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Original Research Article

THE EFFECT OF GLOSSOPHARYNGEAL NERVE BLOCK ON POST-TONSILLECTOMY PAIN IN ADULT PATIENTS.

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ABSTRACT

Background: Tonsillectomy is one of the most common operations in general otolaryngology and produces severe pain on the first postoperative day. This study assesses the efficacy of percutaneous peristyloid glossopharyngeal block by ultrasound guided technique for acute post tonsillectomy pain.

Materials and Methods: This longitudinal comparative study, after approval of the research protocol by the hospital ethics committee and obtaining personal informed consent, a total of 60 adult patients of either sex aged between 18 and 60 years of American Society of Anesthesiologists (ASA)grade 1 and 2 who were undergoing elective tonsillectomy surgeries and receiving general anesthesia were selected. After surgery they received bilateral GNB with 0.25% bupivacaine (group G), or no intervention (Group C) using ultrasound guided technique. The outcomes were time to first analgesic requirement, pain at rest and during swallowing.

Results: The intensity of pain was assessed at rest after the interval of 1 hour, 3 hours, 6 hours, 9 hours and 12 hours following post operative (after tonsillectomy operation) administration of glossopharyngeal nerve (GPN) block, This difference in the intensity of post tonsillectomy pain between the control group and GPN block group at rest was found to be statistically significant ($p< 0.001$). For treating the post operative pain, this difference in the requirement of number of intravenous paracetamol doses (given as rescue analgesic on patient demand) between the control group and GPN block group was found to statistically significant ($p< 0.001$). Therefore the post operative administration of glossopharyngeal nerve (GPN) block is useful in reducing the post operative pain following tonsillectomy operation.

Conclusion: The post-operative ultrasound guided administration of glossopharyngeal nerve (GPN) block via the styloid process is helpful and safe method in reducing the post operative pain following tonsillectomy operation.

Key words: glossopharyngeal nerve block, ultrasound guided, tonsillectomy, styloid process.

INTRODUCTION

Tonsillectomy is one of the most common operations in general otolaryngology. Pain following a tonsillectomy contributes significantly to patient morbidity. Poor oral intake and the potential risk of hemorrhage are the two effects of postoperative discomfort. Additionally, the rise in day-case tonsillectomy has raised the need for better postoperative analgesia.[1]

Tonsillectomy produces severe pain on the first postoperative day. Tonsillectomy pain is produced by peripheral tissue damage that releases a variety of inflammatory mediators during the inflammatory process. Bradykinin, serotonin, and prostaglandins alter neuronal excitability, lowers pain thresholds, and increase sensitivity to nociceptive stimuli.[1] Consequently, greater inflammation is linked to more pain and discomfort following surgery, especially on the first postoperative day several techniques have been described for the alleviation of

this pain, including the use of opioids, steroids, and nonsteroidal anti-inflammatory drugs, as well as local anesthetic sprays and infiltration with local anesthetics around the tonsillar bed.[2]

One local anesthetic technique that can be used to control postoperative pain after tonsillectomy is the glossopharyngeal nerve block. Sensory fibers of the glossopharyngeal nerve supply the tonsillar and peritonsillar areas.[3] Thus, the bilateral glossopharyngeal nerve block may alleviate post-tonsillectomy pain and improve postoperative analgesia.

Bupivacaine because of its rapid onset and prolonged action is gaining popularity as an effective method for pain reduction after tonsillectomy. It can be used by local infiltration, topical spray or topical application with a pack in the tonsillar bed.[4]

In current study, we investigated the efficacy and safety of ultrasound guided glossopharyngeal block via infiltrating the bupicaine in peristyloid process for better control of pain in post operative tonsillectomy patients.

MATERIALS AND METHODS

After approval of the research protocol by the hospital ethics committee for human studies and obtaining personal informed consent, American Society of Anesthesiologists (ASA) grade 1 and 2 adult patients undergoing elective tonsillectomy surgeries and receiving general anesthesia were included in this study.

