



# The Effect of Glossopharyngeal Nerve Block on Post-Tonsillectomy Pain of Children; Randomized Controlled Trial

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## Abstract

**Background:** Sensory fibers of the glossopharyngeal nerve supply the tonsillar and peritonsillar areas. Thus, bilateral glossopharyngeal nerve block may alleviate post-tonsillectomy pain and improve postoperative analgesia.

**Objectives:** The purpose of this clinical trial was to evaluate the effect of glossopharyngeal nerve block on postoperative analgesia in children undergoing adeno-tonsillectomy

**Methods:** Ninety ASA I-II pediatric patients presented for adeno-tonsillectomy were included in this trial. They were equally divided and randomly assigned to one of two groups: A control group, in which children did not receive a nerve block, and a glossopharyngeal nerve block group, in which children received bilateral glossopharyngeal nerve block after surgery. The postoperative pain score (FLACC score) during rest and swallowing, the time for the first request for rescue analgesia, the total dose consumption of pethidine rescue analgesia, and the incidence of postoperative complications were all assessed. Moreover, response to gag reflex, degree of difficulty in swallowing, and parents' satisfaction were recorded.

**Results:** Bilateral glossopharyngeal nerve block in children presented for adeno-tonsillectomy significantly prolonged the time for the first request of rescue analgesia, compared to the control group, reaching  $5.833 \pm 2.667$  hours ( $P < 0.0001$ ). It also decreased postoperative pethidine consumption to  $0.878 \pm 0.387$  mg/kg ( $P = 0.0009$ ). Moreover, it significantly decreased the postoperative FLACC score assessed two, four, six, and twelve hours after surgery, during rest and swallowing ( $P < 0.05$ ). The response to gag reflex and difficulty in swallowing were also significantly decreased ( $P \leq 0.0001$  and  $0.006$ , respectively). In addition, glossopharyngeal nerve block significantly increased parents' satisfaction ( $P = 0.0002$ ), with no significant increase in the incidence of postoperative complications ( $P > 0.05$ ).

**Conclusions:** Bilateral glossopharyngeal nerve block in children undergoing adeno-tonsillectomy improved the duration and the quality of postoperative analgesia, decreased swallowing difficulties, and improved parents' satisfaction.

**Keywords:** Glossopharyngeal Nerve, Tonsillectomy, Analgesia, Gag Reflex, Swallowing

## 1. Background

Adeno-tonsillectomy surgery in pediatrics is commonly managed as an ambulatory surgery. This may be attributed to the use of the electro-dissection surgical technique that decreases the incidence of immediate postoperative hemorrhage. However, use of the electro-cautery technique increases postoperative inflammation (1, 2). The inflammatory process involves the release or generation of multiple inflammatory mediators from the damaged tissues. Some mediators, such as bradykinin and serotonin, may directly activate the peripheral nociceptive receptors. Other mediators, such as prostaglandins, increase the sensitivity of nociceptive receptors to other mediators. Thus, increased inflammation is associated with increased post-

operative pain and discomfort, especially during the first postoperative day (3, 4).

Increased postoperative pain can delay hospital discharge, delay return to school, and affect the child's nutrition (5). Many techniques were tried to alleviate postoperative pain following adeno-tonsillectomy and improve the patients' and parents' comfort, with conflicting outcomes. These included the use of systemic opioid analgesics (6), non-steroidal anti-inflammatory medications (7), corticosteroids (8), local anesthesia spray (9), and local anesthesia infiltration (10).

One local anesthetic technique that can be used to control postoperative pain after tonsillectomy is the glossopharyngeal nerve block. However, this is debatable, as some trials revealed its effectiveness (11), while others

found it ineffective (12).

## 2. Objectives

Glossopharyngeal nerve block, when used in children presented for tonsillectomy, may improve the duration and the quality of postoperative analgesia. The aim of this clinical trial was to evaluate the effect of glossopharyngeal nerve block on the time of the first call for rescue analgesia (primary outcome) and pain scores during swallowing and resting (secondary outcome) in children undergoing tonsillectomy.

## 3. Methods

This prospective double-blinded trial was conducted at Tanta University Hospitals after approval of the local research ethics committee was obtained (Tanta Faculty of Medicine Research Ethics Committee 34531/07/2017), and it was registered at the Pan African Trial Registry (identification number: PACTR201711002816160). It lasted for nine months (August 2017 to April 2018). Children aged four to ten years old, of both genders, American Society of Anesthesiologists classes I or II, and scheduled for adenotonsillectomy were included in this study. Diabetic children, those with cardiac, renal, or liver diseases, those suspected for or having evident hypersensitivity to the used medications, those with peritonsillar abscess, those with swallowing disorders, and those receiving regular analgesia within the last week before surgery were all excluded from the study.

