



RESEARCH

THE EFFECT OF COBLATION TONSILLECTOMY ON THE MIDDLE EAR PRESSURE

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SUMMARY

Purpose: The aim of this study is to investigate early postoperative effect of tonsillectomy with cold knife blunt dissection and with coblation on the middle ear pressure. **Material and Method:** We randomized patients internalized in I.ENT Clinic of Dr.Lütfi Kırdar Kartal Education and Research Hospital for tonsillectomy into 2 groups including 13 patients. Tonsillectomy techniques via coblation and cold knife to these two groups of patients were performed. Changes in middle ear pressure during postoperative period were measured by tympanometric examination, on each day for 7 days. **Result:** The average of the tympanometry values in coblation tonsillectomy group was more negative than the average of tympanometry values in cold knife tonsillectomy group but no statistically significant difference was found. **Conclusion:** Coblation plasma surgery system had no negative effect on the postoperative pressure of middle ear compared to the cold knife tonsillectomy.

Keywords: Coblation tonsillectomy, cold knife tonsillectomy, middle ear pressure

COBLATION TONSİLLEKTOMİNİN ORTA KULAK BASINCI ÜZERİNE ETKİSİ

ÖZET

Amaç: Coblation ve soğuk bıçak tonsillektominin erken postoperatif dönemde orta kulak basıncına etkilerinin araştırılması. **Yöntem ve Gereç:** Dr. Lütfi Kırdar Kartal Eğitim ve Araştırma Hastanesi 1. KBB Kliniğinde tonsillektomi yapılmak üzere yatan hastalardan randomize olarak 13' er kişilik iki grup oluşturuldu. Bu iki grup hastaya coblation ve soğuk bıçak teknikleri ile tonsillektomi uygulandı. ki farklı yöntemle tonsillektomi yapılan hastalarda postoperatif dönemde orta kulak basınç değişimleri 7 gün boyunca timpanometrik olarak incelendi. **Bulgular:** Coblation tonsillektomi yapılan grupta timpanogram değerlerinin ortalaması soğuk bıçak tonsillektomi yapılan grubun timpanogram değerlerinin ortalamasından daha negatif değerlerde bulunmasına rağmen istatistiksel olarak anlamlı farklılık tespit edilmedi. **Sonuç:** Coblation plasma cerrahi sisteminin soğuk bıçak tonsillektomiye kıyasla postoperatif orta kulak basıncı üzerine olumsuz etkisi görülmedi.

Ahtar Sözcükler: ses handikap endeksi, parsiyel larenjektomi, larinks kanseri

INTRODUCTION

Tonsillectomy is the most common type of operation used in developing countries, and it is applied with a wide range of techniques. As an alternative to cold knife blunt dissection methods described by Crowe, Watkins and Rottholz, from the early 1980's several methods such as laser, ultrasonic technology, bipolar and monopolar radiofrequency systems have become of considerable use in order to decrease the operation time and reduce the amount of bleeding without undergoing any change in the surgical procedure¹.

Being a new electrodissection technique, which runs on a diverse principle than the conventional electrosurgical tools, tonsillectomy with radiofrequency is a novel modality. Although it was claimed to be a novel tonsillectomy procedure decreasing the amount of intraoperative bleeding and

operation time as well as reducing the postoperative pain due to lesser peripheral tissue damage than conventional electrosurgical methods, studies for search and development of new surgical techniques are still going on in order to both reduce surgical morbidity and increase post-operative patient comfort.

The functions of eustachi tubes are damaged following a tonsillectomy operation, however the number of studies related with the effect of tonsillectomy operation on the functions of eustachi tube is very limited.

In a study including adult patients, Bonding and Tos have found negative pressure on the middle ear in 60% of the patients following the operation of tonsillectomy² whereas Hone et al obtained Type C typanogram postoperatively at day 1 in 39% of the patients³.

