

ORIGINAL ARTICLES

## Comparison of treatment costs of plasma knife tonsillectomy with conventional tonsillectomy at Ho Chi Minh City Otolaryngology Hospital, 2020

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### ABSTRACT

**Objective:** Tonsillitis is one of the common diseases in children and adults. Tonsillectomy is one of the most popular surgeries performed by ear-nose-throat doctors in the world as well as in Vietnam. Currently, in Vietnam, there is no scientific study evaluating the costs (include treatment cost, non-medical cost and direct cost) of 2 methods of tonsillectomy with Plasma knife and conventional tonsillectomy. Compare the treatment costs of Plasma knife tonsillectomy with conventional tonsillectomy at Ho Chi Minh City Otolaryngology Hospital in 2020 by descriptive cross-sectional method.

**Methods:** Crossectional study with 100 patients with plasma knife tonsillectomy and 36 patients with conventional tonsillectomy

**Result:** The results show that the average cost of a tonsillectomy with a Plasma knife is 17,695,000 ± 6,690,000 VND, the average cost of a conventional method is 21,413,000 ± 7,901,000 VND. The plasma knife tonsillectomy method has a lower total cost than the conventional method and is statistically significant with  $p < 0.05$ . The average cost saved when choosing the plasma cutting method instead of the convention is 3,178,000 VND. Although the direct cost of treatment in the Plasma group is higher than that of the conventional group, the direct costs not for treatment such as travel and meals, indirect costs of lost income of patients and caregivers lower. Because the number of days off due to surgery of the Plasma group is  $6.54 \pm 3.51$ , lower than the conventional group  $8.14 \pm 2.32$  days

**Conclusion:** The hospital needs to advise patients on issues of expenses through seminars, scientific reports and on the hospital's media: website, facebook, Fanpage.

**Keywords:** Cost, tonsillectomy, plasma knife, conventional tonsillectomy, Ho Chi Minh City Otolaryngology Hospital.

### INTRODUCTION

Tonsillitis is one of the most common diseases in children and adults. Tonsillectomy is one of the most popular surgeries performed by ear-nose-throat doctors in the world as well as in Vietnam. According to data from the Organization for Economic Co-operation and Development (OECD),

tonsillectomy in developed countries is performed at an average rate of 128 cases per 100,000 population, ranging from 23 to 254 cases per 100,000 population, in 2013 there were 1.57 million tonsillectomy (1). Tonsillectomy is a common technical service accounting for 24.7% of surgeries performed in the specialty of Ear, Nose and Throat in Vietnam (2).



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At the Ho Chi Minh City Otolaryngology Hospital, since 2014, the Plasma knife has been applied to cut tonsils in parallel with other techniques such as classical dissection, coblato cutting, etc. Although the direct cost of plasma knife tonsillectomy is more expensive than conventional tonsillectomy (dissection), the number of plasma tonsillectomy is increasing; So, why with more cost, but plasma tonsillectomy is still chosen by patients compared to conventional tonsillectomy. Currently, in Vietnam, there are no scientific studies evaluating the treatment costs of two methods of tonsillectomy with plasma knife and classical tonsillectomy. It is for this reason that we conduct a study: “Comparison of treatment costs of plasma knife tonsillectomy with conventional tonsillectomy at Ho Chi Minh City Otolaryngology Hospital in 2020”.

## METHODS

**Study design:** A cross-sectional descriptive study.

**Time and location of the study:** from July 15, 2020 to September 15, 2021, at the Department of Surgery of the Day, Ho Chi Minh City Otolaryngology Hospital.

### Sample size

Formula for calculating sample size for a study comparing two means

$$n_1 = \frac{(\sigma_1^2 + \sigma_2^2 / \kappa)(z_{1-\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

$$n_2 = \frac{(\kappa * \sigma_1^2 + \sigma_2^2)(z_{1-\alpha/2} + z_{1-\beta})^2}{\Delta^2}$$

Thus, we selected 100 patients in the plasma group and all patients during the data collection period (3 months) in the non-plasma group, actually 36 patients were selected.