All patients underwent pre-anesthetic checkup, and routine laboratory investigations were requested from them, including complete blood count and coagulation assessment. The study was adequately explained to the guardians of the children, including its purpose, technique, benefits, and risks, as well as methods to overcome them. Parents, who accepted to participate were reassured and asked to sign informed written consent. The children were kept fasting from solid food for six hours and from clear water for two hours before surgery. They were also reassured and received full explanation of the whole process on the morning of the surgery.

In the preparation room and under the supervision of a well-trained expert nurse, all children were premedicated 30 minutes before surgery with atropine 0.01 mg/kg and midazolam 0.04 mg/kg, intravenously. They were then transported to the operating room and attached to a non-invasive monitor consisting of a 5-lead electrocardiogram, a Noninvasive Blood Pressure (NIBP) monitoring system, and a pulse oximeter to measure oxygen saturation (SpO<sub>2</sub>).

The induction of anesthesia was carried out by fentanyl 1 µg/kg, propofol 2 mg/kg, and cisatracurium 0.15mg/kg to facilitate tracheal intubation. A cuffed endotracheal tube of suitable size was then introduced, with the patient attached to a mechanical ventilator, parameters being adjusted to maintain normocapnia (EtCO<sub>2</sub> 35 ± 4 mmHg). Isoflurane 1.2% in oxygen:air (1:1) was used to maintain anesthesia. All children received an intravenous fluid infusion composed of D5 ½ at a rate of 6 mL/kg/hour. Paracetamol 15 mg/kg I.V. was administered over the span of 15 minutes.

Tonsillectomies were carried out by the same expert surgeon using the same technique (bipolar electrocautery). The patients were randomly distributed to two equal groups by the aid of a computer generated software of randomization that introduced groups in sealed closed envelopes. This made sure that parents stay blind to the group their children were assigned to.

### 3.1. Control Group (Group C)

The patients in this group did not receive glossopharyngeal nerve block at the end of the surgery.

### 3.2. Glossopharyngeal Nerve Block Group (Group G)

At the end of the surgery, glossopharyngeal nerve block was carried out using 10 mL (5 mL in each side) of a local anesthetic mixture composed of 0.25% plain bupivacaine (Marcaine, ASTRA, UK).

### 3.3. The Technique of Glossopharyngeal Nerve Block

Glossopharyngeal nerve block was carried out by the surgeon with the aid of McIvor gag and a 25-gauge spinal needle, set at an angle of 45 degrees at a distance of 1 cm from its tip. In the middle point of the palatopharyngeal fold (posterior tonsillar pillar), the needle pierced the retropharyngeal mucosa and was directed behind the posterior tonsillar pillar as lateral as possible. It was then inserted in the pharyngeal wall at a depth of about 0.5 cm. After careful aspiration, the prepared local anesthetic mixture was slowly injected over the span of three minutes.

At the end of the surgery, inhalational anesthesia was switched off and muscle relaxation was reversed (using neostigmine 0.05 mg/kg and atropine 0.01 mg/kg), with full awake extubation, and the children being kept in lateral position. They were then transported to the PACU for close observation and monitoring. They were discharged when the modified Aldrete score reached 10. All measurements were obtained by an assistant physician, who was not participating in the study and who was blinded to its groups.

The FLACC behavioral pain assessment scale (13) was used to assess postoperative pain during rest and during swallowing, 30 minutes, two, four, six, 12, 18, and 24 hours after surgery. Children with a pain score of four or more received pethidine 0.5 mg/kg I.V. as rescue analgesia, which may be repeated, taking in consideration that the total daily dose should not exceed 1.5 mg/kg. The time of first request of rescue analgesia was recorded, representing the time interval between the end of the surgery and the first request of rescue analgesia (primary outcome). The total dose of pethidine consumed in the first 24 hours was also recorded.

In the PACU, gag reflex was assessed by a tongue depressor that was used to lightly touch the posterior wall of the lower part of the oropharynx and estimate the patients response (none: no response, mild: grimace but tolerable, moderate: facial flushing, or severe: facial flushing with coughing, lacrimation, or restlessness). Moreover, before discharge from the PACU, swallowing was assessed by the aid of a four-point scale (none: normal or no difficulty in swallowing, mild: some difficulty in swallowing, moderate: effort is required for swallowing, or severe: no swallowing or swallowing only with maximal effort).

The incidence of perioperative complications, such as postoperative nausea and vomiting, delayed hospital discharge, choking, local anesthetic toxicity, dyspnea, bradycardia, dry mouth, nasal obstruction, hoarseness of voice, or foreign body sensation in the throat, was also assessed. On the second postoperative day, the parents were asked to rate their satisfaction with postoperative analgesia given to their children, as either very good, good, fair, bad, or very bad. The children were discharged from the hospital after at least 24 hours and when there was no bleeding, nausea, or vomiting, they were able to swallow clear fluids, and their pain score was less than four.

