Hemodynamic Effects of Topical Adrenaline During Septoplasty

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Received: 31 March 2014 / Accepted: 28 July 2014 / Published online: 8 August 2014
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Abstract Vasoconstrictors agents is used in septal surgery, in attempt to improve haemostasis and thereby improve the surgical field. We aimed to compare the effect of lignocaine with adrenaline injection and alone lignocaine injection with topical adrenalin on perioperative hemodynamic effect, hemorrhage and postoperative pain. Patients undergoing surgery were randomised into two groups: group I in whom infiltration was performed with lignocaine (2 %) with adrenaline (1:100,000), group II in whom infiltration was performed with lignocaine (2 %) injection with topical adrenalin application (1:10,000). The two groups were matched by age, sex, body weight, pre-anesthesia blood pressure, heart rate, oxygen pressure and hemorrhage. The hemostatic effects postoperative pain in each group were analyzed. No statistically significant differences in operation time, hemodynamic effect, and intraoperative blood loss were reached between the two groups of patients ($p > 0.05$). But also group I had significantly better pain scores versus control group in the 2nd, 4th, 6th postoperative hours ($p < 0.05$). We suggest that the use of adrenaline infiltration during septal surgery is unnecessary and may subject the patient to the risk of cardiogenic side-effects of systemic absorption.

Keywords Epinephrine · Adrenaline · Septoplasty · Vasoconstrictor agents · Lignocaine

Introduction

Because the smaller anatomical structure of the sinonasal region limits the approach of the open or close septoplasty, good hemostasis to enable more optimal visualization is imperative for septoplasty surgery. Vasoconstrictors agents is used in septal surgery, in attempt to improve haemostasis and thereby improve the surgical field. These agents had been conventionally applied both topically and injected [1]. Infiltration of solutions with adrenaline concentration of 1:100,00–1:200,00 are commonly used while solutions with the concentration of 1:10,000 are commonly used just for topical applications [2, 3]. Also infiltration of those agents provide mucoperichondrial flap elevation through hydrodissection in the septal surgery. However in patients with minimal cardiac reserve, myocardial ischemia or infarction can be following injection of adrenaline containing solutions [4].

This study was designed to determine if adrenaline reduced blood loss and improved surgical field such that would justify its use despite the potential risks. We aimed to compare the effect of lignocaine with adrenaline injection and alone lignocaine injection with topical adrenaline application on perioperative hemodynamic effect, hemorrhage and postoperative pain.

Materials and Methods

Informed consent for participation in the study was obtained from 88 patients undergoing close/open septal

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surgery by one consultant. Patients with known cardiovascular disease, any medication with cardiovascular side effects, clotting disorders and known hypersensitivity to the trial drugs were excluded. Local Research Ethics Committee approval was sought and obtained for the study. Patients undergoing surgery were randomised into two groups; group I in whom infiltration was performed with lignocaine (2 %) with adrenaline (1:100,000), group II in whom infiltration was performed with lignocaine (2 %) and topical adrenaline (1:10,000). One surgeon (CG) performed all procedures.

Intraoperative blood loss Gross amount of blood loss was carefully collected with a suction bottle and accurately measured. One hundred mL of normal saline solution was used to clean the suction catheter. Blood loss (mL) equaled the volume of the suction bottle (mL) minus 100 mL of normal saline solution.

Operation time The interval between 10 min after the first application of adrenaline (either topical or injected) and nasal packing at the end of operation was recorded as operation time (minutes).

