The Role of Local Anesthetic Agents on Reducing Early Post-Tonsillectomy Pain

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Abstract:

Objective: To reduce early post-tonsillectomy pain by using local anesthetic agents and encouraging early swallowing and decreasing the risk of dehydration, infection and secondary bleeding.

Patients and Methods: This study was undertaken on 99 patients (for whom tonsillectomy done under general anesthesia), between ages of 8 - 42 years, to compare the efficacy of topical application of (4%) lignocaine, (0.5%) bupivacaine, and normal saline in reducing postoperative pain after tonsillectomy. Patients were divided into 3 groups, each group composed of 33 patients. Group I, in whom (0.5%) bupivacaine was used, in group II (4%) lignocaine was used, and in group III (control group) normal saline was used. After removal of both tonsils, a gauze measuring 2.4 centimeter square mixed with 2.0 ml of either (0.5%) bupivacaine, (4%) lignocaine, or normal saline according to the group was kept in both tonsillar fossae for a period of 5 minutes. Postoperative pain was assessed using the Wong - Baker Faces pain rating scale up to a period of 24 hours after surgery**.**

Results: There was a significant difference in pain intensity between the control group and the other groups in first, fourth, eighth, and twenty fourth hours postoperatively ($p<0.05$), but not in second hour ($p>0.05$). The accumulated scores for pain, dysphagia and difficulty in speaking were significantly lower in groups I (bupivacaine) and II (lidocaine) as compared to group III (normal saline) ($p <0.05$), while scores of group II were significantly lower than those in group I ($p<0.05$).

Conclusion: Topical application of (4%) lignocaine and (0.5%) bupivacaine in the tonsillar bed is a safe and effective method of reducing postoperative pain following tonsillectomy that if not treated may devoid the patient from swallowing and lead to dehydration, infection and secondary bleeding**.**

Study design: A single blind prospective comparative clinical study.

Keywords: Post-tonsillectomy pain relief, Topical lignocaine, Topical bupivacaine.

Introduction:

Tonsillectomy is one of the most commonly performed surgical procedures and is often associated with postoperative pain [(1)]. For that reason an adequate postoperative analgesia is essential after tonsillectomy, as pain after tonsillectomy impairs swallowing with a risk of dehydration, infection and secondary bleeding [(2)]. Multiple methods have been tried to reduce post-tonsillectomy pain like opoids, NSAIDS and paracetamol but they are associated with many side effects or not so potent [(3, 4, 5)]. Pain occurs due to trauma to the local tissue, releasing inflammatory mediators. These mediators cause generation of action potentials which are conducted by A delta fibres and C fibres to the spinal cord [(6)]. Application of the local anaesthetic at the site of injury

soon after trauma can reduce this barrage of action potential traveling to the spinal cord and hence reduce the post-operative pain. There are numerous studies in which a local anaesthetic has been applied to the tonsillar fossae after tonsillectomy either by infiltration or topical spray. There are risks with infiltration technique such as accidental intravascular injection leading to life threatening arrhythmias. Life threatening upper airway obstruction after infiltration of bupivacaine has been reported in children [(7)]. The paucity of literature on the effect of topical application of (4%) lignocaine and (0.5%) bupivacaine on post tonsillectomy pain relief, has led us to design this study and there by evaluate the post operative analgesia produced by local application of bupivacaine and lignocaine. The advantages of decreasing the pain are short recovery period, lower risk of postoperative bleeding, shorter hospitalization stay, and returning to a normal dietary regimen and a status of activity which is appropriate for the patient and patient's parents sooner [(8)]. The basic components in the structure of local anesthetics are the lipophilic aromatic portion (a benzene ring), an intermediate chain, and the hydrophilic amine portion (figure1). The intermediate chain has either an ester linkage from the combination of an aromatic acid and an amino alcohol or an amide linkage from the combination of an aromatic amine and an amino acid. The commonly used local anesthetics can be classified as esters or amides based on the structure of this intermediate chain [(9)].