In this study, we designed to investigate the effect of tonsillectomy with both cold knife blunt dissection and Coblation in middle ear pressure. We found no study about the changes in the middle ear

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pressures following the coblation tonsillectomy procedure in the literature, which means that the present study is the first one in this sense.

MATERIAL & METHOD

The present study was carried out on 26 patients over 12 years old who were eligible for recurrent acute tonsillitis and underwent tonsillectomy operation under general anaesthesia at the 1st ENT Clinic of Dr. Lütfi Kirdar Kartal Training and Research Hospital between April 2003 and December 2003. All patients or guardians gave signed informed consent before enrolling in the study.

The criteria used for patient selection were as follows:

1) Being 12 years of age or more, 2) Having a history of recurrent acute tonsillitis where the criteria for recurrent acute tonsillitis included⁴:

- Three exacerbations per year during the last 3 years or five exacerbations per year during the last 2 years or seven exacerbations during the last 1 year
- Each exacerbation was accompanied at least with one of the followings:
 - Oral fever at 38° C and over, >2 cm or sensitive anterior cervical lymph node
 - Tonsillary exudate
 - Positive culture for Group A beta hemolytic Streptococcus
- Sufficient use of antibiotic therapy at diagnosed or suspected exacerbations,
- Confirmation of each exacerbation by examination, and their documentation with detailed characteristics.

3) Lack of adenoid vegetation in patients, 4) Lack of anamnesis for middle ear disease, 5) Normal findings of tympanic membranes by microscopic examination, 6) Presence of bilateral cross acoustic reflexes, 7) normal pneumoscopic examination, 8) No history of ENT operation, 9) Absence of any other chronic disease, 10) No history of drug allergy, 11) Absence of regular analgesic use during preoperative period, 12) Absence of any pacemaker and other electronic implants, 13) Bilateral Type "A" preoperative tympanogram curve types.

The preoperative tympanometry was carried out using AZ 26, Interacoustics, Denmark by otologists in a sitting position following an otoscopic examination with no oral intake in the morning one day before the operation.

For analysis of tympanogram curve, 3 main features were present: shape of the curve (presence of

any peaks), pressure of the peak point and amplitude of the peak.

Several tympanogram curves were defined depending on these features.

Type A : It was a tympanogram curve with a peak at 0 (+49,-99) daPa pressure and having a peak amplitude of normal limits (average 0,6 ml).

Type B : It was a tympanogram curve without any peak.

Type C : It was a tympanogram curve with a normal peak amplitude, but the peak being between – 100 daPa and – 350 daPa pressures⁵.

Subgroups were not classified in this study.

The patients with Type B and Type C tympanogram curves were excluded, and the 26 patients with bilateral type "A" were randomized into two groups of 13 patients.

The preoperative data of the patients including age, gender, vital findings, physical examination findings, drug allergies, medical history and background were recorded. All were preoperatively hospitalized, and then discharged the day after the operation following one night hospitalization.

During the operation, the anaesthetic technique was standardized. Orotracheal intubation was carried out by using induction IV 5-7 mg/kg tiopental, 1.0-2.0 mcg/kg phentanyl citrate, 0.1 mg/kg vecuronium. The anaesthetic management was provided by 50% nitrogen protoxide, 50% oxygene and 1% isoflorane. For postoperative analgesia, 1 mg/kg tramadole was given.

15 patients in the cold knife group underwent tonsillectomy with a standard blunt dissection technique by the same ENT resident under the supervision of a staff surgeon. After complete removal of the tonsil tissue from fossa tonsillaris, haemorrhage was controlled by placing a dry gas tampon. In haemorrhages non-arrestable by tampons, it was sutured by lasso ties with a cutgut 3/0, and this procedure was repeated until the haemorrhage was under control.