Anesthetic Methods and Surgery Technique

One surgeon (CG) performed all procedures. One anesthetist (SS) anesthetized all the patients following a standard protocol. The anesthetist were blinded to the contents of the adrenaline vials until the end of the study. A 22G venous cannula was inserted into the patient's forearm. During cannulation 4 ml of venous blood were taken for estimation of haemoglobin concentration. Propofol (2/2.5 mg/kg), fentanyl (1 mcg/kg), rokuronyum (0.6 mg/kg) were given intravenously to induce anesthesia. An appropriate sized endotracheal tube was inserted to artificially ventilate the patient with 40 % oxygen, 60 % nitrous oxide and 2 % sevoflurane. Mechanical ventilation was maintained to keep the end-expiratory CO₂ values between 34 and 42 mmHg through the surgery. Patients received tramadol 1 mg/kg IV and after all of patients with IVPCA (intravenous patient controlled analgesia) received 10 mg bolus of tramadol and started with continuous infusion of 20 mg/h⁻¹, and lock out of 30 min before extubation. For prevention of postoperative nausea and vomiting, 4 mg IV ondansetron was administered before extubation. Patients were later transferred to the post-anaesthesia care unit and pain assessments made using visual analog scala (VAS) pain scores (0 = 'no pain' and 10 = 'worst pain imaginable'). Pain was assessed at 1st, 2nd, 4th, 6th, 12th and 24th h. Patients received intramuscular diclofenac 75 mg when the VAS score was >4 or when the patient requested analgesic. Ratio demand/delivery, tramadol and diclofenac use were recorded.

Before the operation, in the group I, the septum was bilaterally infiltrated lignocaine 2 % with adrenaline 1:100,000 solution. In the group II, the septum was bilaterally infiltrated with plain lignocaine 2 % for hydrodissection. Topical application of 1:10,000 adrenaline-soaked cotton pledgets were used after mucoperikondrial flebs were elevated, packed for 10 min as the beginning of surgery.

The systolic and median arterial blood pressures were measured using a non-invasive automated machine and the heart rate recorded from the ECG monitor. A finger probe pulse oximeter was used to measure arterial oxygen saturation. Readings were taken before induction of anesthesia and after drug application. Thereafter readings were taken every five minutes until 30 min after surgery had finished. Heart rate, systolic and median blood pressures (mmHg) were recorded at 1, 5 and 10 min after drug application from the basal values (pre-injection) were taken into considerations for calculations.

The quality of the surgical field was assessed by the surgeon, using a linear scale from 1 to 10 (1 poor, very bloody to 10 excellent, dry). Complications and/or side effects, if any, were recorded.

The Kolmogorov–Smirnov test was used to evaluate whether the distribution of continuous variables were normally. Independent Samples t test was used to compare normally distributed independent variables and descriptive statistics are presented as mean $\pm$ standard deviation. Mann–Whitney U test was used to compare the non-normally distributed independent variables and descriptive statistics are presented as median (25–75 %). To analyse the categorical variables, a Chi square test was used and descriptive statistics are presented as frequency (percent). *P* values below 0.05 were considered statistically significant.

Results

A total of 88 patients (25 female and 63 male) met the inclusion criteria and were enrolled in the study. There were no differences with respect to the distribution of age, sex, body weight, pre-anesthesia systolic blood pressure (SBP), median blood pressure (MBP) and after administration adrenaline first minute SBP, MBP between two groups ($p > 0.05$). The 5th and 10th min SBP and MBP values were significantly lower in the group I than group II (respectively, $p = 0.029$, $p = 0.01$, $p = 0.015$, $p = 0.001$) (Table 1). There were no significant differences in the perioperative and after administration 1st, 5th and 10th min heart rates in the two groups ($p > 0.05$) (Table 2). There was no significant differences in the partial oxygen pressure between the two groups of patients ($p > 0.05$).