Mechanism of Action:

Nerve impulse conduction occurs in the form of an action potential, a sudden reversal in resting trans-membrane potential lasting less than 1 millisecond. The change in potential is triggered by an appropriate stimulus and involves a rapid influx of Na + into the interior of the nerve axon [(10)]. This inward flow proceeds through a channel, a membrane pore protein that, upon being opened (activated), permits rapid movement of Na + down a chemical gradient. Local anesthetics are capable of inhibiting this rapid inward flux of Na +; initiation and propagation of excitation is therefore blocked. ***(4%) Lidocaine:*** Is an amide type, onset of action is rapid with an average duration of action of 1 to 1½ hours. This duration may be extended by the addition of epinephrine, the usual recommended dilution being 1:50,000 to 1:100,000. The maximum recommended dose of (4%) Lidocaine Hydrochloride Injection should be kept below 300 mg and in any case should not exceed 4.5 mg/kg body weight. The maximum dose of lidocaine hydrochloride and epinephrine injection should not exceed 7 mg/kg of body weight [(10)]. ***Bupivacaine hydrochloride (Marcaine, Sensorcaine) (0.5%)*** **:** Is an ester type has particularly long action, and some nerve blocks last more than 24 hours; this is often an advantage for postoperative analgesia [(9)]. Bupivacaine is approximately four times more potent and more toxic than mepivacaine and lidocaine. It can be used with or without epinephrine [(10)]. The recommended upper limit of safe dosage of bupivacaine is 2mg/kg body weight, which is equivalent to 25-30 ml of (0.5%) solution [(11)].

Patients and Methods:

A prospective comparative clinical study implemented in the department of (otolaryngology-head and neck surgery)

at AL-Sulaimania Teaching Hospital, from 1st April 2010 to 1st December 2010. After taking informed consent, tonsillectomy was done for 99 patients of either sex (41 males and 58 females) including ages of 8 years and above (from 8-42 years) they were divided in to 5 age groups (8-10years, 11-20years, 21 - 30 years, 31 - 40 years, and more than 40 years), with mean age of (16.73) years. The indications of tonsillectomy being chronic tonsillitis (chronic inflammatory hypertrophy, recurrent episodes of acute tonsillitis in the order of (more than 6-7 episodes in one year, 5 episodes per year for two consecutive years, or 3 episodes per year for three consecutive years) , and/or hypertrophic obstructive tonsils causing sleep apnoea syndrome. Cases of adenotonsillitis, peritonsillar abscess and neoplastic lesions were excluded. Patients were divided into 3 groups of 33. Group I, for whom (0.5%) bupivacaine was used, for group II (4%) lignocaine was used, and for group III (control group) normal saline was used. Patients were preoxygenated with (100%) O2 for 3 min and then were induced with one of thiopentone sodium injection 5 mg/kg or propofol 2-2.5 mg/kg plus halothane inhalation (1-3%) and intubation was facilitated with ismiron injection (Rocuronium) 0.6 mg/kg. An appropriate size endotracheal tube was placed and secured. Anaesthesia was maintained with halothane (2-3%). Intravenous fluids were given as per individual requirement. Analgesics given included either injection of fentanyl 1-2µg/kg or ketamin 0.5mg/kg. Tonsillectomies were done under general anesthesia by dissection method. After removal of both the tonsils, a gauze measuring 2*4 cm^2 soaked in 2.0 ml of either (0.5%) bupivacaine, (4%) lignocaine, or normal saline according to the group and it was kept in both tonsillar fossae for a period of 5 minutes. At the completion of surgery and after recovery from anaesthesia, pain assessed at intervals of 1st hour, 2nd hour, and 4th hour and at 8th hour in the ward, and at 24th hour post - operatively in the ward on the 1st visit after their discharge from hospital. Intensity of early post-tonsillectomy pain was assessed by the Wong-Baker Faces pain rating scale with a number ranging from zero (no hurt, or no pain) to 5 (hurting worst or worst pain) (figure 2).

Dysphagia (odynophagia) and difficulty in speaking were also assessed within the first 8 hours, using scores (0-4) for dysphagia (table 1) and (0-3) for difficulty in speaking (table 2).

Patients should be able to understand the concept of them; therefore, literated patients older than 8 years were selected. No patient was given systemic analgesics in the first 24 hours after surgery and was discharged on the same day of the operation. Data were analyzed by SPSS (statistical package for the social sciences) version 16.0 software.

Results:

This study composed of 99 cases of either sex (41 males and 58 females), with equal number of 33 cases in each group. Mean age was 16.73 years and male to female ratio was 1:1. During postoperative follow-up it was noticed that with time the mean of pain scores for all of the three groups increased, being lowest in the first hour (0.93) and reaching the highest mean of pain score (1.61) towards the end of the first postoperative 24 hours, means of dysphagia, and difficulty in speaking were (2.18, 1.38) respectively, (table 3).