And the patients in Coblation group underwent a tonsillectomy operation by the same ENT resident under the supervision of a specialist using a Bipolar ENTec Coblator Plasma Surgical System and Evac 70 Plasma probe and adjusting the output voltage rate to 8 (248-303 Vrms) via main panel or foot control pedal. Wet hypopharynx tampones were used to prevent severe and life threatening complications such as burns in mouth and glottis resulting from anaesthetic gases used during the coblation electrodissection procedure. A sterile 0,9 % NaCl was attached to the irrigation liquid port

of the probe, and adjusted to 1-3 drops/sc. For aspiration, system in the probe was used.

The haemorrhage regions were selectively blocked by pressing the C (coagulation) mode on pedal. In cases where bleeding region was not visible due to extreme haemorrhage, a saturation was carried out by performing lasso ties with a cutgut 3/0.

At the end of the operation, neuromuscular block was reestablished by neostigmine 0.04-0.07 mg/kg and atropine 0.01 mg/kg. All patients were extubated in the operation room, and then transferred to the awakening room.

All patients received amoxicillin suspension (50 mg/kg) and paracetamol suspension (10 mg/kg). Amoxicillin was taken three times daily while paracetamol suspension was received two times daily for a period of 7 days and their time was recorded. The replacement of intravenous liquids was continued until the oral intake of the patient was started.

During the postoperative period otoscopic examination was carried out everyday in the morning before any oral intake, and then a tympanometric examination was performed in a seating position at a private clinic using AZ 26, Interacousics, Denmark by otologists for a period of 7 days starting from the postop day 1. Follow-up was available on 26 patients.

For the assessment of our findings, SPSS (Statistical Package for Social Sciences) for Windows 10,0 program was used. In addition to descriptive statistical methods (average, standard deviation), in the evaluation of data obtained from the study for comparing quantitative data, Student's t test was used for age comparisons while using Mann Whitney U test for other parameters since their distribution was not normal. And for qualitative comparisons, The results were evaluated at 95% safety interval, and the significance at the level of $p < 0,05$.

RESULTS

The age of our cases ranged from 13 to 49 years with an average of $27,77 \pm 9,79$ years, and the study include 9 male and 17 female (Fig 1).

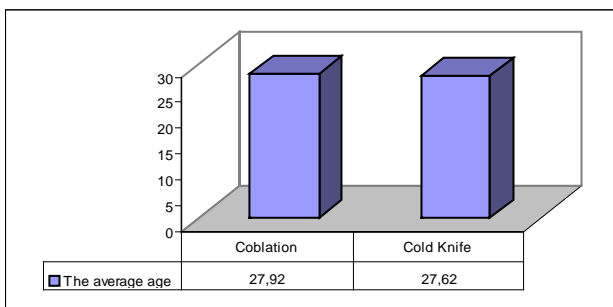


Fig 1. The average age of patients in both groups

No statistically significant difference was found between the gender and the average age of cases in the Coblation and Cold Knife groups ($p > 0,05$) (Table1, Fig 1).

	Coblation		Cold Knife		p
	Mean	S.D.	Mean	S.D.	
Age	27,92	10,96	27,62	8,93	0,938
Gender	n	%	n	%	p
Male	3	23,1	6	46,2	0,205
Female	10	76,9	7	53,8	

Table 1. Demographic findings

No statistically significant difference was found between preoperative averages of right and left middle ear pressure measurements of Coblation and Cold Knife groups for the following seven days ($p > 0,05$) (Table II, Fig 2) (Table III, Fig 3).

