Use of local anesthesia in ear surgery: technique, modifications, advantages, and limitations over 30 years' experience

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Background
Local anesthesia (LA) is safe and well established for a variety of ear operations. It has many advantages compared with general anesthesia (GA).
Objective
This article is intended to be a comprehensive reference for those who use this art, in which we have more than 30 years of experience. We also aimed to find out the effect of LA on blood pressure (BP) and heart rate (HR), operative time, time of anesthesia with different adrenaline concentrations, and patient satisfaction with LA.
Patients and methods
This was a retrospective study of our experience in the technique of LA in more than 2600 patients spanning more than 30 years, along with modifications introduced. Additional prospective trials were also conducted. BP and HR were monitored during LA injection in 200 patients. The calculated operative time was compared between two groups of 21 patients each: the first group was operated upon under LA and the other under GA. Anesthesia time was calculated for LA with different adrenaline concentrations (1 : 20 000–1 : 200 000 and 0% or no adrenaline) by means of injections over both the mastoid and the forearm on five volunteers. Patient satisfaction was measured using postoperative questionnaire in 200 patients.
Results
Patients showed initial increase in BP due to apprehension, which was abolished with diazepam; a second increase in BP and HR occurred after LA injection by 3–10 min. LA statistically significantly shortened the operative time compared with GA. Time of anesthesia was longer using anesthetic solution with higher adrenaline concentration and was longer on the mastoid as compared with the forearm. Finally, 92% of the patients showed satisfaction from the procedure.
Conclusion
LA is a safe and effective way of anesthesia in ear surgery, allowing intraoperative testing of hearing, facial nerve action, and eustachian tube patency. With high adrenaline concentration, it allows excellent hemostasis, shortens the operative time, and increases the time of anesthesia, allowing probable prolonged postoperative analgesia and is well tolerated by the patients.

Keywords:
advantages of local anesthesia, anesthesia time, ear surgery, local anesthesia, operative time, technique of local anesthesia

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Introduction

Local and general anesthesia (LA and GA) are two different modalities of anesthesia used in ear surgery. Although each offers its own advantages and disadvantages, usually the choice of anesthesia in ear surgery depends mainly on the surgeon's preference.

GA offers comfort to the patient and ease to the surgeon, especially for patients who cannot tolerate the procedures under LA. However, LA decreases the operative time, improves hemostasis, and allows intraoperative hearing assessment. LA can be used in a wide range of otologic surgeries, including myringoplasty, tympanoplasty, mastoidectomy, ossiculoplasty, and stapes surgery [1].

Although LA for middle ear (ME) surgery is a well-established procedure, only a limited number of otolaryngologists adopt it (20% in UK) [2].

In Egypt, it has been used in Ain Shams University (ASU) since 1982. It was introduced by the first author, after Professor D. Plester in Tubingen, Germany. The method was modified by using standardized high adrenaline concentration (1 : 20 000) to prolong the anesthesia time and to achieve less bleeding. In

addition, preoperative lidocaine bolus and sublingual nifedipine as prophylaxis against arrhythmias and hypertension were given [3]. The method was popularized by teaching it at ASU hospitals, ear surgery courses held since 1997, and in ear surgery campaigns and workshops in small towns and charity hospitals in Egypt since 2012.

In this article we present a retrospective study of more than 30 years' experience of the use of LA in ear surgery in a tertiary referral center (ASU and Al Azhar University Hospitals) and in private practice by the authors, on more than 2600 ear surgeries. It includes description of our used technique with its modifications, advantages, and limitations and lastly some clinical trials done to standardize it, with reviewing the effect and side effects of the used drugs. The study was approved by the ASU, Faculty of Medicine Research Ethics Committee. A written informed consent was signed by all patients involved in the trials.

Methods

The procedure begins with preoperative patient counseling and education in the outpatient clinic. The patients are informed about the advantages and the potential disadvantages of both LA and GA in ear surgeries. They are taught how to cooperate during surgery.

In the theater, cardiac and blood pressure (BP) monitoring is started. An intravenous access is established and an intravenous fluid is given. Diazepam 10 mg or midazolam 1–2 mg is used to sedate apprehensive patients. A volume of 3–5 ml of lidocaine 2% bolus is given intravenously as prophylaxis against arrhythmias. In hypertensive patients, preoperative oral β-blocker (propranolol) or sublingual captopril 25 mg is given (previously sublingual nifedipine was used during operation).