There was a significant difference in pain intensity between the control group and case groups in 1st, 4th, 8th, and 24th hours postoperatively ($p<0.05$), but not in 2nd hour ($p>0.05$) (table 4). Table 4 shows that in the 1st hour a high percentage of the control group III (12.1%) had score 3 of pain (hurting even more or moderate pain), while a lower percentage of bupivacaine group I (9.1%) had the same score 3 of pain, and no patients of the lidocaine group II (0.0%) had the score 3 of pain . This association between the pain score and the three groups is statistically significant ($p<0.05$). In the 2nd hour a high percentage of the 1st group (bupivacaine) (12.1%) had score 3 of pain (hurting even more), while a lower percentage of control group (normal saline) (3.0%) had the same score 3 of pain, and no patients of the lidocaine group (0.0%) had the score 3 of pain. This association between the pain score and the three groups is not statistically significant ($p>0.05$). In the 4th postoperative hour, (3.0%) of the group I (bupivacaine) had score 4 of pain (severe pain), while no patients (0.0%) in the other two groups had the score 4 of pain. This association between the pain score and the three groups is also statistically significant ($p<0.05$), (table 4). In the 8th postoperative hour an equal percentages (3.0%) of both bupivacaine group and normal saline group had score 4 of pain (severe pain), and no patients of the lidocaine group (0.0%) had the score 4 of pain. This association between the pain score and the three groups is statistically significant ($p<0.05$). In the 24th postoperative hour an equal percentages (3.0%) of both bupivacaine group and normal saline group also had score 4 of pain (severe pain), and no patients of the lidocaine group (0.0%) had the score 4 of pain, meaning that the lidocaine was most effective in reducing pain in the 24th hour postoperatively. This association between the pain score and the three groups is statistically significant ($p<0.05$) (table 4).

In regard to the dyspahgia, there was a significant difference in dysphagia scores between the control group and case groups within the first 8 hours postoperatively, ($p<0.05$), (table 5). (Table 5) shows that a high percentage of the control group (normal saline) (12.1%) had the highest score (score 4) of dysphagia (not drinking at all) with in the first 8 hours postoperatively, while no patients (0.0%) of bupivacaine group and the lidocaine group had score 4 of dysphagia, indicating that the lidoacine and bupivacaine were effective in reducing dysphagia with in the first 8 hours postoperatively. This association between the dysphagia score and the three groups is statistically significant ($p<0.05$), (table 5). In regard to the difficulty in speaking, (table 5) shows that (6.1%) of the control group (normal saline) had the highest score (score 3) of difficulty in speaking (not speaking at all) with in the first 8 hours postoperatively, while no patients (0.0%) of bupivacaine group and the lidocaine group had score 3 of difficulty in speaking, indicating that the lidoacine and bupivacaine were effective in reducing difficulty in speaking with in the first 8 hours postoperatively, but this association between the difficulty in speaking score and the three groups is not statistically significant ($p>0.05$), (table 5).

The accumulated scores for pain, dysphagia and speaking difficulty were significantly lower in groups I (bupivacaine) and II (lidocaine) as

compared to group III (normal saline) ($p<0.05$), while scores of group II were significantly lower than those in group I ($p<0.05$), (table 6). This means that the lidocaine was the most effective among the other groups in reducing the accumulated pain score, followed by bupivacaine, and the normal saline was the least effective.

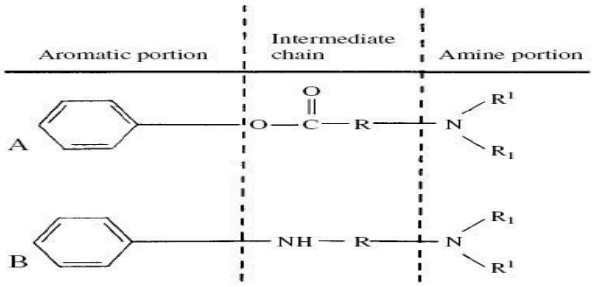

Figure (1): Model structure of local anesthetics showing aromatic portion, intermediate chain, and amine portion.

Figure (2): Wong-Baker Faces pain rating scale**.**

Table (1): Scores for dysphagia (odynophagia).

4	Not at all
3	Sips very reluctantly when encouraged
2	Sips on their own
1	Gulps on their own
0	Drinking as usual

Table (2): Scores for difficulty in speaking.

3	Not at all
2	A few words quietly
1	In a normal voice but less talkative than usual
0	Talking as usual

Table (3): Means of pain, dysphagia, and difficulty in speaking.

Scores	Range	Minimum	Maximum	Mean ± Std. Deviation
Pain scores				
1st hour	3	0	3	0.93 ± 0.95
2nd hours	3	0	3	1.10 ± 0.88
4th hours	4	0	4	1.42 ± 0.90
8th hours	4	0	4	1.57 ± 0.96
24^{th} hours	4	0	4	1.61 ± 0.96
Dysphagia scores	3	1	4	2.18 ± 0.78
Difficulty in speaking scores	3	0	3	1.38 ± 0.58

Table (4): Association between pain scores and study group.