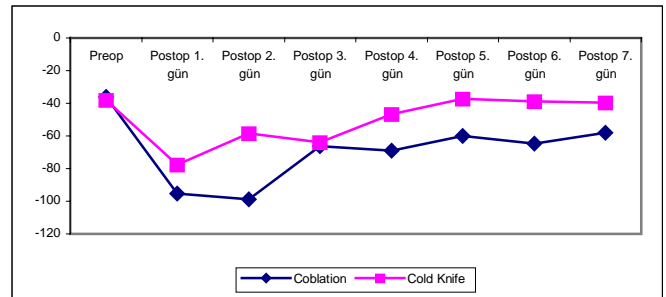


Fig 2. Evaluation of right ear measurements by groups in graphic

Right side	Coblation		Cold knife		p
	Mean	S.D.	Mean	S.D.	
Preop	-36,00	14,79	-37,85	25,70	0,836
Postop 1. day	-95,23	123,45	-77,54	94,37	0,738
Postop 2. day	-98,77	134,73	-58,46	79,64	0,258
Postop 3. day	-66,08	106,78	-64,00	69,70	0,588
Postop 4. day	-69,15	122,75	-46,77	18,91	0,303
Postop 5. day	-59,92	92,44	-37,08	13,33	0,918
Postop 6. day	-64,85	109,45	-38,77	18,14	0,715
Postop 7. day	-58,15	85,11	-39,69	18,86	0,897

Table II: Evaluation of right ear measurements by groups

Although the average measurements Coblation and Cold Knife groups of left middle ear were almost significant at post-operative day 3, it was not found statistically significant ($p > 0,05$).

When postoperative tympanogram curve type changes were compared, separate statistical analysis for both ears showed no significant difference between the two groups.

2 patients (15%) in the group whom coblation tonsillectomy was applied without taking the changing day of the curve into account changed to Type "C" in the tympanogram curve.

One patient of this group had type "C" tympanogram curve for both ears at postoperative days 1 and 2, and the tympanogram curve at postoperative day 3 showed improvement in the middle ear pressure resulting in a bilateral type "A"

tympanogram, which was succeeded in following days.

One patient, again who underwent coblation tonsillectomy, had type “C” tympanogram for both ears at day 1, followed by type “B” at tympanogram of day 3 in the right ear. This patient in coblation group had air fluid leveling and bubbles in otoscopic examinations .

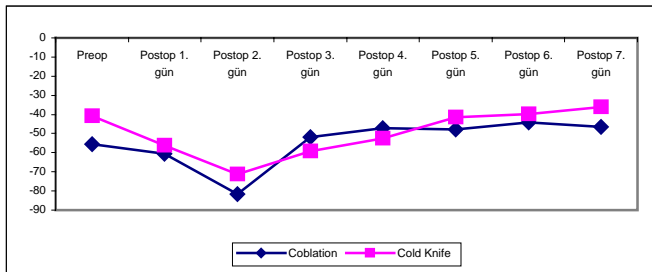


Figure 3: Evaluation of left ear measurements by groups in graphics

Left side	Coblation		Cold knife		P
	Ort.	S.D.	Ort.	S.D.	
Preop	-55,69	86,05	-40,92	19,33	0,303
Postop 1. day	-60,46	76,79	-56,15	54,81	0,643
Postop 2. day	-81,54	110,34	-71,38	67,43	0,979
Postop 3. day	-51,92	72,72	-59,38	46,09	0,056
Postop 4. day	-47,08	63,42	-52,46	35,93	0,110
Postop 5. day	-47,85	60,11	-41,54	22,38	0,290
Postop 6. day	-44,00	45,96	-39,85	15,06	0,302
Postop 7. day	-46,46	56,79	-36,00	14,05	0,571

Table III. Evaluation of left ear measurements by groups

In successive follow-ups, there was a change from type “B” to Type “C” in the tympanogram at postoperative day 7 in the right ear while the left ear maintained type “C” tympanogram until postoperative day 7. This patient was followed, and his both ears improved within 15 days resulting in a Type “A” tympanogram.

Three patients (23%) of Cold Knife group changed to Type “C” tympanogram postoperatively.. In this group of patients, two patients had bilateral Type “C” tympanogram from postoperative day 1 to 4, and at postoperative day 4 it was improved to bilateral Type “A”, which was also maintained in the successive days .