Anesthetic solution

The authors used 2% lidocaine solution with 1 : 20 000 adrenaline. The total amount of injected anesthetic solution (AS) should not exceed 7 mg/kg body weight (i.e. 20 ml in average adult). In most patients, 12–15 ml was needed. Sometimes, lidocaine is totally substituted or partially mixed with bupivacaine 1%. The AS is prepared by adding 1 mg of adrenaline to 20 ml of 2% lidocaine. Lower adrenaline concentration is used in patients with pre-existing cardiac disease. Injection is strictly extravascular; the syringe piston is usually withdrawn before each injection to assure extravascular injection. Post injection massage is avoided. Because of their possible complications, preparation, and administration of the solutions or drugs should only be carried out by the surgeon himself or under his supervision without depending on his assistant or nurse in their preparation or administration.

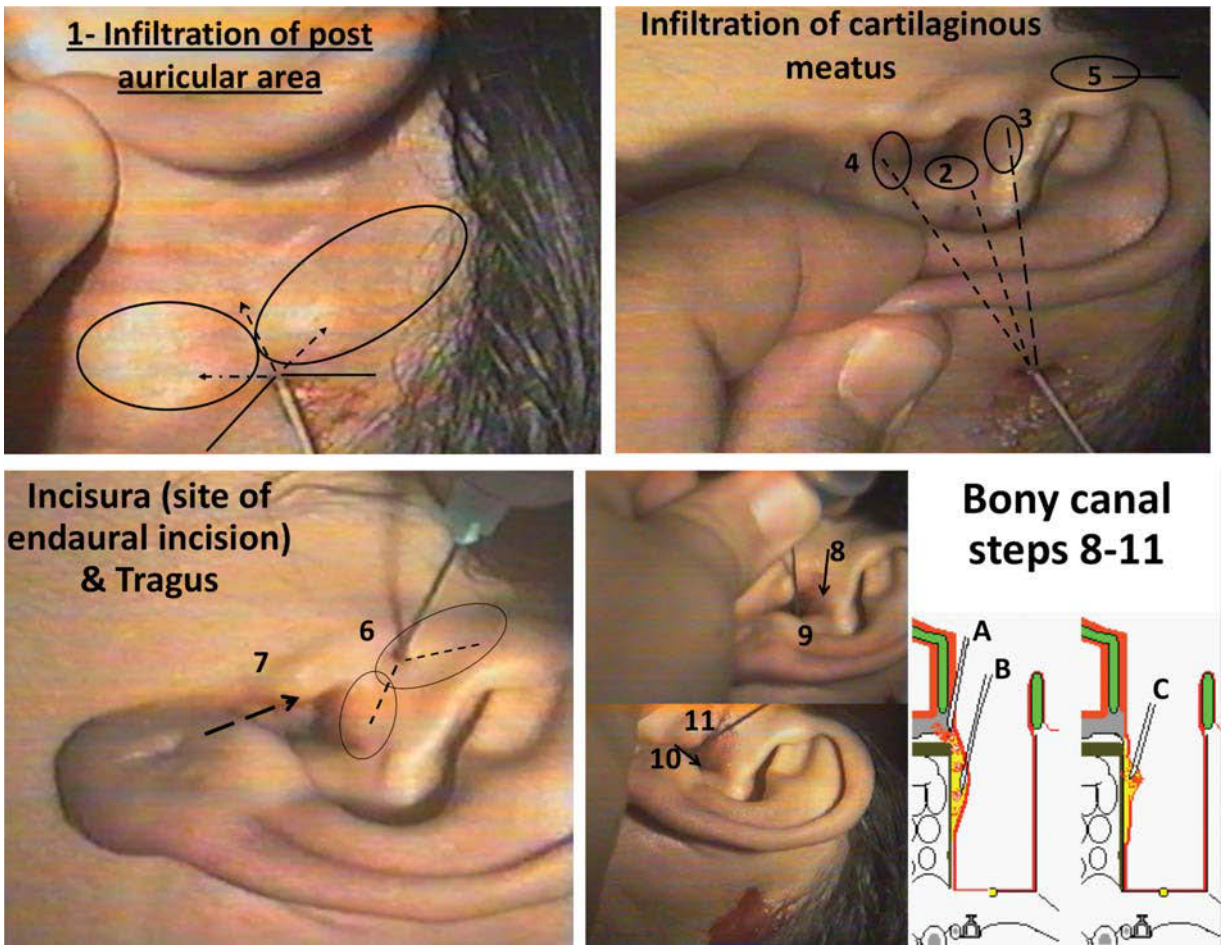
LA injection technique involves anesthetizing 12 points (Fig. 1). First, 3–5 ml is injected in the postauricular region (1). The needle is then advanced anteriorly through the same entry under the concha and 0.5 ml of AS is injected in the posterior (2), the superior (3), and inferior (4) meatal walls. Another 0.5 ml is injected in the front of the helix crus (5) to block auriculotemporal nerve, and then at the site of endaural incision at the incisura (6). The medial surface of the tragus (7) is then injected to abolish sensation induced by the retractor positioned at this area, and it facilitates harvesting tragal cartilage grafts. The external meatus is opened using the Killian speculum, and 0.5–1 ml is injected superiorly in the bone meatus at the 12 O'clock position (8), posteriorly (9), inferiorly at the 6 O'clock position (10) and anteriorly (11). Injecting the posterior and inferior ear-canal skin anesthetizes the auricular branch of the vagus nerve. The bevel of the needle is directed toward the bone, and the AS is injected subperiosteally. If the bevel is directed toward the lumen of the external canal, blebs will form and the skin may be damaged (Fig. 1c). The authors modified the injection of bone meatus by introducing the needle in the thick skin of cartilagenous meatus, and then proceeding subcutaneously until it reaches the bone meatus to infiltrate it (Fig. 1a). This simple method helps to keep the integrity of the thin skin of the bone canal.