### Sampling method

Selection of patients with tonsillectomy by day surgery package at the Department of Surgery during the study period from July 15, 2020 to December 15, 2020. Two research groups cutting tonsils with Plasma knife and the group cutting tonsils by dissection method performed by the same group of surgeons.

**Research subjects:** Patients who cut tonsils with plasma knife and classic dissection at the Department of Surgery of the Day, Ho Chi Minh City Otolaryngology Hospital from July 15, 2020 to December 15, 2020.

**Sample selection criteria:** Indication for tonsillectomy: According to 2012 guidelines of AAO – HNS (American Academy of Otolaryngology & Head and Neck Surgery); Patients aged  $\geq 16$  years; The patient consented to participate in the study

**Exclusion criteria:** Patients with coagulopathy, cardiovascular disease, tuberculosis, diabetes...

### The method of data collection

**Direct costs for treatment:** The cost of tonsillectomy at the surgical department is a fixed full cost. We selected all the patients who do not use health insurance card. The direct costs were collected from the direct payment voucher/slip for the patient's treatment.

**Direct non-treatment costs and Indirect costs for treatment:** Patients or caregivers were interviewed using structured questionnaires in order to collect detailed information about direct non-treatment costs as well as patients and caregivers' income lost during the patient's treatment period.

### Methods of data analysis

Data was entered and managed by Excel software, using SPSS 18.0 program for processing and analysis. Qualitative variables, discrete variables are represented by percentage statistics. Quantitative variables,

continuous variables are represented by the statistical mean (mean  $\pm$  standard deviation) or median. Using the chi-square test to compare the ratios, the t-test to compare the average costs, the threshold is statistically significant when  $p < 0.05$ .

**Ethics approval:** With the consent of the Hanoi university of Public Health's medical ethics committee at: 322/2020/YTCC-HD3 August 3, 2021.

## RESULTS

### General information of research subjects

The study was conducted on 100 patients undergoing Plasma, and 10 samples were lost due to the situation of Covid-19 disease, the number of patients coming to Plasma surgery at the hospital decreased by 30%. The total sample size of the Conventional group was 36 people.

**Table 1. General characteristics of research subjects**

Characteristics	Plasma (n=100)		Conventional (n=36)		Total	
	n	%	n	%	n	%
<b>Age</b>						
Mean	32,32 $\pm$ 8,93		30,28 $\pm$ 9,43		31,78 $\pm$ 9,07	
(min - max)	(17 - 60)		(17 - 52)		(17 - 60)	
<b>Sex</b>						
Male	48	48,0	20	55,6	68	50
Femal	52	52,0	16	44,4	68	50
<b>Place to live</b>						
HoChiMinh city	50	50,0	24	66,7	74	54
Other provinces	50	50,0	12	33,3	62	46
<b>Occupation</b>						
Pupils - Students	6	6,0	6	16,7	12	8,82
Office staffs	29	29,0	12	33,3	41	30,15
Workers - Farmers	24	24,0	8	22,2	32	23,53
Traders - others	41	41,0	10	27,8	51	37,50
Income (1.000VND)	536 $\pm$ 281		770 $\pm$ 208		598 $\pm$ 282	
	(200 – 1.500)		(400 -1.500)		(200 -1.500)	

Comparison of treatment costs of plasma knife tonsillectomy with conventional tonsillectomy