Again one patient had Type “C” tympanogram in the left ear from day 2 to day 6 although he had Type “A” tympanogram for a period of 7 days in the right ear. At day 6 , the tympanogram was changed to Type “A” in the left ear.

None required myringotomy nor ventilation tube placement.

None of our patients had complications.

DISCUSSION

The negative pressure change in the middle ear has been defined as a result of various therapeutic

applications in the Ear, Nose and Throat (ENT) diseases^{2,6-9}.

It has been shown that there was a reduction in the middle ear pressure following bilateral anterior nasal packing and posterior nasal packing procedures, and it drastically improved after the removal of tampons^{6,7}.

It has also been showed that prolonged nasotracheal entubation and nasogastric entubation led to pressure changes in the middle ear and went back to normal status after the removal of tubes^{8,9}.

Tonsillectomy alone is one of the most common surgical procedures used in ENT^{10,11}. Transient negative middle ear pressure commonly occurs following tonsillectomy.

It may be suggested that tonsillectomy may have a two-stage effect on the functions of middle ear in the early postoperative period. In the first stage, the surgical tissue trauma resulting from both fine and blunt dissection might lead to an edema within the nasopharynx or an obstruction over the lymphatic drainage ways, which in turn may result in swollen peritubal lymphatic plexus and changes in the mucosal capillary pressures of the middle ear. Another effect might present itself as narrowing the eustachi tubular access by means of air absorption into the ear and mucosal inflation, and consequently formation of intratympanic compliance alterations¹².

Secondly, during tonsillectomy, the manipulation of the soft palate can result in damage, tension, partial laceration or hematoma. The tension on the soft palate might indirectly damage the function of ‘Tensor Veli Palatini’ muscle¹³, the inflammation in lower nasopharynx and soft palate following the trauma and tonsillectomy may result in the reduction of smoothly coordinated activity, which is present in the nasopharyngeal and eustachian muscles and necessary for the ventilation of middle ear.

Most of tonsillectomy patients also have a short-term abnormal deglutition, which may be affected from the pain, and from time to time inappropriate nasopharyngeal or eustachian tube coordination may be observed. Furthermore, orovelopharyngeal sphincter activity is weak and insufficient due to loss of lateral support by tonsilles.

It is likely to have abnormal middle ear function because of a combined activity of mechanisms. As it improves, inflammation and lymphatic stasis recede and functions of the middle ear goes back to normal¹².



Number of studies related with the changes of middle ear pressures following a Cold Knife tonsillectomy is very limited. Bonding and Tos reported that 9 out of 15 patients (60%) developed negative pressure in the middle ear². Six patients became normal within 2 days while it took several days for the other 3 patients.

Hone et al found that 39% of patients had a middle ear pressure less than -99 daPa at the first day after the tonsillectomy³.

They thought that patients with negative middle ear pressure had more sore throat, however the statistical analysis showed no significant relation between sore throat and negative middle ear pressure.

Electrosurgery is the only procedure enabling both incision and coagulation. Tonsillectomy is achieved by a controlled tissue dissection and lesser bleeding in a shorter period of time. Spot coagulation techniques prevent wider tissue damages, which in turn shortens the time for postoperative recovery and going back to normal activities¹⁴.

ENTec Coblator Plasma Surgery System functions at voltages between 96-312 Vrms and at 100 kHz. It amplifies the electrical impedance of the tissue, running in a lower frequency than the conventional electrosurgery system. The collapse of intracellular molecular bonds and increase in the ionic activities result in tissue heating between 60-100°C and evaporation, which in turn prevents extra heating of the peripheral tissues¹⁵⁻¹⁷.

Theoretically electrodissection is less harmful to the peripheral tissues than the conventional system^{15,18-19}.