#### 3.4. Statistics

A pilot study was conducted to assess the effect of glossopharyngeal nerve block on the time for the first request for pethidine rescue analgesia in 10 children (not included in the final study) presented for tonsillectomy. The use of glossopharyngeal nerve block significantly increased the time for the first request of analgesia from  $3.11 \pm 1.73$  hours to  $6.93 \pm 2.88$  hours. Based on these results, 45 patients from each group were required to detect a significant increase by two hours in the time for the first request of rescue analgesia, at an  $\alpha$  value of 0.05 and 90% power of the study. The SPSS computer program (SPSS Inc., Chicago, IL, USA) was used for statistical analysis of the measured data by unpaired *t*-test for parametric data (expressed as a mean and standard deviation) and Fisher's exact test for categorical data (expressed as a number and percent). Pain

score, response to gag reflex, degree of swallowing, and parents' satisfaction were assessed by the Mann-Whitney test. When the P value was less than 0.05, changes were considered significant.

#### 4. Results

Along the nine months of the study, 111 patients were enrolled. Twenty-one were excluded (nine were not meeting the inclusion criteria and 11 declined participation). The remaining 90 patients were randomly allocated to either the control group or the glossopharyngeal nerve block group, with successful follow-up and analysis of the data of all patients (Figure 1). Differences in age, gender, body weight, and the ASA class of the studied patients between the two groups were statistically insignificant ( $P = 0.903, 0.662, 0.442, \text{ and } 0.758$ , respectively). Also, the duration of the surgery was comparable between both groups ( $P = 0.362$ ) (Table 1).

The time for the first request for pethidine rescue analgesia was significantly prolonged in the glossopharyngeal nerve block group compared to the control group ( $P < 0.0001$ ). Moreover, the postoperative dose of pethidine consumed by the glossopharyngeal nerve block group was significantly lower than the control group ( $P = 0.0009$ ). The postoperative pain score during rest (FLACC score) was statistically decreased in the glossopharyngeal nerve block group compared to the control group, at two, four, six, and 12 hours, respectively ( $P \leq 0.0001, 0.0002, 0.0009, \text{ and } 0.039$ , respectively). However, the FLACC pain score during rest was comparable between the two groups at 30 minutes, 18 hours, and 24 hours after surgery ( $P = 0.168, 0.791, \text{ and } 0.464$ , respectively). In addition, the glossopharyngeal nerve block group showed significantly lower postoperative pain scores during swallowing compared to the control group, at two, four, and six hours postoperatively ( $P \leq 0.0001, 0.0012, \text{ and } 0.0013$ , respectively), with an insignificant difference between the two groups at 30 minutes, 12 hours, 18 hours, and 24 hours, postoperatively ( $P = 0.234, 0.197, 0.994, \text{ and } 0.360$ , respectively) (Table 2).

Postoperatively, in the post-anesthesia care unit, the response to gag reflex was significantly lower in the glossopharyngeal nerve block group than in the control group ( $P < 0.0001$ ). Furthermore, glossopharyngeal nerve block significantly decreased the difficulty in swallowing compared to the control group ( $P = 0.006$ ) (Table 3).

Parents of the glossopharyngeal nerve block group were statistically more satisfied with postoperative analgesia given to their children than those of the control group ( $P = 0.0002$ ) (Figure 2). The incidence of postoperative complications, including nausea and vomiting, choking, dry mouth, nasal obstruction, or foreign body sensation in