Inclusion Criteria: Patients fulfilling following criteria are included

1. Adult patients (18 - 60yrs) of both genders were included after receiving informed written consent
2. Patients belonging to American Society of Anaesthesiologist class 1&2
3. Patients scheduled to undergo elective tonsillectomy surgery under general anesthesia
4.

Exclusion Criteria: Following patients are excluded

1. Cardiac conduction anomalies, liver or kidney disease,
2. Hypersensitivity to local anaesthetics,
3. Chronic pain,
4. Regular analgesic use within 1 wk of surgery
5. Peritonsillar abscess, Swallowing disorder.

General anesthesia was induced with Midazolam 0.04mg/kg, fentanyl l 2mcg/kg, glycopyrrolate 0.004mg/kg and a dose of 2mg/kg propofol intravenous. An intubating dose of atracurium 0.5mg/kg is injected to all patients for muscle relaxation. After tracheal intubation, anesthesia was maintained with 50% nitrous oxide and 1%–2% sevoflurane. Paracetamol 15 mg/kg I.V. was administered over the span of 15 minutes.

Tonsillectomies was carried out by the expert surgeon. The patients were randomly distributed to two equal groups by the aid of a computer generated software of randomization

Control Group (Group C): The patients in this group did not receive glossopharyngeal nerve block at the end of the surgery.

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

Once the patients head is in the lateral position, the mastoid and mandibular angle were identified via high frequency linear probe scanning. An imaginary line was drawn connecting these two landmarks (first line). A second imaginary line was created starting 1.5cm beyond the posterior margin of the mandibular angle and extended to the mastoid. To view the styloid process, the linear array probe was fitted on second line. The arteries beneath or behind the styloid process were identified using the color flow Doppler technique. The mandible was punctured using 22 gauge 3.5inch needle with an ultrasound guided. The needle path is seen when the needle tip entered the styoid process. When no blood or CSF appeared after careful withdrawal of the needle, 0.25% of bupivacaine 5ml was injected on each side.

After the bilateral GPN block was completed, sevoflurane is discontinued muscle relaxation was reversed (using neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg), with full awake extubation,

Pain was estimated in all patients by an observer who was unaware as to the group allocation only in group C and G. Visual analogue score (VAS) was assessed on a 0- 100 mm scale (0 mm: no pain; 100 mm: maximum imaginable pain) was estimated at rest and on deglutition at 1 hour, 3 hours, 6 hours, 9 hours, 12 hours and 24 hours after surgery.

Paracetamol 15 mg IV was given as rescue analgesic on patient demand or whenever VAS estimations at rest was more than 30 mm.

RESULTS

In our study, total 60 post operative tonsillectomy patients were included. These 60 patients were randomly allocated in to control group (30 patients) and GPN block group (30 patients). The mean age (mean ± standard deviation) of the total 60 patients was 34.35 ± 8.81. The mean age of control group and GPN group was found to be 37.0 ± 8.60 and 31.70 ± 8.33 respectively. Among total 30 patients in control group, 15 (50%) were males and 15 (50%) were females. Similarly among total 30 patients in GPN block group, 11 (36.6%) were males and 19 (63.4%) were females. [Figure 1]

Table 1: Distribution of post operative tonsillectomy patients according to their age group

Age group (in years)	Post- tonsillectomy patients		Total (%)
	Group - Control (%)	Group - GPN block (%)	
18 to 25	4 (30.7)	9 (69.3)	13 (21.6)
26 to 35	9 (45.0)	11(55.0)	20 (33.4)
36 to 45	12 (57.1)	9 (42.9)	21 (35.0)
46 to 60	5 (83.3)	1 (16.7)	6 (10.0)
Total	**30**	**30**	**60**

Among total 60 patients, 20 (33.4%) and 21 (35.0%) of the patients belonged to age group 26 to 35 years and 36 to 45 of age respectively. Of 21 (35.0%) in the age group 36 to 45 years of age, 12 (57.1%) were in control group and 9 (42.9%) were in GPN block group. Only 6 (10.0%) patients belonged to the age group 46 to 60 years of age. [Table 1]