Variables	Status			P value
	Bupivacaine N (%)	Lidocaine N (%)	Control (Normal saline) N (%)	
1^{st} hour				0.000
0	15(45.5)	22(66.7)	4(12.1)	
1	9(27.3)	10(30.3)	12(36.4)	
2	6(18.2)	1(3.0)	13(39.4)	
3	3(9.1)	0(0.0)	4(12.1)	
2^{nd} hour				0.066
0	11(33.3)	16(48.5)	2(6.1)	
1	11(33.3)	15(45.5)	10(30.3)	
2	7(21.2)	2(6.1)	20(60.6)	
3	4(12.1)	0(0.0%)	1(3.0)	
4^{th} hour				0.000
0	9(27.3)	7(21.2)	0(.0)	
1	11(33.3)	18(54.5)	7(21.2)	
2	11(33.3)	7(21.2)	19(57.6)	
3	1(3.0)	1(3.0)	7(21.2)	
4	1(3.0)	0(0.0)	0(0.0%)	
8^{th} hour				0.003
0	7(21.2)	5(15.2)	0(.0)	
1	13(39.4)	18(54.5)	7(21.2)	
2	8(24.2)	9(27.3)	15(45.5)	
3	4(12.1)	1(3.0)	10(30.3)	
4	1(3.0)	0(0.0)	1(3.0)	
24^{th} hour				0.019
0	7(21.2)	4(12.1)	0(0.0)	
1	12(36.4)	17(51.5)	9(27.3)	
2	10(30.3)	9(27.3)	12(36.4)	
3	3(9.1)	3(9.1)	11(33.3)	
4	1(3.0)	0(0.0)	1(3.0)	

Table (5): Association between (scores of dysphagia and difficulty in speaking) and the study groups within 1st 8 hours postoperatively.

Variables	Status			P value
	Bupivacaine N (%)	Lidocaine N (%)	Control (Normal saline) N (%)	
Dysphagia				
1	6(18.2)	4(12.1)	9(27.3)	0.005
2	15(45.5)	23(69.7)	9(27.3)	
3	12(36.4)	6(18.2)	11(33.3)	
4	0(0.0)	0(0.0)	4(12.1)	
Difficulty in Speaking				
0	1(3.0)	2(6.1)	0(0.0)	0.066
1	18(54.5)	24(72.7)	15(45.5)	
2	14(42.4)	7(21.2)	16(48.5)	
3	0(0.0)	0(0.0)	2(6.1)	

Table (6): Accumulated scores for pain, dysphagia and difficulty in speeking +/_ SD.

Scores	Groups			P value
	Bupivacaine Mean ± S.D	Lidocaine Mean ± S.D	Normal saline Mean ± S.D	
Pain scores	1.3 ±1.05	1.18 ±0.72	2.15 ±0.79	0.000
Dysphagia scores	2.1 ±0.72	2.06 ±0.55	2.20 ±0.96	
Difficulty in speaking scores	1.4 ±0.61	1.15 ±0.50	1.75 ±0.80	

Discussion:

Tonsillectomy is a common surgical procedure and is often associated with post-operative pain that is a challenge to treat. Inadequate pain management after tonsillectomy may result in poor oral intake, dehydration, sleep disturbances, behavioral changes, and emesis and bleeding. Tonsillectomy produces large areas of exposed muscle in the oropharynx, resulting in considerable pain from muscle spasm, irritation of nerve endings, excessive dissection and use of cautery-haemostasis may produce even greater amount of inflammation and post-operative pain [(2)]. The pain does not completely subside until the exposed and inflamed muscles become covered with regenerated mucosa, i.e. 14 to 21 days after surgery [(6)]. Studies have shown that anti-inflammatory analgesics such as aspirin and indomethacin can decrease postoperative pain in patients undergoing tonsillectomy. However, these agents are also strong inhibitors of prostaglandins and platelets and can increase the incidence of postoperative bleeding [(12)]. Paracetamol has been shown to be a safe and relatively effective analgesic in children but insufficiently potent if used alone for tonsillectomy pain [(13)]. There are numerous studies in which a local anesthetic drug has been applied to the tonsillar fossae in tonsillectomy to decrease the postoperative pain.Omer Afsin Ozmen and Suay Ozmen compared the topical effects of (0.5%)