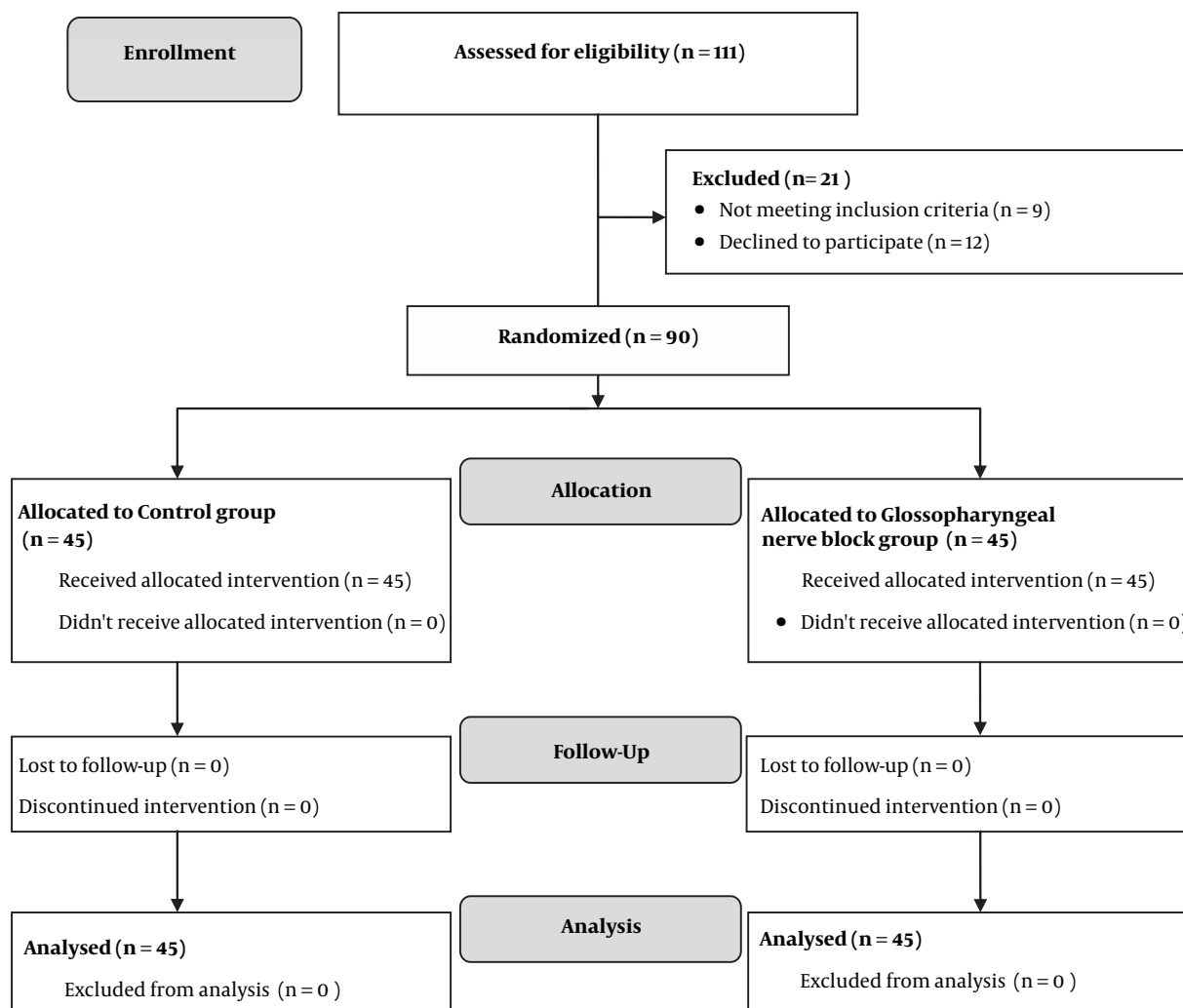


Figure 1. CONSORT flowchart of the study

the throat, was comparable between the two groups ( $P > 0.05$ ). No cases of local anesthetic toxicity, postoperative hoarseness of voice, or delayed hospital discharge were reported in the two studied groups (Table 1).

## 5. Discussion

The results of this clinical study proved that the use of bilateral glossopharyngeal nerve block in children presented for adeno-tonsillectomy significantly prolonged the time for the first request of pethidine rescue analgesia. It also decreased the postoperative dose consumed of pethidine, postoperative FLACC score during rest and swallowing, and postoperative gag reflex and difficulty of swal-

lowing. Moreover, glossopharyngeal nerve block significantly increased parents' satisfaction, without increasing the incidence of complications.

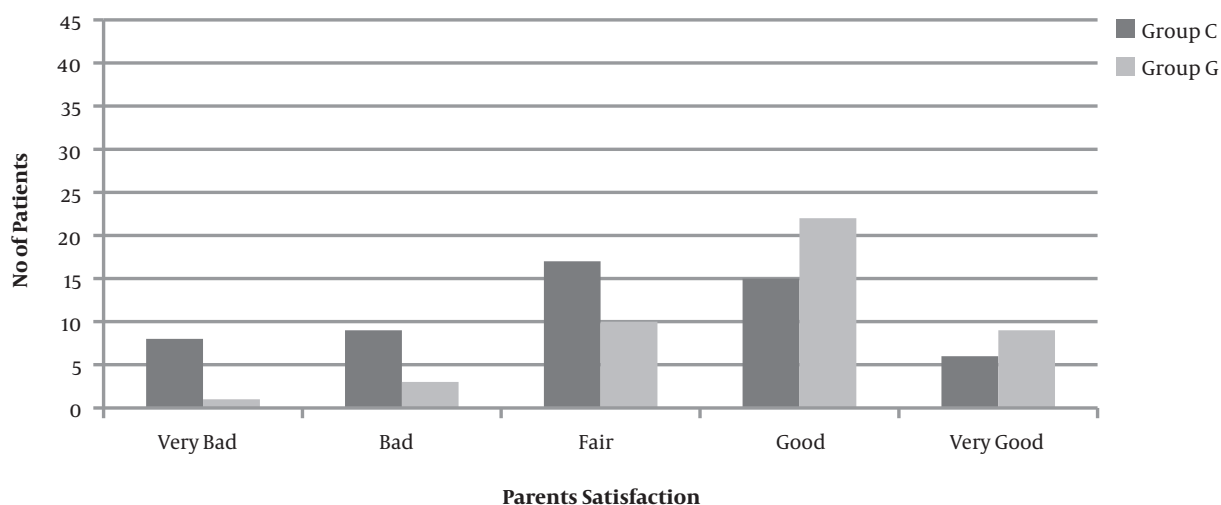
The tonsillar and peritonsillar areas are supplied by sensory fibers from the glossopharyngeal nerve. Consequently, glossopharyngeal nerve block resulted in decreased postoperative pain after tonsillectomy and decreased analgesic consumption. The control of postoperative pain following adeno-tonsillectomy resulted in decreased morbidity and increased satisfaction (3, 11).