**Table 2. Comparison of treatment costs for the 2 study groups (1.000 VND)**

Parameters	Plasma (n=100)	Conventioanl (n=36)	p-value
<b>Direct treatment costs</b>	<b>8.119</b>	<b>5.990</b>	
<b>Direct non-treatment costs</b>	<b>970 ± 533</b> (140 – 2.325.000)	<b>1.262 ± 360</b> (620 – 2.015)	<b>0,9**</b>
- Traveling cost	418 ± 257 (50 – 1.125)	610 ± 174 (300 – 975)	0,07
Patients' meal cost	552 ± 291 (80 – 1.440)	651 ± 185 (320 – 1.040)	<b>&lt; 0,001**</b>
<b>Indirect costs</b>	<b>8.534 ± 6.301</b> (700 – 39.000)	<b>14.161 ± 7.714</b> (3.600– 38.500)	<b>&lt;0,001**</b>
- Number of day-off from work for treatment	6,54 ± 3,51 (1 - 16)	8,14 ± 2,32 (4 - 13)	<b>0,012**</b>
- Patients' average income	3.328 ± 2.659 (400- 16.000)	6.244 ± 2.596 (2.400- 16.500)	<b>&lt;0,001**</b>
- Caregivers' average income	2.721 ± 1.866 (150- 8.400)	4.417 ± 2.480 (1.200- 11.000)	<b>0,04**</b>
- Hiring carers cost	3.501 ± 2.775 (150- 15.000)	5.727 ± 2.311 (2.000- 11.000)	<b>&lt;0,001**</b>
<b>Total costs</b>	<b>17.695 ± 6.690</b> (9.030 – 49.430)	<b>21.413 ± 7.901</b> (10.210 – 46.195)	<b>0,034**</b>

(\*\*) *t*-test (independent *t*)

The total cost of a treatment in this study was calculated as the sum of the direct costs for the treatment, the direct non-treatment costs and the indirect costs. The total cost in the Plasma group was VND 17,695,000 ± 6,690,000, lower than the total cost in the Conventional group of VND 21,413,000 ± 7,901,000 with  $p < 0.05$ .

The direct cost for treatment included examination cost, package cost of the Plasma or Conventional knife tonsillectomy and re-examination cost. The average direct cost for Plasma knife tonsillectomy was VND 8,190,000, and the Conventional knife tonsillectomy was VND 5,990,000.

Direct non-treatment costs were the costs of travel and meals of the patients. In the

Plasma group it was VND 970,000 ± 533,000 and in the Conventional group it was VND 1,262,000 ± 360,000. In which, the cost of travel in the Plasma group was lower than that of the Conventional group with no statistical significance ( $p = 0.07$ ), while the cost of meals in the Plasma group was lower than that of the conventional group with statistical significance ( $p < 0.001$ ). The direct non-treatment cost in the Plasma group and the conventional group was not statistically significant ( $p = 0.9$ ).

Indirect costs were calculated based on the daily income of the patient and carer with the total number of days off due to surgery. In the Plasma group, the number of days off due to surgery was  $6.54 \pm 3.51$  days, lower than the

Conventional group  $8.14 \pm 2.32$  days with  $p = 0.012$ . The indirect cost in the Plasma group was VND  $8,534,000 \pm 6,301,000$ , lower than

the Conventional group VND  $14,161,000 \pm 7,714,000$ , statistically significant with  $p < 0.001$ .

**Table 3. Comparison of indirect costs by 2 methods according to demographic characteristics and disease status of patients (1,000 VND)**

	Plasma (n=100)					Conventional (n=36)				
	Mean	SD	max	min	p	Mean	SD	max	min	p
Age	6.816 + 53 x Age				0,05	13.206 + 31 x Age				0,06
Gender										
Male	7.421	1.995	2.310	800	0,09	13.825	8.052	38.500	3.600	0,7
Femal	9.563	7.198	3.390	700		14.581	7.507	3.300	5.500	
Place to live										
HCM	8.142	6.919	3.900	700	0,5	14.367	8.985	38.500	3.600	0,8
Other provinces	8.927	5.659	2.310	800		13.750	4.498	21.000	7.500	
Occupation										
Pupils - Students	4.817	1.790	7.200	2.100	0,3	7.767	3.035	13.000	5.500	0,08
Office staff	8.372	5.238	2.190	700		15.850	5.470	24.000	7.000	
Workers - Farmers	7.979	5.367	2.310	2.200		12.787	4.781	19.200	7.500	
Traders - Others	9.518	7.669	3.900	800		17.070	11.393	38.500	3.600	
Amount of blood lost	-337 + 1.230 x Bloodlost				0,04	20.214 – 241 x Bloodlost				0,1
Bleeding after 24hrs										
Yes	7.620	4.177	13.500	4.000	0,06	-				
No	8.582	6.405	3.900	700						
Pain level										
Day 01	4.117 + 603 x Painlevel				1,9	33.194 – 2.182 x Painlevel				0,3
Day 05	5.693 + 768 x Painlevel				0,7	10.820 + 647 x Painlevel				0,8
Day 12	6.310 + 3.223 x Painlevel				0,02	16.689 – 1.820 x Painlevel				0,4