Table 1 Patient demographics, pre-anesthetic and post-administration adrenaline systolic and median arterial blood pressure values

	Group I	Group II	<i>P</i> value
Age ^a	22 (20 ± 31)	22.5 (21 ± 28)	0.531
Sex (male/female) [†]	34/14	29/11	1
Body weight (kg) ^a	70 (60 ± 78)	70.50 (60.00 ± 79.75)	0.883
Pre- anesthetic systolic blood pressure ^a	120.38 ± 16.16	119.30 ± 16.33	0.758
1' systolic blood pressure ^b	110 (97.25 ± 118)	104.50 (96.25 ± 110)	0.133
5' systolic blood pressure ^a	99.96 ± 15.446	107.23 ± 15.049	0.029
10' systolic blood pressure ^a	99.54 ± 16.243	108.35 ± 14.878	0.01
Pre- anesthetic median blood pressure	89.77 ± 11.284	87.98 ± 11.761	0.553
1' median blood pressure ^b	81 (71.75 ± 91)	77 (72 ± 85)	0.146
5' median blood pressure ^a	77.31 ± 11.454	83.40 ± 11.397	0.015
10' median blood pressure ^b	74 (66 ± 80.75)	81.50 (76.50 ± 89)	0.001

[†] Analytic method: Chi Square tests

^a Analytic method: independent samples t test

^b Analytic method: Mann–Whitney test

Table 2 Peri-anesthetic and post-administration adrenalin heart rate ratio

	Group I	Group II	<i>P</i> value
Preop. heart rate	79.60 ± 13.877	78.18 ± 12.993	0.622
1th heart rate	81.33 ± 19.551	75.95 ± 13.241	0.142
5th heart rate	78.65 ± 14.501	73.45 ± 12.327	0.077
10th heart rate	73.92 ± 14.306	72.68 ± 12.454	0.668

Table 3 Assessment of operation time, and intra-operative partial oxygen pressure, blood loss, surgery field

	Group I	Group II	<i>P</i> value
Operation time	35 (15–75)	40 (20–80)	0.724
Partial oxygen pressure	99 (98–100)	99 (98–99.75)	0.638
Blood loss	50 (30–83.75)	75 (50–100)	0.075
Surgery field	6.50 (5–7)	4.50 (3–6)	<0.001

The median operation time of the group I (35 min) was not significantly different from that of the group II (40 min) ($p > 0.05$). In addition, the median blood loss of the group I (50 mL) was similar to that of the group II (75 mL) ($p > 0.05$). Surgery field was significantly better in the group I than group II ($p < 0.001$) (Table 3). The 2nd, 4th, 6th h pain scores were significantly better in the group I than group II (respectively, $p = 0.006$, $p = 0.025$, $p = 0.03$) whilst no significant differences in VAS 1st, 12th, 24th h and ratio demand/delivery between groups ($p > 0.05$) (Table 4).

Patients were also continuously monitored with a three lead ECG machine. No major complications were noted

Table 4 Post-operative pain scores

	Group I	Group II	<i>P</i> value
Demand	3.50 (2–12)	2 (2–6)	0.592
Delivery	3 (2–7.25)	4 (2–8)	0.820
VAS 1	5 (4–7)	6 (3.25–8)	0.350
VAS 2	7 (5.25–8)	6 (4–7)	0.006
VAS 4	8 (6–9)	7 (6–8)	0.025
VAS 6	8.50 (8–9)	8 (7–9)	0.030
VAS 12	8 (8–9)	9 (8–9)	0.060
VAS 24	9 (8–9)	9 (9–10)	0.085

during this study. None of the patients in either group required a blood transfusion.

Discussion

Septal surgery are standard procedures throughout otolaryngology practice. Good visualization is actually critical because the smaller anatomical structure in addition to vascularity in the nose limits access of vision and in many cases a small hemorrhage may reduce completeness in the surgical procedure. Septoplasty surgeon usually use an intranasal injection of the vasoconstrictor to enhance the operative area in the course of septal surgery [1].