The ME mucosa (12) is anesthetized by trickling of the AS through tympanic membrane (TM) perforation; in case of intact TM, 1 ml of AS is instilled in the ME cavity once opened after elevation of the annulus and left for 1–2 min to anesthetize the tympanic plexus.

Modifications in certain situations

(1) Lower adrenaline concentration (1 : 100 000–1 : 200 000) is used in patients with pre-existing cardiac disease. Presence of severe arrhythmias may contraindicate the procedure.
(2) LA for tympanostomy tube insertion needs only infiltration of 5 ml on the external meatus and topical application of lidocaine on the TM

Figure 1



Points of infiltration of the ear for local anesthesia: (1) postauricular area, (2,3,4) posterior, superior, and inferior walls of the cartilaginous meatus, respectively, (5) in-front of the crus of helix (auriculotemporal nerve), (6) incisura, (7) tragus, (8, 9,DD 10, 11) superior, posterior, inferior, and anterior walls of the bone meatus, respectively. (A) Injecting the bone meatus through the skin overlying cartilaginous meatus, and proceeding subcutaneously. (B) Classical injection of the skin overlying the bony meatus. (C) Needle bevel directed wrongly to skin causing its damage.

surface. The latter is only enough for intratympanic injection of drugs.

(3) LA for auricular procedures (auriculoplasty, evacuation of auricular hematoma or perichondritis, preauricular sinus excision) involves mainly steps 1–5 with infiltration around the lesion in preauricular sinus excision.

(4) Supplementary LA may be needed if there is manipulations on the eustachian tube (ET), or if the TM or cholesteatoma matrix is adherent to the ME mucosa, preventing the AS from reaching the tympanic plexus. This is carried out by applying pieces of gel foam or cotton soaked in AS to the desired area of ME mucosa after exposing it.

(5) Temporary facial nerve (FN) anesthesia may occur if there is excessive infiltration below the mastoid tip or injection of the lateral surface of the tragus, thus trickling along the tragal pointer. If it occurs, it usually recovers within a few hours.

(6) Lidocaine 2% and bupivacaine 1% (marcain) mixture by mixing 10ml of each drug together and adding 1mg adrenaline aiming to prolong the anesthesia time was used in 100 patients.

Some prospective clinical trials used in this study:

(1) Although monitoring of the BP and heart rate (HR) throughout the operative time was carried out routinely, it was recorded and studied on paper tapes in 200 patients.

(2) Operative time was calculated in 42 patients; 21 of them were operated under LA and 21 similar cases were operated under GA. The patients were operated upon by the same surgeon, and the operative time of both groups was compared.

