

## Controlled Hypotensive Anesthesia in Children Undergoing Nasal Surgery

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### Abstract

**Background:** The nasal surgery in pediatric patient's carries a major challenge to both anesthesiologist and surgeon. The surgeon faces small nostrils and narrow nasal passages. The anesthesiologist has to produce condition which facilitate the surgery, decrease the operative time by minimize the intraoperative bleeding to allow better visualization this can be achieved by controlled hypotensive anesthesia which is the key issue in the success of nasal surgery in pediatric age group.

**Patient and methods:** Seventy pediatric patients aged 8-12 years scheduled for elective nasal surgery under general anesthesia. Patients were classified into two equal groups (35 patients per group) according to study drugs used. Group (D): The patients in this group received dexmedetomidine 0.5 µg/kg as loading dose over 10 minutes followed by 0.2-0.5 µg/kg/h as maintenance infusion after induction of anesthesia but before surgery. Group (E): The patients in this group received esmolol 0.5 mg/kg as loading dose over 10 minutes followed by 100-300 µg/kg/min as maintenance infusion after induction of anesthesia but before surgery. Measurements: Heart rate, Mean Arterial blood Pressure, Quality of surgical field, duration of surgery, duration of anesthesia, Aspartate aminotransferase (AST), alanine aminotransferase (ALT), blood urea, serum creatinine, adverse events and postoperative analgesia.

**Results:** There were no significant differences between groups as regards to demographic data, duration of surgery, and duration of anesthesia. The MABP and HR were significantly decreased after infusion of study drugs till the end of surgery with no differences between both groups in all times of measurements. The quality of surgical field was comparable between both groups in all times of measurements. There were no changes in blood urea, serum creatinine, AST, and ALT.

**Conclusion:** Our study demonstrated that both dexmedetomidine and esmolol are safe and effective agents for inducing controlled hypotension in pediatric patients undergoing nasal surgery with no reported complications.

**Keywords:** Nasal surgery; Hypotensive anesthesia; Hypotensive drugs; Esmolol; Dexmedetomidine

### Introduction

The anesthetist is an important member of the nasal surgery. The technique of anesthesia plays an important role in success of surgery as the anesthesiologist has to produce conditions which facilitate surgery by inducing immobile bloodless surgical field while maintaining organ perfusion.

A dry surgical condition is needed for nasal surgery; major complications can occurred as result of poor visualization of the nasal and paranasal structures. So the anesthesiologist should use different physical and pharmacologic methods to minimize the bleeding in the operative field.

Major bleeding and poor visualization of the nasal and paranasal structures leads to serious complications include but not limited to optic nerve damage, dural injury, and meningitis have been reported for functional endoscopic sinus surgery under general or local anesthesia [1].

The anesthetists should make an optimum surgical condition to avoid the threat of serious complications which result from poor visibility [2].

Deliberated hypotensive anesthesia is used to induce dry surgical field which allow better visualization of the surgical site and decrease the amount of intraoperative blood loss [3].

Functional endoscopic sinus surgery was done safely in children using hypotensive anesthesia without any adverse events although the blood pressure was reduced up to 25% below baseline [4].

Deliberated hypotensive anesthesia can be done using different drugs which include direct vasodilator, alpha blocker, beta blocker, combined alpha and beta blocker [5].

Reflex increase in the heart rate as result in decrease in blood pressure may increase the surgical site bleeding making its wisdom to use beta-blocker to enable good control of heart rate.

Esmolol is short acting, highly selective beta one antagonist used by intravenous route as bolus and continuous infusion to induce controlled hypotension with very short half-life. The total clearance of esmolol from the body was 3 times of cardiac output and 14 times of hepatic blood flow [6].

Dexmedetomidine is a specific and selective  $\alpha_2$  agonist has anesthetic-sparing properties, anxiolytic, sedative, decrease perioperative opioid consumption, prolong postoperative analgesia and maintain hemodynamic stability [7].

The aim of our study was to compare surgical condition in children undergoing nasal surgeries under general anesthesia combined with dexmedetomidine or esmolol to induce controlled hypotension. The primary outcomes of this study are the quality of surgical field and hemodynamic changes while the duration of surgery, time to first analgesic request and postoperative complications were the secondary outcomes.