Adrenaline is really a sympathomimetic amine with each α as well as β -adrenergic receptor agonist effects. Skin, mucosa, as well as kidney arterioles display vasoconstriction on account of α -receptor predominant activation. Low concentrations of adrenaline lead to preferential β_2 receptor activation leading to vasodilatation in bronchiolar smooth muscle while increased ranges activate

α -receptor-mediated vasoconstriction in vascular smooth muscle [5]. Infiltration of low-dose adrenaline leads to short-term significant hemodynamic alterations, decrease in blood pressure with a slightly increased heart rate during nasal surgery under general anesthesia [6]. In our study, after post-application adrenaline 5th and 10th min systolic and median arterial blood pressure were significantly lower in the patients of group I than group II. We can explain this condition that injection of adrenaline might induce dose-dependent hypotension. The fall in blood pressure may increase the risk of anesthesia during surgery, especially in patients with cardiac disease. On the other hand, there were no significant differences in the perioperative and after adrenaline application 1th, 5th and 10th min heart rates and intraoperative partial oxygen pressure in the two groups.

Vasoconstrictors for example adrenaline could possibly have tragic uncomfortable side effects such as cardiomyopathy, cardiac arrhythmia, cardiac arrest, pulmonary edema and central retinal artery occlusion, when applying an intravascular shot in addition to incurring swift systemic intake [1, 4]. Intranasal injection causing either rapid uptake as a result of near proximity to body vessel or maybe unrecognized intravascular injection might be the explanation of the exaggerated hemodynamic response in some people. In addition a human error may result in an overdose or relevant dose of adrenaline concentrations, leading to serious complications [3]. Absolutely no correlation had been identified among adrenaline amount in addition to hemodynamic response. Due to higher vascularity of the nasal mucosa, it's not really the total measure but rather this systemic uptake of the dose that is the predictor of the blood pressure answer. Intranasal mucosal injection of adrenaline added anesthetic solution may produce up to a 400 % increase in circulating plasma adrenaline, even as quickly seeing that only two a few minutes subsequent injection [7]. It has also been reported that acceptable dose of adrenaline may induce cardiac pathology in a patient with no history of coroner artery disease [8]. In addition sometimes cardiologic disorders may not be detected by electrocardiogram or another routine tests [1]. Cardiac arrhythmia is the most seen side effect according to our experience. However, no cardiac problems have been observed during septoplasty in our study.

The placement of adrenaline-soaked cotton pledgets may shrink the mucosa along with constrict the tiny vessels, which usually provide compression of bleeding also. Lee et al. [1] showed that injection of a adrenaline did not significantly reduce operation time or blood loss when compared with topical application of the adrenaline during functional endoscopic sinus surgery. They reported that correct use of topical adrenaline pledgets offers both

equally surface vasoconstrictive effects and compressional influence on surgical field and may play in an essential role in hemostasis in the surgical treatment. On the other study demonstrated that there were no difference in blood loss and pain after turbinectomy between topical adrenaline applying and injecting adrenaline and xylocaine [9]. In our study the mean operation time and intra-operative blood loss is similiar between the two groups of patients. We hypothesized that topical application of adrenalin may be effective without the additional injection of adrenaline. However surgery field was more clearer in the group I than group II. The vasoconstrictive effect of adrenaline injection was more obvious in the first 15 min of the operation. Therefore, injected adrenaline may provide a clearer surgical field in the beginning of surgery. However, the longer the operation time, the less the hemostatic effect of the adrenaline injection may become. This may explain the relatively clearer surgical field in the patients of group I.

Adequate pain control is usually a purpose following any surgical procedure. Postoperative pain is usually linked to surgery trauma and expression associated with pain mediators. After septoplasty, the maximum a higher level pain is generally experienced within the first 24 h during which individuals need analgesic support. Analgesia within this period diminishes the actual anxiety caused by the pain and therefore prevents the creation of a vicious cycle [10]. Nonsteroidal anti-inflammatory (NSAI) drugs or opioids are commonly used drug [11]. Analgesics in addition to NSAIs utilized usually to relieve postoperative pain. On the other hand, frequent using these types of agencies bring about problems for example gastrointestinal irritability, tendency to bleed, in addition to allergy symptoms, that might reduce their use [12]. John et al. [13] reported that infiltration technique is better than surface anesthesia in pain control but there was no difference in blood loss between two technique. Temple et al. [9] demonstrated that there were no difference in pain after turbinectomy between topical adrenaline applying and injecting adrenaline and xylocaine. In our study the 2nd, 4th, 6th h pain scores are significantly better in the group I than group II whilst no significant differences in VAS 1st, 12th, 24th h and ratio demand/delivery between groups. We thought that peri-operative analgesic use may explain that why there are not differences in VAS 1st h between the two groups. The epinephrine is added to lignocaine resulting in increased duration of action. Therefore VAS 2nd, 4th, 6th h scores of the group I are significantly higher from that of the group II. However this difference were in just early postoperative hours. Our experience showed that there were no complaint of pain after septoplasty among patients when topical adrenaline were used.

