

Effect of using diluted adrenaline injection on hemodynamical parameters during septoplasty

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Received 12 June 2020

Accepted 06 July 2020

Published 21 January 2021

Pan Arab Journal of Rhinology
2020, 10:100–104

Context

Septoplasty is a common surgical procedure performed to correct the deviated nasal septum. A clear surgical field is imperative for the success rate of the procedure. It can be achieved by improving the visualization of the sinonasal structures by optimizing good hemostasis. Adrenaline local infiltration was commonly used despite its potential risks and complications; it is still controversial and referred to as surgeon preference. We aimed to study and evaluate the effect of diluted adrenaline injection in the submucoperichondrial plane in the nasal septum during nasal surgery in relation to hemodynamic parameters of the patient during the procedure.

Aims

We aimed to study and evaluate the effect of diluted adrenaline injection in the submucoperichondrial plane in the nasal septum during nasal surgery in relation to hemodynamic parameters of the patients during the procedure.

Patients and methods

This retrospective single-center study included patients who underwent septoplasty under general anesthesia at Al-Noor Specialist Hospital from 2014 till 2018.

Statistical analysis

Statistical analysis was performed using Statistical Package for Social Science software, version 21.0.

Results

This study included 223 patients who underwent septoplasty. Males were more prevalent than females (72.6 vs. 27.4%). The sample included 19.3% patients with diabetes, 17.5% were hypertensive, 3.6% had cardiac disease, 1.8% had hypothyroidism, and 2.2% had renal diseases. The mean \pm SD of heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation at baseline and after injection for 12 min was recorded, reflecting no significant changes regarding increasing in all parameters.

Conclusions

Injection of diluted adrenaline (1: 100 000 or 1: 200 000) during septoplasty in relation to hemodynamic parameters is safe, as there is no increase in heart rate, blood pressure, or mean arterial pressure after the infiltration in the submucoperichondrial plane regardless of the patients' comorbidities.

Keywords:

adrenaline, diluted adrenaline, epinephrine, infiltration, septoplasty

Pan Arab J Rhinol 10:100–104
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Introduction

Septoplasty is one of the most common operations performed in otorhinolaryngology [1]. Good hemostasis is essential for optimal visualization during septoplasty as the sinonasal region is a small area that can be filled with blood quickly even with a small amount and lead to obscuring of the visual field and limits the approach for open and close septoplasty [2,3]. Most of the otolaryngologists advise infiltration of the submucosal area by local anesthetic containing epinephrine to obtain the hemostasis and reduce postoperative pain [4]. In the present study, we aimed to evaluate and determine the complications that are related to the effect of using diluted adrenaline injection mixed with 1% of lidocaine in the submucoperichondrial

plane in nasal septum during nasal surgery in relation to hemodynamic parameters of the patients including patients with comorbidity.

Patients and method

A retrospective study was conducted that included patients who underwent septoplasty under general anesthesia at Al-Noor Specialist Hospital, Makkah,

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Saudi Arabia, during the period from 1/1/2014 to 3/12/2018. The protocol of the surgery included injecting patients with 10 ml of diluted adrenaline 1: 100 000 or 1: 200 000 into the nasal septal submucoperichondrial plane mixed with 1% of lidocaine. Inclusion criteria are either patients who were not known to have any medical illnesses or with known medical illness, for example, thyroid disease, renal disease, hypersensitivity, cardiovascular disease, hypertension, and using any medications with cardiovascular adverse effects. Exclusion criteria are patients whose ages less than 17 years old, combined with other surgery like rhinoplasty or sinus surgery, and who had hypersensitivity to injected adrenaline. Data were collected using a premade collection sheet from the electronic system. Data collection included patients' demographics, BMI, oxygen saturation (SpO₂), comorbidities, heart rate, blood pressure, mean arterial pressure, and arterial SpO₂ using finger probe pulse oximeter. Readings of patients' parameters of hemodynamics were taken after patient intubation as a baseline and then every minute following local injection till 12 min, as any hemodynamic changes will appear during this period.