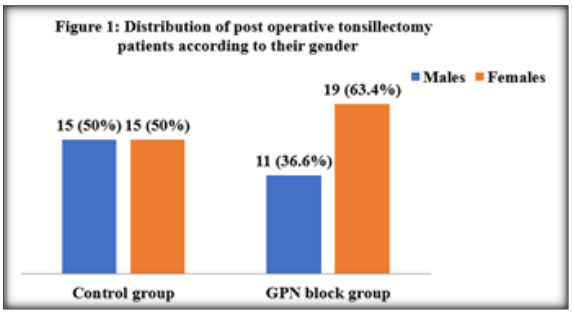

Figure 1: Distribution of post operative tonsillectomy patients according to their gender

Table 2: Distribution of post operative tonsillectomy patients according to the Asian classification of body mass index (BMI)

Body mass index (BMI) in kg/m^2	Post- tonsillectomy patients		Total (%)
	Group - Control (%)	Group - GPN block (%)	
18.5 to 22.9 (Normal)	8 (57.1)	6 (42.9)	14 (23.3)
23 to 24.9 (Over weight)	11 (52.4)	10 (47.6)	21 (35.0)
25 to 29.5 (Obesity class 1)	10 (43.5)	13 (56.5)	23 (38.3)
≥30 (Obesity class 2)	1 (50.0)	1 (50.0)	2 (3.4)
Total	**30**	**30**	**60**

Among total 60 patients, 14 (23.3%) have normal BMI, of which 8 (57.1%) were in control group and 6 (42.9%) in GPN block group. Among total 60 patients, 23 (38.3%) were obese (obesity class 1), of which 10 (43.5%) were in control group and 13 (56.5%) in GPN block group. Among 60 patients, 21 (35.0%) were overweight. Only 2 (3.4%) were belonged to obesity class 2. [Table 1]

Table 3: Assessment of pain intensity using visual analogue scale (VAS) score at rest among the post operative tonsillectomy patients after glossopharyngeal nerve (GPN) block (n=60)

Time period	Pain intensity at rest	Post- tonsillectomy patients		Total (%)	p value
		Group -Control (%)	Group - GPN block (%)		
Pain after 1 hour	No pain	0	20 (66.6)	20 (33.3)	< 0.001
	Mild pain	4 (13.3)	10 (33.4)	14 (23.3)	
	Moderate pain	26 (86.7)	0	26 (43.4)	
	Severe pain	0	0	0	
Pain after 3 hour	No pain	0	0	0	< 0.001
	Mild pain	14 (46.6)	30 (100)	44 (73.3)	
	Moderate pain	16 (53.4)	0	16 (26.7)	
	Severe pain	0	0	0	
Pain after 6 hour	No pain	0	0	0	< 0.001
	Mild pain	3 (10)	15 (50)	18 (30)	
	Moderate pain	27 (90)	15 (50)	42 (70)	
	Severe pain	0	0	0	
Pain after 9 hour	No pain	0	0	0	< 0.001
	Mild pain	20 (66.6)	7 (23.3)	27 (45)	
	Moderate pain	10 (33.4)	23 (76.7)	33 (55)	
	Severe pain	0	0	0	
Pain after 12 hour	No pain	0	0	0	< 0.005
	Mild pain	19 (63.3)	28 (93.3)	47 (78.3)	
	Moderate pain	11 (36.7)	2 (6.7)	13 (21.7)	
	Severe pain	0	0	0	

[**Note**: Visual analogue scale (VAS) score: 0 to 4 mm is No pain, 5 to 44 mm is Mild pain, 45 to 74 mm is Moderate pain and 75 to 100 mm is severe pain]

After 1 hour following post operative (after tonsillectomy operation) administration of glossopharyngeal nerve (GPN) block, at rest among control group, 26 (86.7%) experienced moderate

pain and 4 (13.3%) had mild pain. Where as in GPN block group, 20 (66.6%) of the patients do not experienced any pain and 10 (33.4%) had only mild pain. This indicates that the post operative administration of glossopharyngeal nerve (GPN) block is helpful in reducing the post operative pain following tonsillectomy operation. At rest, this difference in the intensity of post tonsillectomy pain between the control group and GPN block group was found to be statistically significant (p< 0.001). [Table 3]