Hung et al. (14) studied the effect of topical bupivacaine or normal saline on postoperative analgesia in 99 adult patients undergoing tonsillectomy. They found that bupivacaine instillation was associated with better

**Table 1.** Demographic Data and the Incidence of Postoperative Complications in the Studied Groups<sup>a</sup>

	Group C	Group G	P Value	CI (95%)
<b>Age, y</b>	5.956 ± 1.692	5.911 ± 1.743	0.903	-0.764; 0.675
<b>Gender</b>				
Male	27 (60)	30 (66.67)	0.662	0.574; 1.315
Female	18 (40)	15 (33.33)		
<b>Body weight, kg</b>	19.667 ± 3.323	19.067 ± 3.72	0.422	-2.078; 0.8777
<b>Duration of the surgery, min</b>	22.556 ± 3.787	23.333 ± 4.264	0.362	-0.912; 2.467
<b>ASA Class</b>				
Class I	40 (88.89)	38 (84.44)	0.758	0.609; 2.488
Class II	5 (11.11)	7 (15.56)		
<b>Postoperative complications</b>				
Nausea and vomiting	8 (17.78)	10 (22.22)	0.798	0.492; 1.519
Delayed hospital discharge	0	0	-	-
Choking	4 (8.89)	7 (15.56)	0.522	0.312; 1.575
Local anesthetic toxicity	0	0	-	-
Dry mouth	9 (20)	11 (24.44)	0.800	0.512; 1.495
Nasal obstruction	4 (8.89)	6 (13.33)	0.739	0.355; 1.718
Hoarseness of voice	0	0	-	-
Foreign body sensation in the throat	12 (26.67)	19 (42.22)	0.183	0.421; 1.138

Abbreviation: CI, confidence interval.

<sup>a</sup>Values are expressed as mean ± SD or No. (%).**Figure 2.** The parent's satisfaction of the studied patients in the two groups. Data were expressed by the No. of patients and the degree of satisfaction.

postoperative analgesia and early recovery. Naja et al. (15), in their randomized double-blinded study, reported that pre-incisional local anesthetic infiltration in children presented for tonsillectomy significantly decreased post-tonsillectomy pain and helped in better recovery of activi-

ties. Moreover, the systematic review of Grainger and Saravanappa (16) included 13 randomized studies that evaluated the effect of local anesthetic techniques on post-tonsillectomy pain. It was concluded that local anesthetic techniques were effective in controlling postopera-

**Table 2.** The Postoperative Pain Score and Analgesic Consumption in the Two Groups<sup>a</sup>

	Group C	Group G	P Value	CI (95%)
<b>Time for the first request to pethidine, h</b>	3.478 ± 2.116	5.833 ± 2.667	< 0.0001 <sup>b</sup>	1.347; 3.364
<b>Postoperative consumption, dose of pethidine, mg/kg</b>	1.144 ± 0.347	0.878 ± 0.387	0.0009 <sup>b</sup>	0.1127; 0.421
<b>FLACC score during rest</b>				
30 min	3 (2-7)	3 (2-6)	0.168	
2 h	4 (3-6)	3 (2-6)	< 0.0001 <sup>b</sup>	
4 h	5 (3-7)	4 (3-7)	0.0002 <sup>b</sup>	
6 h	5 (3-7)	4 (3-7)	0.0009 <sup>b</sup>	
12 h	3 (2-6)	4 (2-7)	0.039 <sup>b</sup>	
18 h	3 (1-4)	3 (1-4)	0.791	
24 h	2 (1-4)	2 (1-4)	0.464	
<b>FLACC score during swallowing</b>				
30 min	2 (1-6)	1 (1-6)	0.234	
2 h	3 (1-6)	2 (1-5)	< 0.0001 <sup>b</sup>	
4 h	5 (3-7)	4 (3-7)	0.0002 <sup>b</sup>	
6 h	3 (1-6)	4 (1-6)	0.0013 <sup>b</sup>	
12 h	2 (1-5)	3 (1-6)	0.197	
18 h	1 (0-3)	2 (0-3)	0.994	
24 h	1 (0-3)	1 (0-2)	0.360	

Abbreviation: CI, confidence interval.