Although the number of cases in our cold knife tonsillectomy group is similar to the number of cases in the study by Bonding and Tos, we have no definite answer why some patients have normal middle ear functions following tonsillectomy both by cold knife and coblation methods, however the reasons for finding less number of patients with postoperative middle ear pressure in our study than the study of Bonding and Tos might be as follows: We don't know exactly the tonsillectomy technique they used in their study. No information is available about the damage in peripheral tissues and related edema due to the techniques used, amount of bleeding, whether they used any cauter for bleeding control or not, duration of operation and anaesthesia, types and doses of analgesic drugs used for anaesthesia. We don't know anything about the analgesic use in postoperative period, and whether they received any anti-edema therapy or not. All patients received a standart analgesic protocol

following their operation so this should not have been a confounding variable in our study. We also don't know how the tympanometric measurements were performed. As the horizontal position may reduce ventilation of the middle ear we recorded tympanograms with the patient sitting in an upright position.^{2,9}

Depending on all these variable factors, our results may differ from their outcomes.

Compared to the study of Hone et al, the number of cases in our cold knife tonsillectomy group was smaller. Twenty-two patients comprised the experimental group in their study. Two-way analysis of compliance in mm H₂O demonstrated a significant (p less than 0.001) change to abnormal compliance in both ears of the experimental group in the postoperatif period vs preoperatif period. In our study, No statistically significant difference was found between preoperative averages of right and left middle ear pressure measurements of Coblation and Cold Knife groups for the following seven days (p>0,05).

They thought that patients with negative middle ear pressure had more sore throat, however the statistical analysis showed no significant relation between sore throat and negative middle ear pressure. According to Bonding and Tos, the cause of going back to normal middle ear pressures is the reduction in sore throat and increase in frequency of swallowing².

In our study we did not investigate relation between post-operatif all 7 days averages of pain values and the average of tympanometric values of right and left ears in both group. A new study can be designed for this question..

Hone et al used bismuth subgallate binding or bipolar diathermia for perioperative bleeding control. Our results may differ due to the different techniques used for bleeding control or differences in the number of cases.

The present study covers the time just before the tonsillectomy operation and the following seven days, therefore it was not possible to observe the long term effects of the operation. The middle ear pressure during and following the general anesthesia is greatly increased^{20,21}.

Thomsen et al reported that the rapid increase in middle ear pressure is proportionate to the inhaled nitrous oxide concentration²² so the tympanometric examination was performed not at the operation but starting from the next day. In their study, Finkelstein et al compared middle ear pressure changes in 19



patients underwent UPPP with a control group of 7 patients who have undergone only tonsillectomy for recurrent infection. A negative middle ear pressure developed which was significantly lower than in the control group. This fact probably indicates a greater impairment of eustachian tube function in UPPP group. They also stated that subgroup of patients undergoing UPPP with antibiotic treatment showed much less impairment of the eustachian tube function.

All our patients received amoxicillin suspension (50 mg/kg) for a period of 7 days in order to prevent an infective origin ET function impairment following the operation.

Our study included adult patient groups, which enabled us to have a wider range of operation population, and consequently more flexibility. We were not experienced and skillful in coblation procedure as much as we were good in cold knife tonsillectomy. Therefore, we advise the people who will start to use this procedure to be as careful as possible for any damage in the periphery. Furthermore, we would like to indicate some technical problems we had using the devices; difficulty in adjusting the flow rate of irrigation fluid, quick occlusion of the probe aspirator, and difficulty in cleaning and re-opening may complicate the operation and increase intraoperative haemorrhage prolonging the operation time. And, in addition to higher costs compared to cold knife procedure, use of disposable probe for each operation other than the main unit adds up to the financial burden.

CONCLUSION

There are very few studies on tonsillectomy by coblation plasma surgery system, which is a radiofrequency procedure. We found no study about the changes in the middle ear pressures following the coblation tonsillectomy procedure in the literature,

Coblation plasma surgery system had no negative effect on the postoperative pressure of middle ear compared to the cold knife tonsillectomy.

The surgeon must be experienced and skillful to deal with technical problems in coblation procedure. Higher costs compared to cold knife procedure should be remembered.

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