(3) Calculation of anesthesia time with different adrenaline concentrations (1 : 20 000–1 : 200 000 and 0% or no adrenaline) was tried on five volunteers. Comparison was made on two areas:

the mastoid and the forearm. First, the volunteer was injected with 2 ml of lidocaine 2% without adrenaline subcutaneously on the right mastoid and forearm and with 1 : 200 000 lidocaine adrenaline on the left side, and then after 1 week the same person was injected with 1 : 20 000 lidocaine adrenaline. Time of anesthesia of each concentration at each site was calculated using the pin prick test and by comparison with the sensation at the shoulder region.

(4) Patients' satisfaction was measured using postoperative questionnaire in 200 patients. In those patients the incidence of temporary facial paralysis was also recorded.

Results

In our series, LA was used in 2673 patients, 1390 (52%) male and 1283 (48%) female. Their ages ranged from 10 to 69 years, with a mean of 28.4 years. Our patients included 39 cooperative children (10–15 years old).

The indications and number of patients operated upon under LA are mentioned in Table 1

Hearing assessment, FN testing, and ET patency were tested as needed during the procedures.

Results of associated medical trials

Changes in the HR and BP: recordings in 200 patients showed a classic example of changes in HR and BP (Figs 2 and 3). There was an initial momentary elevation of both HR and BP, which was abolished using sedative injection, or patient reassurance. After injection, there was a second rise of HR and BP, which lasted for 3–10 min in most patients and returned to baseline after 15 min. In our early experience, we used sublingual nifedipine routinely before LA injection, and later on we used sublingual captopril 25 mg tablets only if BP exceeds 170/90 or is elevated for more than 15 min. In cases of tachycardia, β-blocker was used (used in 14 patients) and only one patient (0.5%) was given intravenously. Rubbing the postauricular area after injection causes temporary rise of HR and BP because of pressing the AS in the circulation, and so it should be avoided. In our very early, experience we did not use lidocaine intravenously and so mild arrhythmias occurred in 5% of patients, but it decreased to 1% when intravenous lidocaine bolus was used before injection. Only two patients had marked arrhythmias at the beginning of injection and the procedure was stopped.

Effect on operative time: operative time of 21 cases (14 myringoplasties and seven cholesteatoma surgeries), performed under LA, was compared with the operative time of 21 other similar surgeries performed under GA by the same surgeon. It was found that LA shortens the operative time as compared with GA. The difference was statistically significant (Table 2).

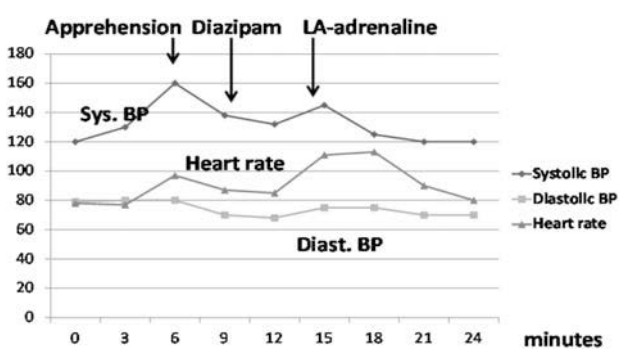
Calculation of anesthesia time on five volunteers with different concentrations of adrenaline in lidocaine 2% (1 : 20 000–1 : 200 000 and lidocaine alone) and comparison of their effect on the mastoid and the forearm revealed that the addition of adrenaline to lidocaine (1 : 200 000) prolonged the time of anesthesia as compared with lidocaine alone (t=9.18, P<0.00001 difference is statistically significant). Moreover, higher adrenaline concentration (1 : 20 000) prolonged the time more compared with low concentration (t=4.06, P=0.00036 difference is statistically significant). It was also found that anesthesia was longer if injected over the mastoid as

Table 1 Indications and number of patients operated upon under local anesthesia

Indications	Number of patients
Tympanoplasty including ossiculoplasty, Tympanosclerosis, adhesive (atelectatic) ME	1548
Tympanomastoidectomy (including cholesteatoma)	610
Stapedectomy	352
Tympanostomy tubes	80
Intratympanic injection	45
Others: congenital atresia	4
Repair of ME floor	8
Glomus tympanicum	3
Otoplasty	3
Other auricular procedures	20
Total	2673

ME, middle ear.