<sup>a</sup>Values are expressed as mean ± SD or median (range).<sup>b</sup>denotes significant changes.**Table 3.** Postoperative Response to the Gag Reflex and Difficulty in Swallowing in the Recovery Room<sup>a</sup>

	Group C	Group G	P Value
<b>Response to gag reflex (No. of patients)</b>			< 0.0001 <sup>b</sup>
None	5	18	
Mild	8	17	
Moderate	19	5	
Severe	13	5	
<b>Difficulty in swallowing (No. of patients)</b>			0.006 <sup>b</sup>
None	9	15	
Mild	8	17	
Moderate	21	11	
Severe	7	2	

<sup>a</sup>Data are expressed as a No. of patients.<sup>b</sup>Denotes significant changes.

tive pain after tonsillectomy and decreasing postoperative analgesic consumption. Topical anesthesia was preferred as it was associated with a lower incidence of side effects.

In concordance with the current results, Mohamed et al. (17) compared the use of bilateral glossopharyngeal nerve block and preoperative dexamethasone (0.5

mg/kg I.V.) in children presented for tonsillectomy. They showed a significant prolongation in the absolute analgesia time, decreased values of postoperative pain score, and decreased difficulty in swallowing with the use of bilateral glossopharyngeal nerve block. Park et al. (18) studied 75 patients to evaluate the effect of bilateral glossopharyngeal

nerve block with ropivacaine, bupivacaine, or no block, on post-tonsillectomy pain. They concluded that bilateral glossopharyngeal nerve block with ropivacaine or bupivacaine significantly decreased the postoperative pain score during rest and swallowing and obtunded the response to gag reflex. Also, there were no significant differences in postoperative nausea and vomiting, difficulty in swallowing, foreign body sensation in the posterior pharynx, dyspnea, nasal obstruction, or dry mouth among the studied groups.

In contrast to the current findings, El-Hakim et al. (19) studied 92 adult patients presented for tonsillectomy and concluded that glossopharyngeal nerve block with 0.5% bupivacaine was not effective in reducing early post-tonsillectomy pain. Their study found that patients in the bupivacaine group reported more severe pain the morning after surgery in comparison to the saline and no block groups. Moreover, the pain score over the entire postoperative period and the analgesic consumption were similar in the three groups. This study, however, was carried out on adult patients, which may explain the difference between its results and that of the current study. In addition, Violaris and Tuffin (20) evaluated the effect of topical infiltration of plain bupivacaine (0.5%) or normal saline on postoperative pain in adult patients presented for tonsillectomy. They revealed that topical infiltration of bupivacaine did not decrease the postoperative pain score or postoperative analgesic consumption. These discouraging results may be attributed to failure of local anesthetics to reach sensory nerve endings, as explained by the expanded case report by Naja et al. (11).

Bell et al. (21) evaluated the effect of bilateral glossopharyngeal nerve block on postoperative analgesia in adult patients undergoing tonsillectomy or uvulopalatoplasty. They reported similar postoperative pain scores with or without glossopharyngeal nerve block. Moreover, the tonsillectomy subgroup analysis revealed increased postoperative pain in the glossopharyngeal nerve block group in comparison with the no block group. This difference may be attributed to the fact that they have conducted their studies on adult patients. In addition, Kountakis (22) assessed the effect of local infiltration of either bupivacaine (0.5%) or normal saline on postoperative pain after tonsillectomy. They revealed an insignificant difference between the two groups. This difference may be explained by the use of standard tonsillectomy in their study instead of bipolar diathermy.

Limitations of this trial include the absence of evaluation of preoperative gag reflex. Postoperative absence of gag reflex may be due to its preoperative absence, which could be found in certain populations. On the other hand, the evaluation of the difficulty in swallowing and parents'

satisfaction was subjective and may depend on other factors, such as the effort exerted by the patients. Moreover, patients in the control group did not receive sham block, and thus the effect of the needle was absent. Another limitation was that pethidine was used for postoperative rescue analgesia. Despite the limitation on its use as a postoperative analgesic in many countries, it is used in Egypt owing to limited resources.

In conclusion, the use of bilateral glossopharyngeal nerve block with plain bupivacaine (0.25%) in children undergoing tonsillectomy significantly prolonged the time for the first call for pethidine rescue analgesia and decreased postoperative analgesic consumption and the postoperative pain score during rest and swallowing. Moreover, it decreased response to gag reflex and difficulty in swallowing and improved parents' satisfaction, without a significant increase in the incidence of complications.

## Footnotes

**Authors' Contribution:** Sameh Abdelkhalik Ahmed contributed in the conception and the design of the study with analysis and interpretation of the data. Also, he helped in drafting the manuscript and approved its final version. Amany Faheem Omara helped in collection of the data and revision of the article content. Also, she approved its final version.

**Conflict of Interests:** No conflict of interests.

**Ethical Approval:** This study was approved by the Ethical Committee of the Faculty of Medicine, Tanta University.

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**Informed Consent:** The guardians of the participating children signed a written informed consent about the study.