Similarly, after 3 hours, among control group, 16 (53.4%) had moderate pain and 14 (46.6%) patients had mild pain. In GPN block group, all 30 (100%) patients had only mild pain. After 6 hours, among control group 27 (90%) suffered moderate pain whereas in GPN group, 15 (50%) had moderate pain. After 9 hours, among the control group, 10 (33.4%) had moderate pain whereas among GPN block group, 23 (76.7%) experienced moderate pain. This difference may be due the decreased action of GPN block. After 12 hours, among control group, 11 (36.7%) suffered moderate pain and 19 (63.3%) had mild pain. Among GPN block group, 2 (6.7%) experienced moderate pain and 28 (93.3%) patients suffered mild pain. [Table 3]

The intensity of pain was assessed at rest after the interval of 1 hour, 3 hours, 6 hours, 9 hours and 12 hours following post operative (after tonsillectomy operation) administration of glossopharyngeal nerve (GPN) block, This difference in the intensity of post tonsillectomy pain between the control group and GPN block group at rest was found to be statistically significant (p< 0.001). Therefore the post operative administration of glossopharyngeal nerve (GPN) block is helpful in reducing the post operative pain following tonsillectomy operation. [Table 3]

Table 4: Assessment of pain intensity using visual analogue scale (VAS) score at deglutition among the post operative tonsillectomy patients after glossopharyngeal nerve (GPN) block (n=60)

Time period	Pain intensity at deglutition	Post- tonsillectomy patients		Total (%)	p value
		Group - Control	Group - GPN block		
Pain after 1 hour	No pain	0	6 (20)	6 (10)	<0.001
	Mild pain	0	24 (80)	24 (40)	
	Moderate pain	30 (100)	0	30 (50)	
	Severe pain	0	0	0	
Pain after 3 hour	No pain	0	0	0	<0.001
	Mild pain	0	30 (100)	30 (50)	
	Moderate pain	30 (100)	0	30 (50)	
	Severe pain	0	0	0	
Pain after 6 hour	No pain	0	0	0	-
	Mild pain	0	0	0	
	Moderate pain	30 (100)	30 (100)	60 (100)	
	Severe pain	0	0	0	
Pain after 9 hour	No pain	0	0	0	<0.001
	Mild pain	27 (90)	1 (3.3)	28 (46.7)	
	Moderate pain	3 (10)	29 (96.7)	32 (53.3)	
	Severe pain	0	0	0	
Pain after 12 hour	No pain	0	0	0	<0.001
	Mild pain	7 (23.3)	29 (96.7)	36 (60)	
	Moderate pain	23 (76.7)	1 (3.3)	24 (40)	
	Severe pain	0	0	0	

[**Note**: Visual analogue scale (VAS) score: 0 to 4 mm is No pain, 5 to 44 mm is Mild pain, 45 to 74 mm is Moderate pain and 75 to 100 mm is severe pain]

After 1 hour following post operative (after tonsillectomy operation) administration of glossopharyngeal nerve (GPN) block, at deglutition among control group, 30 (100%) patients experienced moderate pain. Where as in GPN block group, 6 (20 %) of the patients do not experienced any pain and 24 (80%) had only mild pain. This shows that the post operative administration of glossopharyngeal nerve (GPN) block is helpful in reducing the post operative pain following tonsillectomy operation. At deglutition, this difference in the intensity of post tonsillectomy pain between the control group and GPN block group was found to be statistically significant (p< 0.001). [Table 4]