*p: Chi-square test*

Comparison of indirect costs between groups of socio-demographic characteristics of patients in the two surgical groups showed no difference in indirect costs in both Plasma and Conventional groups. For disease status, in the Plasma group blood loss, pain level had

a linear relationship with indirect costs and there was no difference in indirect costs in the two groups with and without bleeding after 24 hours. Specifically, when the blood lost increased by 1 ml, the indirect cost increased to VND 1,230,000, the pain level after day 12

increased to 1, the indirect cost increased to VND 3,223,000. In the conventional group,

there was no difference in indirect costs across the disease condition groups.

**Table 4. Comparison of direct non-treatment costs by 2 methods according to demographic characteristics and disease status of patients (1,000 VND)**

	Plasma (n=100)					Conventional (n=36)				
	Mean	SD	max	min	p	Mean	SD	max	min	p
Age	1.036 – 2 x Age				0,7	1.692 – 4 x Age				0,5
Gender										
Male	856	499	2.330	140	0,04	1.530	382	2.350	875	0,4
Femal	1.076	547	2.330	140		1.617	278	2.150	1.150	
Place to live										
HCM	809	458	2.240	140	0,02	1.581	340	2.350	1.000	0,7
O t h e r provinces	1.131	559	2.330	155		1.546	349	2.100	875	
Occupation										
Pupils - Students	- 653	229	980	420	0,3	1.600	413	2.350	1.150	0,9
Office staff	873	366	1.680	140		1.523	259	1.900	1.150	
Workers - Farmers	- 1.027	571	2.330	140		1.619	383	2.100	875	
Traders - Others	- 1.052	621	2.330	140		1.567	384	2.150	1000	
Amount of blood lost	-60 +106 x Bloodlost				0,02	1.892 – 13 x Bloodlost				0,04
Bleeding after 24hrs										
Yes	1.085	438	1.400	775	0,7	(only one case)				
No	968	537	2.330	140						
Pain level										
Day 01	797 + 23 x Painlevel				0,5	769 +91 x Painlevel				0,3
Day 05	857 + 31 x Painlevel				0,4	2.103 -103 x Painlevel				0,5
Day 12	839 + 190 x Painlevel				0,03	1.549 + 15 x Painlevel				0,8

*p*: Chi-square test

The direct non-treatment cost for patients in the two surgical groups with different socio-demographic characteristics did not differ, except for the location characteristics in the Plasma surgery group, the direct non-treatment costs in the group of other provinces

was higher than the group in Ho Chi Minh City with  $p = 0.02$ . Regarding the disease status, the amount of blood lost after surgery in both groups had a linear relationship with the direct non-treatment cost: in the Plasma group, when the blood lost increased by 1 ml, the cost

increased to VND 106,000, the bleeding after 24 hours, the pain level on day 01 and day 05 did not affect the cost, however, the pain level on day 12 after surgery in the Plasma

group was statistically significant, when the pain level increased by 1, the cost increased to VND 190,000, but in the Conventional group, there was no statistical significance.