Statistical analysis

Statistical analysis was performed using Statistical Package for Social Science software, version 21.0 (IBM Corp, Armonk, NY, USA). Mean and the SD was used to represent quantitative variables, whereas number and percentage were used to represent qualitative variables.

Results

The present study included 223 patients, and the majority of them were Saudi [197 (88.3%)]. The prevalence of males was more than females [162 (72.6%) vs. 61 (27.4%), respectively]. The age range of patients was 17–60 years, with a mean \pm SD of 30.7 \pm 9.3 years. The range of BMI was 17–44, with a mean \pm SD of 26.8 \pm 5.8; those with normal weight were more prevalent than other weight groups [94 (42.2%)]. Regarding comorbidities, 43 (19.3%) patients had diabetes mellitus, 39 (17.5%) had hypertension, eight (3.6%) only had cardiac diseases, four (1.8%) had hypothyroidism, five (2.2%) had renal disease, and 19 (8.5%) had hypersensitivity for medications (e.g. ibuprofen). Details of patients' demographics and comorbidities are shown in Table 1.

The mean hemodynamic parameters, such as heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and peripheral capillary SpO₂,

were estimated at two points: after intubation as the baseline, and after injection for 12 min, as shown in Table 2. Regarding heart rate, the baseline heart rate ranged from 78 to 99, with a mean \pm SD of 86.8 \pm 6.4, whereas the heart rate decreased to 75–99, with a mean \pm SD of 84.6 \pm 6.5, at 12 min of injection, with *P* value of 0.00. Regarding systolic blood pressure, the baseline reading ranged from 77 to 111, with a

Table 1 Demographics and comorbidities of patients

Variables	Patients (n=223)
Nationality	
Saudi	197 (88.3)
Non-Saudi	26 (11.7)
Sex	
Male	162 (72.6)
Female	61 (27.4)
Age	
Mean \pm SD	30.70 \pm 29.00
Median (IQR)	9.32 (15-60)
Weight (kg)	
Mean \pm SD	71.16 \pm 13.95
Median (IQR)	70.00 (50-100)
Height (cm)	
Mean \pm SD	1.63 \pm 0.08
Median (IQR)	1.60 (1.5-1.8)
BMI	
Mean \pm SD	26.84 \pm 5.76
Median (IQR)	26.56 (16.97-44.00)
Comorbidities	
DM	43 (19.3)
HTN	39 (17.5)
Cardiac diseases	8 (3.6)
Hypothyroidism	4 (1.8)
Renal disease	5 (2.2)
Hypersensitivity for medication	35 (15.7)

n (%) represented the categorical variables, whereas mean \pm SD represented numerical variables. DM, diabetes mellitus; HTN, hypertension; IQR, interquartile range.

Table 2 Comparison of hemodynamics parameters between baseline and fourth 3 min of reading

Variables	Mean \pm SD (median)	<i>P</i>
HR	HR after intubation	HR 12 min
	86.78 \pm 6.43	84.61 \pm 6.53
	85 (78-99)	82 (75-99)
SBP	SBP baseline	SBP 12 min
	91.44 \pm 9.31	87.28 \pm 10.64
	90 (77-111)	83 (74-111)
DBP	DBP baseline	DBP 12 min
	68.15 \pm 4.38	66.32 \pm 5.05
	70 (60-76)	65 (60-75)
MAP	MAP baseline	MAP 12 min
	75.91 \pm 4.52	73.30 \pm 5.44
	75.66 (66.67-84.33)	72.66 (64.67-87)
SpO ₂ 3 min	SpO ₂ baseline	SpO ₂ 12 min
	99.50 \pm 0.50	99.50 \pm 0.50
	100 (99-100)	99 (99-100)