## Patients and Methods

After approval of the ethics committee and obtaining written informed consent from patient's guardian, this study was carried out on seventy pediatric patients aged 8-12 years prepared for nasal surgery under general anesthesia in the otorhinolaryngology department, Tanta University Hospital.

All patients' data were confidential with secret codes and was used for the current study only.

Any unexpected risk appears during the course of the study was cleared to the guardian of the patient and the ethical committee on time and the proper measures were taken to minimize or overcome these risks. The approval code of ethics committee was 30830/03/16.

The randomization of this study was done by using simple method of sealed numbered envelopes. A blind person who did not share in patients' care read the number, open the envelopes and made group classification. A blind anesthesiologist who not participates in the patients' follow up will be responsible for preparation of study drugs. Both attendant anesthesiologist and surgeon were blind to pharmacological intervention and group's classification.

## Inclusion criteria

Pediatric patients aging 8-12 years of both sex with ASA I and II scheduled for elective nasal surgery during general anesthesia.

## Exclusion criteria

Refusal of patients' guardian to participate in the study, patients with disorder of coagulation, thrombocytopenia, patients on anticoagulant therapy, and patients with congenital heart disease. Figure 1 shows the patients flow diagram.

## Anesthetic management

**Preoperative preparation:** All patients underwent preoperative assessment by history taking, clinical examination and laboratory investigations (which include complete blood count, liver function test, renal function test, prothrombin time and INR, bleeding and coagulation time).

Clear fluids were allowed up to 2 h before operation while solid food was omitted 6 hours before anesthesia. All patients received orally 0.5 mg/kg of injectable midazolam mixed with juice 30 min before anesthesia to facilitate parent's separation. Emla cream was applied to patients' skin 30 min before induction of anesthesia.

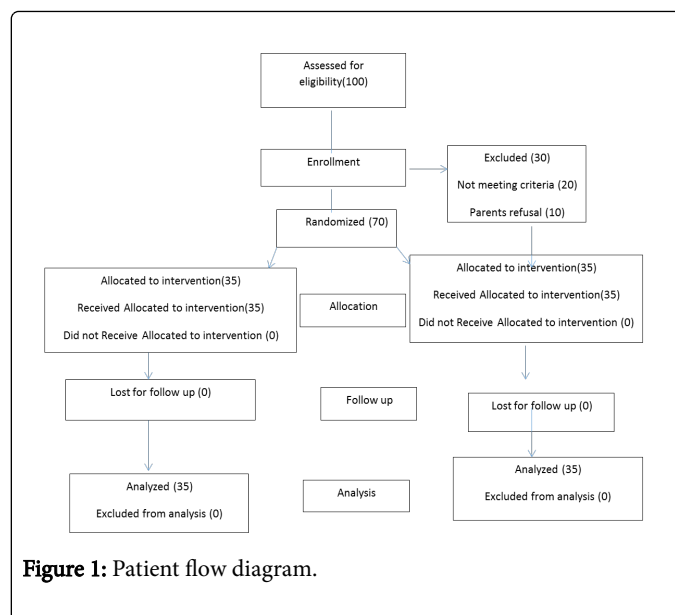


Figure 1: Patient flow diagram.

**Intraoperative management:** On arrival to operating room two intravenous lines were inserted at site of emla cream and secured. One for study drug infusion and the other for fluid infusion and other medications.

Anesthesia was induced by fentanyl 1  $\mu\text{g}/\text{kg}$ , propofol 2 mg/kg and rocuronium 0.6 mg/kg, the patients were ventilated by face mask for 3 min then; airway was secured by suitable size cuffed endotracheal tube by direct laryngoscope. Tracheal intubation was confirmed by observation of chest wall movement, chest auscultation and appearance of square wave of capnography. The patients' lungs were mechanically ventilated. The ventilation was adjusted and controlled by the respiratory rate and tidal volume to maintain normocarbida (ETCO<sub>2</sub> between 32-35 mmHg).

**Maintenance of anesthesia:** Isoflurane 1 to 1.5 vol. % in O<sub>2</sub> was used for anesthesia maintenance and top up dose of rocuronium 0.01 mg/kg was given every 30 minutes. Patients were attached to monitor displaying ECG, HR, NIBP, ETCO<sub>2</sub> and O<sub>2</sub> saturation. All patients received 5% dextrose in 0.9% saline at rate 5 ml/kg/hour.