Similarly, after 3 hours, among control group, all the 30 (100%) patients had moderate pain. In GPN block group, all the 30 (100%) patients experienced only mild pain. After 6 hours, among control group, all the 30 (100%) had moderate pain whereas in GPN group also all the 30 (100%) suffered by moderate pain. After 9 hours, among the control group, 3 (10%) had moderate pain whereas among GPN block group, 29 (96.7%) experienced moderate pain. This difference between control group and GPN block group may be due the decreased action of GPN block. After 12 hours, among control group, 23 (76.7%) experienced moderate pain and 7 (23.3%) had mild pain. Among GPN block group, only 1 (3.3%) experienced moderate pain and 29 (96.7%) patients suffered by mild pain. [Table 4]

After the administration of glossopharyngeal nerve (GPN) block to the post operative (after tonsillectomy operation) patients, at deglutition the

intensity of pain was assessed after the interval of 1 hour, 3 hours, 6 hours, 9 hours and 12 hours. This difference in the intensity of post tonsillectomy pain between the control group and GPN block group at deglutition was found to be statistically significant (p< 0.001). Therefore the post operative administration of glossopharyngeal nerve (GPN) block is useful in reducing the post operative pain following tonsillectomy operation. [Table 4]

Table 5: Number of intravenous paracetamol doses (rescue analgesic on patient demand in case of VAS score more than 30mm at rest) required to treat the pain in control group and GPN block group (n=60)

Number of intravenous paracetamol doses given in post-operative 12 hours	Number of post- tonsillectomy patients received intravenous paracetamol for relief of pain		Total (%)	p value
	Group – Control (%)	Group - GPN block (%)		
1 dose	0	10 (33.3)	10 (16.6)	0.001
2 doses	5 (16.6)	20 (66.7)	25 (41.7)	
3 doses	25 (83.4)	0	25 (41.7)	
Total	**30**	**30**	**60**	

In this study, intravenous paracetamol doses (15mg/kg body weight) were given as rescue analgesic on patient demand for both in control group and GPN block group for relief of pain during the post operative period of first 12 hours.

Among control group, 5 (16.6%) patients were given 2 doses of intravenous paracetamol each and 25 (83.4%) patients were treated by 3 doses of intravenous paracetamol each for post operative pain relief. So during the 12 hours post operative period, 2 doses ×5 and 3 doses×25 = 10 + 75= 85 doses of intravenous paracetamol required for pain relief in patients of control group. [Table 5]

Among GPN block group, 10 (33.3%) patients were given 1 dose of intravenous paracetamol each and 20 (66.7%) patients were treated by 2 doses of intravenous paracetamol each for post operative pain relief. So the during the 12 hours post operative period, 1 dose ×10 and 2 doses×20 = 10 + 40= 50 doses of intravenous paracetamol required for pain relief in patients of GPN block group. [Table 5]

For treating the post-operative pain, this difference in the requirement of number of intravenous paracetamol doses between the control group and GPN block group was found to statistically significant (p< 0.001). Therefore the post operative administration of glossopharyngeal nerve (GPN) block is useful in reducing the post operative pain following tonsillectomy operation. [Table 5]

DISCUSSION

In our study, among total 60 post operative tonsillectomy patients, 30 patients were in control group and 30 patients were in GPN block group. The mean age of control group and GPN group was found to be 37.0 ± 8.60 and 31.70 ± 8.33 respectively. The mean age (mean ± standard deviation) of the total 60 patients was 34.35 ± 8.81.

After 1 hour following post operative (after tonsillectomy operation) administration of glossopharyngeal nerve (GPN) block, at rest among control group, 26 (86.7%) experienced moderate pain and in GPN block group, 20 (66.6%) of the patients do not experienced any pain and 10 (33.4%) had only mild pain. At rest, this difference in the intensity of post tonsillectomy pain between the control group and GPN block group was found to be statistically significant (p< 0.001).