Figure 2



Changes of blood pressure and heart rate with local anesthesia lidocaine 2% with 1 : 20 000 adrenaline. BP, blood pressure; LA, local anesthesia.

Figure 3

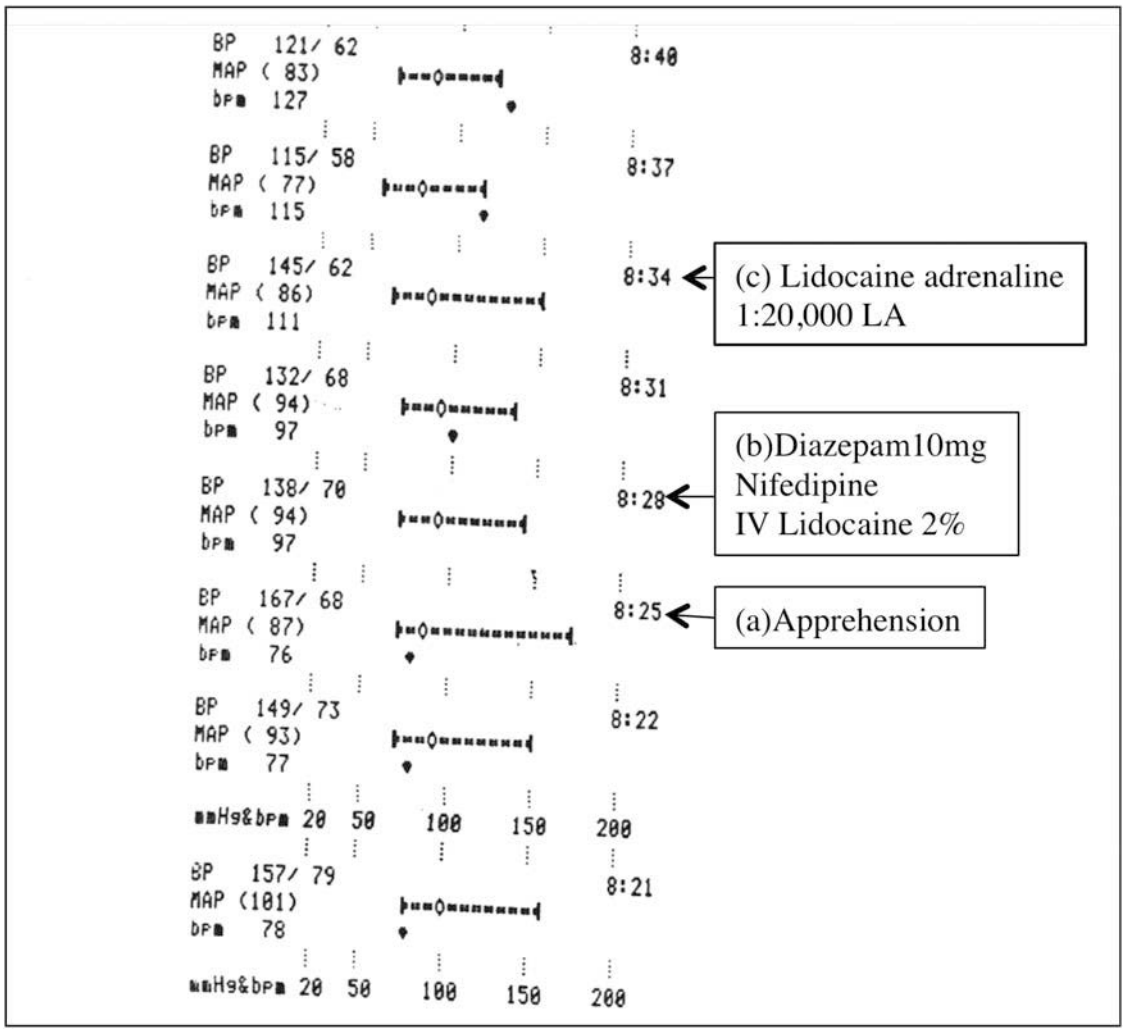


Chart showing monitoring of BP and HR during LA administration. (a) Initial increase in BP due to apprehension. (b) This was abolished with diazepam. (c) A second increase in BP and HR after LA administration; the rise was minimal because sublingual nifedipine was previously given. BP, blood pressure; HR, heart rate; LA, local anesthesia.