Folly catheter was inserted for urinary bladder decompression and to observe urine output. Following induction of anesthesia all patients received topical application of epinephrine 1/1000 to nasal mucosa with cotton for 10 min, after removal of the cotton the surgeon infiltrates 1 ml of lidocaine and epinephrine 1/100000 submucosally. Patients were positioned supine with head up 30 degrees to facilitate venous drainage.

Signs of inadequate anesthesia (increases in MAP or increases in HR greater than the baseline by 20% or more) were treated with additional fentanyl 1  $\mu\text{g}/\text{kg}$  and recorded. Nitroglycerine was infused as a rescue hypotensive agent if these target levels could not be achieved with the uppermost dose. The primary endpoint was MAP 20-25% below baseline value before beginning of surgery in both groups, while secondary endpoints included: occurrence of tachycardia, and the need to use rescue hypotensive agent.

Decrease in MAP below baseline by 30% was considered hypotension and treated with ephedrine 5 mg. HR below 60 beats/

minute was considered as bradycardia and treated with atropine 0.01 mg/kg.

The infused drugs in both groups was stopped 10 minutes before anticipated end of surgery to allow the pressure to rise to detect bleeding point and to make effective hemostasis.

During placement of nasal pack, intravenous (IV) 15 mg/kg of paracetamol and 1 mg/kg of tramadol were given intramuscular to control postoperative pain in both groups.

For prophylaxis against postoperative nausea and vomiting (PONV) metoclopramide 0.15 mg/kg combined with dexamethasone 0.15 mg/kg were administered at the end of surgery. In case of PONV ondansetron 0.1 mg/kg was given.

After surgery was completed, isoflurane was stopped, residual muscle relaxant was antagonized with atropine 0.02 mg/kg and neostigmine 0.05 mg/kg, awake extubation of the endotracheal tube was done after insertion of suitable size oral airway and suction of the oropharynx.

After extubation the patients were transferred to postanesthesia care unit for close monitoring of conscious level, hemodynamic parameter and oxygen saturation postoperatively.

### Randomization

The randomization of this study was done by using simple method of sealed numbered envelopes. A blind person who did not share in patients' care read the number, open the envelopes and made group classification. A blind anesthesiologist who not participates in the patients' follow up will be responsible for preparation of study drugs.

The process of inclusion in the study went on until the required number of patients was reached. All operating room anesthesiologists, surgeons, and nurses were blinded to randomization, and preparations.

Score	Definition
0	No bleeding.
1	Slight bleeding - no suctioning of blood required
2	Slight bleeding - occasional suctioning required. Surgical field not threatened
3	Slight bleeding - frequent suctioning required. Bleeding threatens surgical field a few seconds after suction is removed.
4	Moderate bleeding - frequent suctioning required. Bleeding threatens surgical field directly after suction is removed
5	Severe bleeding - constant suctioning required. Bleeding appears faster than can be removed by suction. Surgical field severely threatened and surgery not possible.

**Table 1:** Average category scale (ACS) for assessment of intra-operative surgical field.

The postoperative pain was evaluated by a chef nurse blind to study by using FLACC scale Table 2 graded from 0 to 10 (0=no pain, 10=the worst possible pain) at 2 hours, 4 hours, 6 hours, 8 hours, 12 hours, and 18 hours after recovery.

Intravenous paracetamol 15 mg/kg was given as rescue analgesic every 6 hour as long as pain scores less than 5.

Tramadol 1 mg/kg was given intravenously if the pain scores more than 5.

### Patients classification

Patients were classified randomly into two equal groups (35 patients per group) according to study drugs used.

**Group D:** Dexmedetomidine (Precedex<sup>®</sup>, Meditera, 200 µg/2 mL) 0.5 µg/kg in diluted 20 ml of normal saline was given over 10 minutes as loading dose followed by continuous infusion 0.2-0.5 µg/kg/h after induction of anesthesia but before surgery, in order to maintain the mean arterial blood pressure 20-25% below baseline value.