## References

- Alkhalil ARY, Mohammad SM, Allela OQ. Post tonsillectomy pain of bipolar electrocautery and coldsteel dissection: A randomized prospective comparative study. *J Pharm Pract Community Med.* 2018;**4**(2):121-3. doi: [10.5530/jppcm.2018.2.27](https://doi.org/10.5530/jppcm.2018.2.27).
- Sharma K, Kumar D. Ligation versus bipolar diathermy for hemostasis in tonsillectomy: A comparative study. *Indian J Otolaryngol Head Neck Surg.* 2011;**63**(1):15-9. doi: [10.1007/s12070-010-0094-5](https://doi.org/10.1007/s12070-010-0094-5). [PubMed: [22319711](https://pubmed.ncbi.nlm.nih.gov/22319711/)]. [PubMed Central: [PMC3109967](https://pubmed.ncbi.nlm.nih.gov/PMC3109967/)].
- Arbin L, Enlund M, Knutsson J. Post-tonsillectomy pain after using bipolar diathermy scissors or the harmonic scalpel: A randomised blinded study. *Eur Arch Otorhinolaryngol.* 2017;**274**(5):2281-5. doi: [10.1007/s00405-017-4451-9](https://doi.org/10.1007/s00405-017-4451-9). [PubMed: [28213775](https://pubmed.ncbi.nlm.nih.gov/28213775/)]. [PubMed Central: [PMC5383688](https://pubmed.ncbi.nlm.nih.gov/PMC5383688/)].
- Toma AG, Blanshard J, Eynon-Lewis N, Bridger MW. Post-tonsillectomy pain: The first ten days. *J Laryngol Otol.* 1995;**109**(10):963-4. doi: [10.1017/S0022215100131767](https://doi.org/10.1017/S0022215100131767). [PubMed: [7499949](https://pubmed.ncbi.nlm.nih.gov/7499949/)].

