. The secondary bleeding in this

Table 2 Surgical time (ST), intra-operative bleeding (IOB) and pain scores at different postoperative days (POD) in two groups ($x \pm s$)

Group	ST (min)	IOB (ml)	Pain score			
			POD1	POD3	POD5	POD8
A	$6.13 \pm 1.87^*$	$11.92 \pm 0.250^{**}$	$5.78 \pm 0.21^{***}$	$5.86 \pm 0.24^{***}$	$4.21 \pm 0.17^{***}$	$2.34 \pm 0.18^{***}$
B	7.68 ± 2.04	12.07 ± 1.77	7.75 ± 0.28	8.16 ± 0.32	7.93 ± 0.23	4.87 ± 0.26

Comparison between group A and B: * $P > 0.05$; ** $P > 0.05$; *** $P < 0.01$

study indicated more serious thermal injury shown by intraoperative operation cavity ooze and widespread electric setting. Most likely explanation is that the tonsil is very sticky which greatly diminished the effect of pushing tonsil away from lateral pharyngeal wall by injecting hypertonic saline into peritonsillar gap. Although hypertonic saline injection into peritonsillar gap have benefits to most monopolar tonsillectomy, it is reduced or negated by tonsil adhesion.

Our study demonstrated that monopolar electrical cautery unit is a simple, affordable and effective equipment for performing tonsillectomy with the help of the injection of hypertonic saline into peritonsillar gap compared to other hot tonsillectomy equipments. Hypertonic saline injection into peritonsillar gap is a efficient way to relieve patients from postoperative pain.

Conflict of interest We declare that we have no financial and personal relationships with other people or organizations that can inappropriately influence our work, there is no professional or other personal interest of any nature or kind in any product, service and/or company that could be construed as influencing the position presented in, or the review of, the manuscript entitled.

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