Table 2 Comparison of operative time under GA and LA in 21 cases for each group

	GA	LA: lidocaine adrenaline (1 : 20 000)	*t*-test, *P* value, Significance
Myringoplasty			
Number of patients	14	14	t=7.2435, P=0.00001, Statistically significant difference ($P<0.05$)
Time (mean) (min)	100	60	
SD	18.13	8.24	
Time reduction (%)		40	
Tympanomastoidectomy			
Number of patients	7	7	t=4.899, P=0.0005, Statistically significant difference ($P<0.05$)
Time (mean) (min)	161.4	115.7	
SD	19.58	11.78	
Time reduction (%)		28.4	

GA, general anesthesia; LA, local anesthesia.

Table 3 The time of local anesthesia using lidocaine 2% with different adrenaline concentrations at two different sites (forearm and mastoid)

AS/site of injection	Time of anesthesia at the mastoid (min)	Time of anesthesia at the forearm (min)	*t* and *P* values on comparison between mastoid and forearm
Lidocaine (2% only)	40–60	30–50	t=2, P=0.04
Lidocaine +adrenaline (1 : 200 000)	150–180	100–120	t=8.62, P=0.000013
Lidocaine +adrenaline (1 : 20 000)	210–300	150–195	t=4.6, P=0.00084

AS, anesthetic solution.

compared with the forearm. All differences were statistically significant ($P<0.05$) (Table 3).

In our study, 3 h were enough to perform most of the ear operations, including cholesteatoma surgery, so using high adrenaline concentration, the time of anesthesia was more than enough to perform ear surgery.

The use of lidocaine–bupivacaine – adrenaline mixture was also efficient, as it prolongs the time of anesthesia up to 7–8 h; although this additional time was not needed in most ear surgeries, it probably improves postoperative analgesia. Strict extravascular injection is mandatory as bupivacaine is cardiotoxic.

Patient tolerance and satisfaction: questionnaire on 200 patients showed that 184 (92%) of our patients tolerated the LA for ear surgery. They had good experience and may prefer it if a second operation is performed. Patients' intolerance was mainly due to noise, anxiety, and backache; defective LA technique by beginner surgeons with improper injection of the posteroinferior bone canal (site of the auricular branch of vagus nerve) or defective psychological reassurance of the patients explained some intolerence. Patients should be instructed that the loud sounds of instruments such as suction or drilling should not be interpreted as pain. Patients with ME pathology adherent to mucosa were annoyed during the dissection of the pathology, which usually takes few minutes. In four patients (about 2%) we had to convert to GA. In 5% of the patients there was transient facial paralysis with full gain of function a few hours after injection.

Discussion

LA provides several advantages in ear surgery, such as less bleeding, cost-effectiveness, postoperative analgesia, faster mobilization of the patient, and the ability to test hearing intraoperatively [4]. In our study, hearing could be assessed during the operations using free-field audiometry. In a successful hearing reconstruction, the patient could hear whispered voice at 1 m distance. This is valuable in all ear operations aiming to improve hearing, such as myringoplasty, ossiculoplasty, and stapedectomy. In the latter two operations, minimal adjustment of the position of the replaced ossicle or prosthesis may cause marked improvement in hearing.

Test of FN action, by asking the patient to smile or close the eye lids, was a good alternative for FN monitoring in our study. It is an excellent advantage of LA, especially with mastoidectomy or manipulations near the FN. However, sometimes, temporary FN paralysis may occur due to excessive injection at the mastoid tip or on the lateral surface of the tragus, which may be explained by trickling of AS along the tragus to the tragal pointer. In one case, temporary paralysis occurred due to direct application of LA on a dehiscent FN. FN paralysis usually recovers within a few hours, but deprives the surgeon from intraoperative testing of FN action. This condition was met in about 5% of our cases. Lancer and Fisch [5] had a higher incidence of FN anesthesia due to injection in the region of the stylomastoid foramen. Using their injection technique in a series of 32 patients, they reported that 97% developed a temporary postoperative facial weakness.