The intensity of pain was assessed at rest and deglutition separately after the interval of 1 hour, 3 hours, 6 hours, 9 hours and 12 hours following post operative (after tonsillectomy operation) administration of glossopharyngeal nerve (GPN) block, This difference in the intensity of post tonsillectomy pain between the control group and GPN block group at rest was found to be statistically significant (p< 0.001). Therefore the post operative administration of glossopharyngeal nerve (GPN) block is helpful in reducing the post operative pain following tonsillectomy operation. the findings of our study is similar to the finding the studies conducted by A. Alshawadfy et al,[1] Park HP, et al,[2] and Albazee E, et al.[4]

In our study, intravenous paracetamol doses (15mg/kg body weight) were given as rescue analgesic on patient demand for both in control group and GPN block group for relief of pain during the post operative period of first 12 hours. 85 doses of intravenous paracetamol required for pain relief in patients of control group and 50 doses of intravenous paracetamol required for pain relief in patients of GPN block group. Therefore the post operative administration of glossopharyngeal nerve (GPN) block is useful in reducing the post operative pain following tonsillectomy operation. This finding of our study is similar to study conducted by Ahmed SA, et al.[3]

A. Alshawadfy et al. conducted a double blinded randomized controlled trial among the 54 children in Egypt. They found post tonsillectomy pain score during rest and swallowing, rescue analgesic request, recovery from general anesthesia were comparable between landmark technique and ultrasound technique. Both landmark technique and ultrasound guided glossopharyngeal block were safe and effective.[1]

Park HP, et al., conducted a randomized controlled study to evaluate the effects of glossopharyngeal nerve block on postoperative pain relief after tonsillectomy and correlated the extent of obtunded

gag reflex as a clinical indicator. The three groups are 0.75% ropivacaine with epinephrine (Group R), 0.5% bupivacaine with epinephrine (Group B) at the end of the operation, or no intervention (Group C), the pain scores at rest and when swallowing in group R and B were significantly lower than those in group C ($P<0.001$) they found that glossopharyngeal nerve block was a useful method for reducing of post-tonsillectomy pain and an obtunded gag reflex response may be a clinical indicator for analgesia from glossopharyngeal block.[2]

Ahmed SA, et al. conducted a randomized controlled trial among the 90 pediatric patients who underwent adenotonsillectomy. Post operatively they performed bilateral glossopharyngeal nerve (GPN) block. In this they observed that significantly prolonged the time for the first request of rescue analgesia in Group G (glossopharyngeal block group), compared to the control group, in which children did not receive nerve block. The quality of postoperative analgesia, decreased swallowing difficulties and improved parents' satisfaction.[3]

In 2024, Albazee E, et al. conducted systematic review and Meta analysis of randomized controlled trials to assessed effectiveness of glossopharyngeal nerve block in the treatment of postoperative pain. Among total 492 patients, 245 and 247 in GPN group and control group respectively. They observed postoperative pain levels during rest and swallowing was significantly reduced in GNB group when compared to control group. They concluded that the glossopharyngeal nerve block was an effective, safe, straightforward method for managing early postoperative pain.[4]

A prospective randomized controlled trial was conducted by Debasish G, et al. among the 64 post operative tonsillectomy patients to evaluate the benefit of glossopharyngeal nerve (GPN) block with long acting local anaesthetic like Bupivacaine. Group A received bilateral GPN block and group B not received GPN block (control group). The visual analogue score for was significantly lower in GPN block group at rest and while swallowing as that of in the control group. They concluded that GPN block was an important method of reducing post tonsillectomy pain.[5]

CONCLUSION

The post-operative ultrasound guided administration of glossopharyngeal nerve (GPN) block via the styloid process is helpful and safe method in reducing the post operative pain following tonsillectomy operation. Glossopharyngeal nerve (GPN) block administration will reduces the number of doses of intravenous paracetamol doses 15mg/kg body weight given as rescue analgesic on patient demand) required to reduce the post operative pain. Therefore the post operative administration of glossopharyngeal nerve (GPN) block is useful in reducing the post operative pain following tonsillectomy operation.