5. Hamers JP, Abu-Saad HH. Children's pain at home following (adeno) tonsillectomy. *Eur J Pain*. 2002;**6**(3):213-9. doi: [10.1053/eujp.2001.0326](https://doi.org/10.1053/eujp.2001.0326). [PubMed: [12036308](https://pubmed.ncbi.nlm.nih.gov/12036308/)].
6. Ozalevli M, Unlugenc H, Tuncer U, Gunes Y, Ozcengiz D. Comparison of morphine and tramadol by patient-controlled analgesia for postoperative analgesia after tonsillectomy in children. *Paediatr Anaesth*. 2005;**15**(11):979-84. doi: [10.1111/j.1460-9592.2005.01591.x](https://doi.org/10.1111/j.1460-9592.2005.01591.x). [PubMed: [16238560](https://pubmed.ncbi.nlm.nih.gov/16238560/)].
7. Naesh O, Niles LA, Gilbert JG, Ammar MM, Phibbs PW, Phillips AM, et al. A randomized, placebo-controlled study of rofecoxib with paracetamol in early post-tonsillectomy pain in adults. *Eur J Anaesthesiol*. 2005;**22**(10):768-73. doi: [10.1017/S0265021505001274](https://doi.org/10.1017/S0265021505001274). [PubMed: [16211736](https://pubmed.ncbi.nlm.nih.gov/16211736/)].
8. Hanasono MM, Lalakea ML, Mikulec AA, Shepard KG, Wellis V, Messner AH. Perioperative steroids in tonsillectomy using electrocautery and sharp dissection techniques. *Arch Otolaryngol Head Neck Surg*. 2004;**130**(8):917-21. doi: [10.1001/archotol.130.8.917](https://doi.org/10.1001/archotol.130.8.917). [PubMed: [15313860](https://pubmed.ncbi.nlm.nih.gov/15313860/)].
9. Kaygusuz I, Susaman N. The effects of dexamethasone, bupivacaine and topical lidocaine spray on pain after tonsillectomy. *Int J Pediatr Otorhinolaryngol*. 2003;**67**(7):737-42. doi: [10.1016/S0165-5876\(03\)00091-0](https://doi.org/10.1016/S0165-5876(03)00091-0). [PubMed: [12791448](https://pubmed.ncbi.nlm.nih.gov/12791448/)].
10. Ginstrom R, Silvola J, Saarnivaara L. Local bupivacaine-epinephrine infiltration combined with general anesthesia for adult tonsillectomy. *Acta Otolaryngol*. 2005;**125**(9):972-5. doi: [10.1080/00016480510043413](https://doi.org/10.1080/00016480510043413). [PubMed: [16193589](https://pubmed.ncbi.nlm.nih.gov/16193589/)].
11. Naja MZ, El-Rajab M, Sidani H, Kabalan W, Ziade MF, Al-Tannir MA. Modified infiltration technique in tonsillectomy: Expanded case report of 25 children. *Int J Pediatr Otorhinolaryngol*. 2005;**69**(1):35-41. doi: [10.1016/j.ijporl.2004.07.024](https://doi.org/10.1016/j.ijporl.2004.07.024). [PubMed: [15627444](https://pubmed.ncbi.nlm.nih.gov/15627444/)].
12. El-Hakim H, Nunez DA, Saleh HA, MacLeod DM, Gardiner Q. A randomised controlled trial of the effect of regional nerve blocks on immediate post-tonsillectomy pain in adult patients. *Clin Otolaryngol Allied Sci*. 2000;**25**(5):413-7. doi: [10.1046/j.1365-2273.2000.00397.x](https://doi.org/10.1046/j.1365-2273.2000.00397.x). [PubMed: [11012656](https://pubmed.ncbi.nlm.nih.gov/11012656/)].
13. Merkel SI, Voepel-Lewis T, Shayevitz JR, Malviya S. The FLACC: A behavioral scale for scoring postoperative pain in young children. *Pediatr Nurs*. 1997;**23**(3):293-7. [PubMed: [9220806](https://pubmed.ncbi.nlm.nih.gov/9220806/)].
14. Hung T, Moore-Gillon V, Hern J, Hinton A, Patel N. Topical bupivacaine in paediatric day-case tonsillectomy: A prospective randomized controlled trial. *J Laryngol Otol*. 2002;**116**(1):33-6. doi: [10.1258/0022215021910311](https://doi.org/10.1258/0022215021910311). [PubMed: [11860649](https://pubmed.ncbi.nlm.nih.gov/11860649/)].
15. Naja MZ, El-Rajab M, Kabalan W, Ziade MF, Al-Tannir MA. Pre-incisional infiltration for pediatric tonsillectomy: A randomized double-blind clinical trial. *Int J Pediatr Otorhinolaryngol*. 2005;**69**(10):1333-41. doi: [10.1016/j.ijporl.2005.03.020](https://doi.org/10.1016/j.ijporl.2005.03.020). [PubMed: [16159655](https://pubmed.ncbi.nlm.nih.gov/16159655/)].
16. Grainger J, Saravanappa N. Local anaesthetic for post-tonsillectomy pain: A systematic review and meta-analysis. *Clin Otolaryngol*. 2008;**33**(5):411-9. doi: [10.1111/j.1749-4486.2008.01815.x](https://doi.org/10.1111/j.1749-4486.2008.01815.x). [PubMed: [18983373](https://pubmed.ncbi.nlm.nih.gov/18983373/)].
17. Mohamed SK, Ibraheem AS, Abdelraheem MG. Preoperative intravenous dexamethasone combined with glossopharyngeal nerve block: Role in pediatric postoperative analgesia following tonsillectomy. *Eur Arch Otorhinolaryngol*. 2009;**266**(11):1815-9. doi: [10.1007/s00405-009-0937-4](https://doi.org/10.1007/s00405-009-0937-4). [PubMed: [19263066](https://pubmed.ncbi.nlm.nih.gov/19263066/)].
18. Park HP, Hwang JW, Park SH, Jeon YT, Bahk JH, Oh YS. The effects of glossopharyngeal nerve block on postoperative pain relief after tonsillectomy: The importance of the extent of obtunded gag reflex as a clinical indicator. *Anesth Analg*. 2007;**105**(1):267-71. doi: [10.1213/01.ane.0000266440.62424.fi](https://doi.org/10.1213/01.ane.0000266440.62424.fi). [PubMed: [17578986](https://pubmed.ncbi.nlm.nih.gov/17578986/)].
19. El-Hakim H, Saleh H, Nunez DA, Dacleod D, Gardiner D. The effect of regional nerve blocks on immediate post tonsillectomy pain in adult patients: A randomised controlled trial. *Clin Otolaryngol*. 2000;**25**(1):90. doi: [10.1046/j.1365-2273.2000.00337-8.x](https://doi.org/10.1046/j.1365-2273.2000.00337-8.x).
20. Violaris NS, Tuffin JR. Can post-tonsillectomy pain be reduced by topical bupivacaine? Double blind controlled trial. *J Laryngol Otol*. 1989;**103**(6):592-3. doi: [10.1017/S0022215100109429](https://doi.org/10.1017/S0022215100109429). [PubMed: [2671218](https://pubmed.ncbi.nlm.nih.gov/2671218/)].
21. Bell KR, Cyna AM, Lawler KM, Sinclair C, Kelly PJ, Millar F, et al. The effect of glossopharyngeal nerve block on pain after elective adult tonsillectomy and uvulopalatoplasty. *Anaesthesia*. 1997;**52**(6):597-602. doi: [10.1111/j.1365-2222.1997.131-az0127.x](https://doi.org/10.1111/j.1365-2222.1997.131-az0127.x). [PubMed: [9203892](https://pubmed.ncbi.nlm.nih.gov/9203892/)].
22. Kountakis SE. Effectiveness of perioperative bupivacaine infiltration in tonsillectomy patients. *Am J Otolaryngol*. 2002;**23**(2):76-80. doi: [10.1053/ajot.2002.28771](https://doi.org/10.1053/ajot.2002.28771). [PubMed: [11893973](https://pubmed.ncbi.nlm.nih.gov/11893973/)].