DBP, diastolic blood pressure; HR; heart rate; MAP, mean arterial pressure; SBP, systolic blood pressure; SpO₂, oxygen saturation

mean \pm SD of 91.4 ± 9.3 , and at 12 min, it became 74–111, with a mean \pm SD of 87.3 ± 10.6 . The range and mean \pm SD of diastolic blood pressure at baseline and at 12 min were 60–76, with a mean \pm SD of 68.2 ± 4.4 , and 60–75, with a mean \pm SD of 66.3 ± 5.1 , respectively. The *P* value was 0.00 for both systolic and diastolic blood pressure. However, the mean arterial pressure at baseline was 66.7–84.3, with a mean \pm SD of 75.9 ± 4.5 , and at 12 min after injection was 64.7–87, with a mean \pm SD of 73.3 ± 5.4 , with a *P* value of 0.00. The range and mean \pm SD of SpO₂ were 99–100 and 99.5 ± 0.5 , respectively, at baseline reading, and 99–100 and 99.5 ± 0.5 at 12 min, with *P* value of 0.94. The changes in the previous parameters were investigated (Table 2). There were no statistically significant differences regarding the increase of the hemodynamic parameters including the mean heart rate, systolic blood pressure, mean arterial pressure, and SpO₂ when comparison was done between the baseline reading and after injection for the total 12 min.

However, we also did a comparison between recorded parameters in relation to the comorbidity status of the patients, and there were no significant statistical differences between comorbid and noncomorbid patients in different hemodynamic parameters (Table 3). Finally, there was no increase in all collected parameters after infiltration even with general patient health status.

Discussion

A good visual field is the key factor to achieve a successful and safe nasal surgery. It can be optimized by many measurements, such as elevating the head of

the bed, anesthetic hypotension technique, injecting vasoconstrictor agent, or applying various topical medications including phenylephrine, cocaine, oxymetazoline, and epinephrine [5]. However, during such surgical procedure, general anesthesia and some local anesthetics cause hyperemia of local (nasal) mucosa and a bloody surgical field as a manifestation of vasodilating effect, which advocates the need for using topical vasoconstrictors in addition to local anesthetics to reduce nasal blood flow [6]. Using concentrated epinephrine either as a topical or submucosal injection is widely used by otorhinolaryngologists in endoscopic sinonasal surgery, as it is considered a powerful nonselective alpha-agonist because of its arteriolar and venous sinusoidal constrictions. Moreover, the risk of systemic effects such as arrhythmia and hypertension is increased by perioperative use of volatile anesthetic agents, which increase the myocardial sensitization to the effects of epinephrine [7]. Knowing there is no agreement regarding what is the appropriate topical vasoconstrictor used in nasal surgery regardless this fact [7]. Vasoconstrictors agents were applied conventionally either by injection or topically [8]. Overall, good visualization is a key factor in preventing complications related to sinonasal surgeries and achieving a good functional nasal airway. Complications that may occur include bleeding; cerebrospinal fluid rhinorrhea; extraocular muscle damage; wound infection; septal abscess; toxic shock syndrome; septal perforation; saddle nose deformity; nasal tip depression; and sensory changes, such as anosmia or dental anesthesia [9]. However, the infiltration of epinephrine concentration of 1: 10 000–1: 20 000 solutions is commonly used for topical applications [10,11]. Besides, one study showed that topical and injection of epinephrine (adrenaline) resulted in a similar hemostatic effect in endoscopic sinus surgery [8]. Epinephrine is a hormone released from the adrenal medulla in response to stress, mediated by sympathetic fibers. It is also called adrenaline, derived from the name of its gland [12]. It stimulates both alpha-adrenergic and beta-adrenergic systems; causes systemic vasoconstriction, gastrointestinal relaxation, and bronchodilation; and dilates the cerebral vessels [13]. Alternative medications, such as common nasal decongestants can be used as topical vasoconstrictors, including phenylephrine (alpha-1 agonist) and oxymetazoline (alpha-1 agonist and partial alpha-2 agonist), but both have lower affinity for alpha receptors in comparison with adrenaline [7]. In addition, cocaine has a unique effect, which provides both analgesia and vasoconstriction effect, and unfortunately has a higher risk of perioperative cardiac complication especially on the elderly population [14]. Recently, a systemic review suggested the efficacy and the safety of using topical