ET patency could be tested during operations under LA by asking the patient to perform valsalva maneuver, or by injecting saline in the ET through a small malleable catheter and asking if the patient feels it in his or her throat (a test developed by the first author). ET patency is the key of success for all tympanoplasty operations.

Under LA, vertigo may be felt during stapedotomy or dissection of cholesteatoma over inner ear fistula, alarming the surgeon of potential inner ear injury during manipulations. However, momentary vertigo may occur following cold saline irrigation. In a previous study of data analysis in our department, it was found that the incidence of severe sensorineural hearing loss after stapedectomy was 4% with GA, whereas it was 1% with LA [6].

Moreover, in the management of tinnitus due to high dehiscent jugular bulb in ME floor dehiscence, LA was crucial for the success of surgery as it allows intraoperative revisions and manipulation in ME floor reconstruction until achieving tinnitus control [7].

Despite its advantages, surgeons were always concerned that patients may not tolerate discomfort during the operation. However, 89% of patients in the study by Yung [2] and 73% in the series by Caner *et al.* [1] reported that they would prefer LA for a similar procedure. Yung [2] reported that discomforts associated with LA, in a descending order, are noise, anxiety, dizziness, backache, claustrophobia, and earache. Caner *et al.* [1] reported that the most disturbing sensations during ME surgery under LA were irritability, noise, and anxiety. Sarmento and Tomita [8] reported that discomfort was mainly from body and neck position, and to a lesser extent due to anxiety and pain and least due to noise. In our series, 92% of the patients reported they would prefer LA for a similar procedure; in the rest of the patients discomfort was mainly due to noise, anxiety, and backache. Good patient counseling is very important. They should understand that, although LA allows analgesia to the infiltrated area, it does not eliminate tactile sensation, and so they would be able to feel tissue manipulations and noise of the instruments, which should not be interpreted as pain [8]. Moreover, surgeons should not get alarmed if the patients move their body slightly due to discomfort, but must ask them, instead, whether they feel any pain, and even allow them to adjust their position as long as it does not compromise the surgical field [8].

The overall safety of LA is greater compared with GA, including elimination of the risk for laryneotracheal trauma by means of endotracheal intubation. Any complications related to GA agents are avoided, especially cardiopulmonary and hepatic complications. There is less postoperative nausea and vomiting, and, in general, mobilization is early [5].

Halothane-induced hepatitis, one of the GA complications, is avoided in case of LA [9]. Halothane is one of the inhalational anesthetics widely used in Egypt because of its low cost; with the wide prevalence of viral hepatitis in Egypt, it has to be replaced with other more expensive anesthetic agents. Halothane also sensitizes the heart to catecholeamines, causing cardiac arrhythmias [10]. Therefore, we recommend to give prophylactic propranolol and wait for at least 15 min after injection of LA if we have to convert to GA using halothane.

Lidocaine (xylocaine) is the main anesthetic used in our operations. It is characterized by a rapid onset and intermediate duration of action [11]. Its adverse reactions as a local anesthetic are rare. Allergic reactions to lidocaine rarely occur [12]. They were not met in our cases. Systemic exposure to excessive quantities of lidocaine mainly results in central nervous system and cardiovascular effects. Because of its action causing hypotension, bradycardia, and even cardiac arrest, lidocaine use is contraindicated in patients with second or third degree heart block (without pacemaker), severe sinoatrial block (without pacemaker), hypotension, and bradycardia [12].

Addition of adrenaline prolongs its action and decreases its toxicity. The dose of lidocaine should not exceed 4.5 mg/kg without adrenaline, but with adrenaline it can reach 7 mg/kg [13]. Toxicity may be avoided using strict extravascular injection of AS and avoiding rubbing the skin after injection. In our study, it was found that the time of action of lidocaine was nearly doubled if adrenaline 1 : 200 000 was added and increased by 1.5-fold again with 1 : 20 000 adrenaline. This is in agreement with the opinion of Neal *et al.* [13], who stated that adrenaline vasoconstricts arteries, reducing bleeding, and delays the resorption of lidocaine, almost doubling the duration of anesthesia. We also found that prolongation of lidocaine action was also related to the site of injection. Unlike the mastoid region, the forearm region overlies vascular muscles probably causing more rapid absorption of AS and shortening the duration of its action.

Due to its vasoconstrictive action, adrenaline decreases the operative time and improves haemostasis [1]. In our study it allowed a less bloody operative field and more precise operative technique, reducing the operative time.