**Table 5. Comparison of total treatment cost by 2 methods according to demographic characteristics and disease status of patients (1,000 VND)**

	Plasma (n=100)					Conventional (n=36)				
	Mean	SD	Max	min	p	Mean	SD	Max	min	p
Age	1.604 + 51 x Age				0,5	20.887 + 27 x Age				0,8
Gender										
Male	16.467	5.323	33.500	9.130	0,07	21.346	8.302	46.600	10.600	
Femal	18.828	7.619	49.400	9.030		22.189	7.639	41.100	12.600	
Place to live										
HCM	17.141	7.306	49.400	9.030	0,4	21.937	9.200	46.600	10.600	0,8
Other provinces	18.248	6.036	33.500	9.150		21.286	4.690	28.700	14.400	
Occupation										
Pupils Students	- 13.660	1.974	16.200	10.700	0,3	15.357	3.435	21.300	12.600	0,1
Office staff	17.435	5.509	31.500	9.030		23.363	5.624	31.900	14.400	
Workers Farmers	- 17.196	5,771	3.350	10,500		20.396	5.018	27.000	14.400	
Traders - Others	18.760	8.130	4.940	9,130		24.627	11.710	46.600	10.600	
Amount of blood lost	7.793 + 1.335 x Bloodlost				0,04	28.097 – 254 x Bloodlost				0,08
Bleeding after 24hrs										
Yes	18.025	7.155	23.100	13.000	0,9					
No	17.688	6.720	49.400	9.030						
Pain level										
Day 01	13.103 + 627 x Painlevel				0,2	39.954 -2.090 x Painlevel				0,3
Day 05	14.740 + 799 x Painlevel				0,07	18.913 + 543 x Painlevel				0,6
Day 12	15.340 + 3.413 x Painlevel				0,02	24.228 – 1.805 x Painlevel				0,4

*p: Chi-square test*

The total cost of patients in the two surgical groups with different socio-demographic characteristics did not differ. For the disease condition, in the Plasma group, the amount of blood lost after surgery and the pain level on day 12 had a linear relationship with the total cost: when the blood lost was 1ml, the total

cost increased to VND 1,335,000, the level pain increased to 1, the total cost increased to VND 3,413,000 and was statistically significant with  $p < 0.05$ , the bleeding after 24 hours and pain level at day 1 and day 5 did not affect the total cost. In the Conventional group, the disease status characteristics such



as blood lost, pain level at day 1, day 5, day 12 did not affect the total cost with  $p > 0.05$ .

## DISCUSSION

### Total cost for tonsillectomy surgery

The choice of the plasma knife tonsillectomy method had a lower total cost than the conventional method, with statistical significance with  $p < 0.05$ . The results showed that the average cost of a tonsillectomy with a Plasma knife was VND 17,695,000  $\pm$  6,690,000, the lowest cost of surgery was VND 9,030,000 and the highest was VND 49,430,000. The average cost of the conventional tonsillectomy was VND 21,413,000  $\pm$  7,901,000, the lowest cost was VND 10,210,000 and the highest was VND 46,195,000. Thus, the average cost saved when choosing the plasma cutting method instead of the conventional was VND 3,178,000. The tonsillectomy in our study was a within-a-day surgery package.

According to a study by Mohammad Faramarzi et al in 2021, the study compared the cost-effectiveness of same-day tonsillectomy compared with inpatient tonsillectomy in Southern Iran. As a result, the total cost of a day surgery was 915.1 USD (~ VND 21,083,647.77, in 2021) lower than a package of surgery and inpatient treatment 1227.9 USD (~ VND 28,720,581, in 2021). The author also calculated this total cost by the direct cost for treatment including hospital fees and surgery package price, the direct non-treatment cost including the patient's food and travel expenses, indirect costs including the cost of lost income for patients, carers, and carer rental costs, were similar to the formula for the total cost of our study (3).

A 2006 study by Fujihara, Keiji & Koltai in Japan compared the cost-effectiveness of

tonsillectomy for recurrent acute tonsillitis included 39 children and 129 adults who had tonsillectomy between 1997 and 2003, showing that the total cost of tonsillectomy (treatment costs and indirect income costs) in adults was \$4,475 (4).