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REFERENCES

1. Alshawadfy A, Ellilly A, Ahmed M. Elewa & Wesam F. Alyeddin (2022) Comparison between landmark and ultrasound-guided percutaneous peristyloid glossopharyngeal nerve block for post-tonsillectomy pain relief in children: a randomized controlled clinical trial, Egyptian Journal of Anaesthesia. 38(1),643-649.
2. Park HP, Hwang JW, Park SH, Jeon, *et al*. 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): 267-271.
3. Ahmed SA, Omara AF. The effect of Glossopharyngeal Nerve Block on Post-Tonsillectomy Pain of Children; Randomized Controlled Trial. Anesth Pain Med. 2019 Apr 30;9(2):e90854.
4. Albazee E, Elsnhory AB, Abdelaziz A, *et al*. Glossopharyngeal Nerve Block for the Management of Post-Tonsillectomy Pain: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Indian J Otolaryngol Head Neck Surg 2024.
5. Debasish G, Anindita S, Aryabrata D. *et al*. Glossopharyngeal Nerve Block with Long Acting Local Anaesthetic Agent (Bupivacaine) and It's Effect on Early Post-operative Period in Adult Tonsillectomy: A Prospective Study. Indian J Otolaryngol Head Neck Surg 71(suppl 1),390-394(2019)
6. Abdelghany MS, Eid GM, Belal AM, Mourad MB, Ultrasound-guided distal glossopharyngeal nerve block for post-tonsillectomy pain relief in adults: a prospective randomized study, Minerva Anestesiol.2024 Jun;90(6):500-508. https://doi.org/10.23736/S0375-9393.24.17925-4
7. Kang YJ, Stybayeva G, Hwang SH. Effects of glossopharyngeal nerve block on pain control after tonsillectomy: a systemic review and meta-analysis, ANZ J Surg. 2024 Jun;94(6):1021-1029. [Kang, Y. J., Stybayeva, G., & Hwang, S. H. (2024). Effects of glossopharyngeal nerve block on pain control after tonsillectomy: a systemic review and meta-analysis. ANZ journal of surgery, 94(6), 1021–1029. https://doi.org/10.1111/ans.18995]
8. Stelter, K., Hempel, J.M., Berghaus, A. *et al*. Application methods of local anaesthetic infiltrations for postoperative pain relief in tonsillectomy: a prospective, randomised, double-blind, clinical trial. Eur Arch Otorhinolaryngol 266, 1615-1620(2009) https://doi.org/10.1007/s00405-008-0909-0
9. Singh N, Singh S, Mishra N, *et al*. Comparison of extraoral and intraoral routes of glossopharyngeal nerve block for pain relief in patient with carcinoma tongue: a prospective randomized study. J Cancer Res Ther 16(3):p 534-538, Apr –jun 2020. DOI: 10.4103/jcrt.JCRT_309_18]
10. Liu Q, Zhong Q, Tang G, He G. Ultrasound-guided glossopharyngeal nerve block via the styloid process for glossopharyngeal neuralgia: a retrospective study. J Pain

Res. 2019 Aug 8;12:2503-2510. doi: 10.2147/JPR.S214596. PMID: 31496791; PMCID: PMC6690851.]
11. Grainger, J., & Saravanappa, N. (2008). Local anaesthetic for post-tonsillectomy pain: a systematic review and meta-analysis. Clinical otolaryngology : official journal of ENT-UK ; official journal of Netherlands Society for Oto-Rhino-Laryngology & Cervico-Facial Surgery, 33(5), 411–419. https://doi.org/10.1111/j.1749-4486.2008.01815.x
12. Wang J, Wang N, Gong F. Efficacy of bupivacaine infiltration for controlling post-tonsillectomy pain, duration of surgery and post-operative morbidities: A systematic review and meta-analysis. Exp Ther Med. 2021 Mar;21(3):198. https://doi.org/10.3892/etm.2021.9631 Epub 2021 Jan 8. PMID: 33488807; PMCID: PMC7812577.
13. Sun J, Wu X, Meng Y, Jin L. Bupivacaine versus normal saline for relief of post-adenotonsillectomy pain in children: a meta-analysis. Int J Pediatr Otorhinolaryngol. 2010 Apr;74(4):369-73. https://doi.org/10.1016/j.ijporl.2010.01.004 Epub 2010 Feb 2. PMID: 20129678.