bupivacaine and (4%) lidocaine with the control group (normal saline) for post-tonsillectomy pain relief in children, and they found that bupivacaine provide more efficient pain control than both saline and lidocaine without any complication [14]. This result was discordant with the present study, where lidaocaine was found to be more effective. Dr. Sona Chaturvedi and Dr. Domkondwar [15] did a comparative study of topical analgesia with (4%) lignocaine and (0.5%) bupivacaine following tonsillectomy. They found that topical application of (4%) lignocaine was superior and produced good analgesia for up to 8 hours postoperatively. This result was consistent with the present study, where lignocaine was also found to be more effective. Kaygusuz and Susama [16] found that bupivacaine, dexamethasone and lidocaine nasal aerosol decreased the pain significantly in the first post-operative day when it was compared with the placebo group. They found that these three medicines could be used to reduce pain for children during the post-operative period after tonsillectomy. Lidocaine was found to be better than bupivacaine for reducing pain in the third post-operative day. This result was consistent with the present study, where lignocaine was also found to be more effective. Bissonnette [17] noted that when he sprayed 4 mg/kg of (10%) lidocaine aerosol directly onto tonsillar fossa, the post-tonsillectomy pain decreased significantly. At the same time, Elhakim and Abdel Hay [18] in their study sprayed 4 mg/kg (10%) lidocaine aerosol onto tonsils 1-3 min before surgical incision and reported that they did not find significant benefit for post-operative pain with the use of lidocaine. Bupivacaine infiltration before tonsillectomy to provide preemptive analgesia has been subjected to many studies. Jebeles et al. [19], Goldsher et al [20] and Wong et al. [21] demonstrated that bupivacaine with or without epinephrine infiltration decreased post-tonsillectomy pain. In contrast, Unal et al. [22] suggested that peritonsillar bupivacaine infiltration was insufficient to control post-operative pain,While Broadman et al. were unable to show any differences between infiltrations of epinephrine containing bupivacaine and normal saline solutions in terms of postoperative pain scores [23, 24]. In this study; it's preferred to use topical bupivacaine and lidocaine in our study, because of the limited data in the literature about the topical use of bupivacaine and lidocaine in pediatric tonsillectomy cases for post - operative analgesia. Bupivacaine is 3-4 times more potent than lignocaine and produces rapid and prolonged analgesia in the post operative period when used for peripheral nerve blocks [2]. It has also been used as infiltration blocks for prevention of post operative pain following tonsillectomy [19, 23]. Lignocaine is absorbed rapidly from the mucosal surfaces, and has been found to be useful as both postoperative spray [19] and postoperative infiltration for control of pain but not as preoperative infiltration [23].

Local infiltration of local anaesthetic agents in the tonsillar fossa is known to produce complications due to accidental intra vascular injection that can lead to cardiac arrest and convulsion [24] Injection was also reported to cause severe upper airway obstruction, facial nerve paralysis, vocal cord paralysis, and brainstem stroke [24] topical application is a safe and simple to perform; therefore it was preferred to

use topical application of bupivacaine and lidocaine as a safer alternative technique to topical infiltration. The duration of action of lidocaine is 1 to 1½ hours, but in our study its duration as a topical analgesic agent was seen to exceed its normal pharmacological duration as a local anaesthetic. In regard to the bupivacaine also pain relief was of longer duration, well beyond the normal duration of pharmacological action of the drug. This protracted pain relief resulting by a single use of bupivacaine and lidocaine cannot be explained by prolonged presence of the local anaesthetic in the area of surgery, but this is explained by the phenomenon of "neuroplasticity", which proposes that neural blockade causes pre emptive blockade of release of nociceptive neuromediators, thus preventing nociceptive impulses from entering the central nervous system during and immediately after surgery and this suppresses formation of the sustained hyperexcitable state responsible for the maintenance of post-operative pain [19, 20].

Conclusions and recommendations:

From the present study it's concluded that topical application of (4%) lignocaine and (0.5%) bupivacaine in the tonsillar bed is an effective method of reducing postoperative pain following tonsillectomy. Of these (4%) lignocaine was found to be superior and proved to provide more efficient pain control than both bupivacaine and normal saline for up to 24 hours postoperatively without any complication. It is easy to apply, and can therefore be used by all grades of surgeons performing tonsillectomy. Another advantage of lignocaine over bupivacaine is the lower incidence of cardiovascular toxicity, and faster onset of action. Topical application of (4%) lignocaine may therefore, be safely recommended to relief post-tonsillectomy pain that if not treated can impair the swallowing and may lead to dehydration, infection and secondary bleeding.

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