Conclusion

This study showed that topical application of adrenaline does not increase operation time or blood loss while it does not effect adversely hemodynamic when compared with the injection of same agent. Therefore we suggest that the use of adrenaline infiltration during septal surgery is unnecessary when considering its relevant adverse effects, although infrequent.

Acknowledgments None.

Conflict of interests The authors of this manuscript declare no conflict of interest.

References

1. Lee TJ, Huang CC, Chang PH et al (2009) Hemostasis during functional endoscopic sinus surgery: the effect of local infiltration with adrenaline. *Otolaryngol Head Neck Surg* 140:209–214
2. McClymont LG, Crowther JA (1988) Local anaesthesia with vasoconstrictor combinations in septal surgery. *J Laryngol Otol* 102:793–795
3. Matoušek P, Komínek P, Garčic A (2011) Errors associated with the concentration of epinephrine in endonasal surgery. *Eur Arch Otorhinolaryngol* 268:1009–1011
4. Talke PAO, Mangano DT (1993) Alpha2-adrenergic agonists and peri-operative ischemia. *Anaesthesiol Pharmacol Rev* 1:310–315
5. Yang JJ, Li WY, Jil Q et al (2005) Local anesthesia for functional endoscopic sinus surgery employing small volumes of epinephrine-containing solutions of lidocaine produces profound hypotension. *Acta Anaesthesiol Scand* 49:1471–1476
6. Gun R, Yorgancılar E, Yıldırım M, Bakır S, Topcu I, Akkus Z (2011) Effects of lidocaine and adrenaline combination on post-operative edema and ecchymosis in rhinoplasty. *Int J Oral Maxillofac Surg* 40:722–729
7. Pasternak JJ, Atkinson JL, Kasperbauer JL et al (2004) Hemodynamic responses to epinephrine-containing local anesthetic injection and to emergence from general anesthesia in transphenoidal hypophysectomy patients. *J Neurosurg Anesthesiol* 16:189–195
8. Sato Y, Tanaka M, Nishikawa T (2000) Reversible catecholamine-induced cardiomyopathy by subcutaneous injections of epinephrine solution in an anesthetized patient. *Anesthesiology* 92:615–619
9. Temple RH, Timms MS (2001) Blood loss reduction during laser turbinectomy. *Rhinology* 39:230–232
10. Koeppe T, Constantinescu MA, Schneider J et al (2005) Current trends in local anesthesia in cosmetic plastic surgery of the head and neck: results of a German national survey and observations on the use of ropivacaine. *Plast Reconstr Surg* 115:1723–1730
11. Karaman E, Gungor G, Alimoglu Y et al (2011) The effect of lidocaine, bupivacaine and ropivacaine in nasal packs on pain and hemorrhage after septoplasty. *Eur Arch otorhinolaryngol* 268:685–689
12. Yilmaz YF, Ozlugedik S, Titiz A, Tuncay A, Ozcan M, Unal A (2008) Comparison of levo-bupivacaine and lidocaine for post-operative analgesia following septoplasty. *Rhinology* 46:289–291
13. John G, Low JM, Tan PE et al (1995) Plasma catecholamine levels during functional endoscopic sinus surgery. *Clin Otolaryngol* 20:213–215