Another method of prolongation of anesthetic time is to use lidocaine–bupivacaine mixture. Bupivacaine is a long-acting LA and its action may last for 7 h; it is markedly cardiotoxic and may cause death if accidentally intravenously injected (in toxic dose). Intravenous lipid emulsion can be effective in treating severe cardiotoxicity secondary to LA overdose [14].

Adverse reactions of adrenaline include palpitation, tachycardia, arrhythmia, anxiety, headache, and

hypertension [15]. In our study, momentary mild cardiac arrhythmias were seen in 5% of cases. It was minimized to 1% of cases using routine preoperative injection of 3–5 ml of lidocaine 2% intravenous bolus (which is a class 1b antiarrhythmic drug used for treatment of ventricular arrhythmias) [16]. We met two cases of severe arrhythmias at the beginning of injection that contraindicated both LA and GA.

Our study showed that elevation of systolic BP was temporary. It did not exceed 150 mmHg in the first 15 min in most cases. If it lasts for more than 15 min or exceeds 170 mmHg, antihypertensive sublingual drugs were used (this occurred in about 10% of patients).

During our early experience, we first used sublingual nifedipine (adalat – epilat) 10 mg as a routine measure to avoid hypertension. Later, we restricted its use only if systolic BP exceeded 150 mmHg for more than 15 min. However, Food and Drug Administration recommended not using sublingual nifedipine for hypertensive emergencies in 1995, as it may cause an uncontrollable decrease in BP and reflex tachycardia. There are several reports about cerebral ischemia/infarction, myocardial infarction, and complete heart block with its use [17,18]. Although such accidents were not met in our practice, we replaced it with the β-blocker propranolol.

Beta-blockers are sympatholytics used for the management of cardiac arrhythmias [19], hypertension and anxiety [20]. They were used by Pöntinen [10] as a prophylactic measure to patients undergoing middle-ear microsurgery where adrenaline was infiltrated during halothane-N_2O/O_2 anaesthesia. In our study we used propranolol till the year 2005; 40-80 mg oral dose was given one hour before operation, it provided good prophylaxis against cardiac arrhythmias and hypertension and kept the patient calm during operation. Rarely IV propranolol was needed.

Lastly, we used sublingual captopril 25 mg, an angiotensin-converting enzyme inhibitor, for control of hypertension after adrenaline injection. It was only needed in 10% of the patients. It was effective in lowering high BP without side effects in our study. Angeli *et al*. [21] and Kazerani *et al*. [22] found in their studies that sublingual captopril effectively and safely loweres arterial blood pressure in patients with hypertensive emergencies.

We used intravenous diazepam 10 mg as a preoperative sedative in our early years of experience. Later it was substituted with intravenous midazolam (2 mg) only in apprehensive patients; preoperative explanation and psycological preparation for the patients were enough for most of them. Larger doses may cause excessive sedation and deprive us of the patient cooperation in hearing testing.

Abdellatif *et al*. [23] found that the use of dexmedetomidine as a sedative, was associated with a near bloodless microscopic surgical field, shorter surgery time, greater patient satisfaction, and lower pain scores with no adverse effects as compared with midazolam. However, we did not try it because it was relatively expensive for use in public and charity hospitals.

The cost-effectiveness of LA is agreed upon by many authors [4,5]; the shorter operative time, saving the cost of GA, and shorter hospital stay all contribute to the low cost of LA as compared with GA. In a previous study carried in Al Azhar University Hospitals, the anesthetic drugs in LA costed less than 20% of the cost of anesthetic drugs of GA [24].

Because of the low cost, early recovery, and shorter hospital stay (day cases), LA was used successfully by the authors in the ear surgery campaigns and workshops carried out in small towns and charity hospitals in Egypt.

Conclusion

LA is a safe and effective way of inducing anesthesia in ear surgery, it allows intraoperative testing of hearing, FN action, and ET patency, with the ability of using intraoperative vertigo as an alarming sign of inner ear injury. With high adrenaline concentration it allows excellent hemostasis, shortens the operative time, and increases the time of anesthesia, allowing probable prolonged postoperative analgesia. It is well tolerated by the patients and is cost-effective.

Conflicts of interest

There are no conflicts of interest.

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