Table 3 Comparison of hemodynamics regarding comorbidity

Variables	Mean \pm SD (median)		<i>P</i>
HR	HR baseline	HR 12 min	0.00
	86.78 \pm 6.43 85 (78-99)	84.61 \pm 6.53 82 (75-99)	
SBP	SBP baseline	SBP 12 min	0.00
	91.44 \pm 9.31 90 (77-111)	87.28 \pm 10.64 83 (74-111)	
DBP	DBP baseline	DBP 12 min	0.00
	68.15 \pm 4.38 70 (60-76)	66.32 \pm 5.05 65 (60-75)	
MAP	MAP baseline	MAP 12 min	0.00
	75.91 \pm 4.52 75.66 (66.67-84.33)	73.30 \pm 5.44 72.66 (64.67-87)	
SPO ₂	SpO ₂ after induction	SpO ₂ 12 min	0.94
	99.50 \pm 0.50 100 (99-100)	99.50 \pm 0.50 99 (99-100)	

Comorbid patients are those having any disease or obese, overlap may occur in some patients. DBP, diastolic blood pressure; HR, heart rate; MAP, mean arterial pressure; SBP, systolic blood pressure; SpO₂, oxygen saturation.

epinephrine in endoscopic sinus surgery, which lowers the overall complications rate, despite that the cardiac complications were the most commonly reported in patients with a history of cardiac disease [5]. In the present study, we aim to confirm that using diluted adrenaline injection during septoplasty is safe regardless of the patients' comorbidities. We found that regarding heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and SpO₂, the mean baseline parameters were not significantly changed after injection, without any increase. Furthermore, many studies suggested that associated cardiovascular complications with the application of topical high-concentrated epinephrine 1: 1000 to 1: 2000 doses are rare. Nonetheless, strict handling protocols are required to prevent erroneous preparation, which is a major contributing factor to reported adverse events [5,7]. In contrast to our findings, the study by Moshaver *et al.* [4] conducted on patients performing endoscopic sinus surgery injected with lidocaine 2% and 1: 100 000 adrenaline showed an increase in the heart rate, systolic and diastolic blood pressure, as well as mean arterial pressure. The increase was found to be significant in the first and second minutes after injection and decreased to the baseline by the fifth minute. A study suggested that the use of combined greater palatine canal and transnasal injection of lidocaine and epinephrine is a safe and effective method for reducing bleeding during septoplasty. Moreover, they found that no significant differences were observed in systolic and diastolic blood pressure, heart rate, and mean arterial pressure of study participants [3]. Another study found that 1% lidocaine combined with 1: 200 000 or 1: 400 000 adrenaline resulted in optimal hemostasis, but a concentration of 1: 800 000 led to significant lower vasoconstriction effects [15]. The study by Alkhaldi *et al.* [16] compared the use of three different concentrations of adrenaline with submucosal infiltration in patients undergoing septorhinoplasty; the study reported that the heart rate was increased, mean arterial pressure was significantly reduced, and systolic blood pressure was decreased. Another study was designed to observe hemodynamic changes caused by epinephrine-containing lidocaine solution in neurosurgical procedures and suggested that the infiltration of epinephrine elicits temporary but significant hemodynamic changes including hypotension before craniotomy [17]. However, another study [2] reported that the application of topical adrenaline of 1: 10 000 concentrations showed no significant hemodynamic effect, and there was no protective effect for intraoperative blood loss. Moreover, the authors suggested that the use of adrenaline infiltration during septoplasty was not necessary. The result of the present study showed no increase in all parameters, with mild decreases in some

parameters, including the heart rate, which is contrary to what has been reported before, and these could be related to the effect of the anesthesia medication during induction. Moreover, no related complications were reported, which was mostly owing to obtaining a good satisfactory surgical field during the procedure, and none of the patients needed any intraoperative blood transfusion. However, further similar studies might be needed to support the results. In general, results of the different studies are controversial. The differences between the studies may be owing to the type of surgery, concentration adrenaline used, its method of application and the site of its application, the protocol of each study, and the patients' clinical characteristics.

Conclusion

The present study showed that injection of 10 ml of diluted adrenaline (1:100000 or 1:200000) in the sub-mucoperichondrial plane for patients undergoing septoplasty is safe as there was no statistically significant increase in the heart rate, systolic and diastolic blood pressure and mean arterial pressure, with stable hemodynamic parameters despite the patient comorbidity.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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