Research by Grace Baik et al in 2018 on "Comparison of pediatric intracapsular tonsillectomy and extracapsular tonsillectomy: A decision analysis of cost and utility". The results showed that extracapsular tonsillectomy was more expensive and had a longer recovery time, leading to more expensive indirect costs. Cost analysis demonstrated that ICT (cut in bag) with a total cost of \$4,177.92 (equivalent to \$4,235.56 in 2021) was the overall cheaper option than ECT (out of bag) with total cost was \$4,546.91 (equivalent to \$4,609.66 in 2021) (5).

### Differences in total costs by groups of population, social and disease status

In our study, patients were operated on the same day and only re-examined 2 times after day 5 and day 12, no serious patients had to be re-examined immediately when there were severe signs, no complications were recorded. The study did not analyze the difference in direct costs in each group because direct costs including the cost of plasma or conventional packages and medical examination fees of the patients in each group were the same.

Analytical results in our study on the difference or influence of socio-demographic characteristics variables such as age, gender, address, occupation with cost types, show that only address had a relationship associated with direct non-treatment costs including meals and transportation in the Plasma group. Specifically, patients living in other provinces had a higher direct cost of no treatment than those living in Ho Chi Minh City, which was statistically significant with  $p=0.02$ . In fact, we found that people who moved from



another province to Ho Chi Minh City TMH hospital had higher travel costs than people in HCM city, which was reasonable. In the Conventional group, it was possible that because of the small sample size, there was no statistically significant difference in cost.

The amount of blood lost affects the direct non-treatment cost, the indirect cost and the total cost of treatment in the Plasma group, but only affected the indirect cost in the Conventional group. In the Plasma group, when the amount of blood lost during surgery increased by 1 ml, the indirect cost increased to VND 1,230,000, the direct non-treatment cost increased to VND 106,000, the total cost increased to VND 1,335,000. and in the Conventional group, when the blood lost increased by 1ml, the direct non-treatment cost increased to VND 13,000. Bleeding after 24 hours did not affect indirect costs, direct non-treatment costs, and total costs. The level of postoperative pain at day 12 affected costs in the Plasma group, specifically, if the pain level increased to 1 after day 12, the indirect cost increased to VND 3,223,000, the direct non-treatment cost increased to VND 190,000 and the total cost increased to VND 3,413,000. As for the conventional group, it might be because the sample size of the conventional group was quite small (36 patients), so it was difficult to have statistical significance when analyzing. According to the results of this study, the pain level of the plasma group was lower than that of the classical group with  $p < 0.001$  ( $0.04 \pm 0.23$  versus  $0.10 \pm 0.36$ ). The surgical process caused blood loss, the patient would feel pain and fatigue, the rest time to recover would increase, the expenses such as food, travel, and lost income due to leave would also increase.

## CONCLUSION

The plasma knife tonsillectomy method had a lower total cost than the conventional method

and had statistical significance with  $p < 0.05$ . The results showed that the average cost of a tonsillectomy with a Plasma knife was VND  $17,695,000 \pm 6,690,000$ , the lowest cost of surgery was VND 9,030,000 and the highest was VND 49,430,000. The average cost of the conventional tonsillectomy was VND  $21,413,000 \pm 7,901,000$ , the lowest cost was VND 10,210,000 and the highest was VND 46,195,000. Thus, the average cost saved when choosing the plasma cutting method instead of the conventional was VND 3,178,000.

Characteristics such as: location of residence was associated with direct non-treatment costs in the Plasma group; blood loss and postoperative pain at day 12 increased the direct non-treatment costs, indirect costs and total treatment costs in the Plasma group. The amount of blood lost after surgery in the conventional group only increased the direct non-treatment costs, other costs had no statistical significance.

Although the direct cost of treatment in the Plasma group was higher than that of the Conventional group, the direct non-treatment costs such as travel and meals, indirect costs of lost income of patients and caregivers lower. Because the number of days off due to surgery of the Plasma group was  $6.54 \pm 3.51$ , lower than the Conventional group  $8.14 \pm 2.32$  days.

**Recommendation:** The hospital needs to advise patients on costs through seminars, scientific reports and on the hospital's media: website, facebook, Fanpage, etc.

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