**Group E:** Esmolol (Brevibloc<sup>®</sup>, Eczacibasi, 100 mg/10mL) 0.5 mg/kg diluted in 20 ml of normal saline was given over 10 min as loading dose followed by continuous infusion 100-300 µg/kg/min after induction of anesthesia but before surgery, in order to maintain the mean arterial blood pressure 20-25% below baseline value.

### Measurements

- Demographic data: age, weight, sex, ASA classification.
- Heart rate and mean arterial blood Pressure (as baseline, after intubation, then every 5 minutes after study drugs infusion till the end of operation).
- Quality of surgical field (by the operating surgeon every 15 minutes): with a predefined scale adapted from Fromme et al. (Table 1) [8].
- Aspartate aminotransferase (AST), alanine aminotransferase (ALT), blood urea and creatinine were analyzed before surgery, and in day one and day two after surgery.
- Duration of surgery.
- Duration of anesthesia.
- Adverse events.
- Postoperative analgesia according to FLACC scores [9].

The time to first dose of analgesia and total amount of tramadol used were recorded.

### Statistical analysis

The sample size was calculated depending on the primary outcome of this study. Power analysis identified 32 patients per group, required to detect 15% difference between groups with a power 80% and a significant level of 0.05.

Criteria	Score 0	Score 1	Score 2
Face	No particular expression or smile	Occasional grimace or frown, withdrawn, uninterested	Frequent to constant quivering chin, clenched jaw
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking, or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No cry (awake or asleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging or being talked to, distractible	Difficult to console or comfort

The Face, Legs, Activity, Cry, Consolability scale or FLACC scale is a measurement used to assess pain for children between the ages of 2 months-7 y or individuals that are unable to communicate their pain. The scale is scored between a range of 0-10 with 0 representing no pain while 10 representing the worst pain. The scale has 5 criteria which are each assigned a score of 0, 1 or 2.

**Table 2:** FLACC scale.

To avoid potential errors, 35 patients were included in each group. Medcalc program version 3.5; was used for sample size calculation.

The primary outcomes of this study are the quality of surgical field and changes in the hemodynamic parameters while duration of surgery, time to first analgesic request and postoperative complications were the secondary outcomes.

Student's t-test was used to compare the demographic data, hemodynamic parameters, duration of surgery, duration of anesthesia, Time to first analgesic request, and total amount of tramadol consumption. Mann-Whitney-U test was used for nonparametric measurements including quality of surgical field and pain score. P<0.05 was considered significant.

## Results

Seventy children aged 8-12 years underwent nasal surgery had completed this study were divided into two equal groups.

There were no statistically significant differences between both groups as regards to demographic data, duration of surgery, duration of anesthesia, and types of surgeries P>0.05 (Table 3).

Variables	Group D: N=35	Group E: N=35	P value
Age (yr.)	10.5 ± 2.05	10.8 ± 1.55	0.2
Weight (kg)	32.6 ± 2.65	34.5 ± 1.45	0.7
Sex (M/F)	22/13	20/15	
Duration of anesthesia (min)	106.15 ± 45.25	108.25 ± 43.35	0.7
Duration of surgery (min)	92.55 ± 7.15	90.65 ± 6.55	0.8
Tramadol consumption (mg)	14.28 ± 8.15	25.15 ± 12.55	0.02
Time to first analgesic request (h)	9.45 ± 2.65	4.55 ± 0.55	0.01

All data expressed as mean ± SD

**Table 3:** Demographic data; duration of surgery, duration of anesthesia, tramadol consumption; time of first analgesic requirement.

There were no statistically significant differences between both groups as regards to heart rate and mean arterial blood pressure values throughout the study period (p>0.05) and the values of HR and MABP were decreased significantly after infusion of the study drugs till the end of surgery when compared to base line values p<0.05 (Tables 4 and 5).

Time	Group D: N=35	Group E: N=35	P1
T0	110.55 ± 6.92	112.25 ± 7.45	0.54
T1	115.35 ± 7.55	118.56 ± 6.65	0.65
T2	102.55 ± 6.52	100.56 ± 6.25	0.54
T3	82.35 ± 5.55	80.43 ± 5.25	0.62
T4	78.42 ± 4.65	80.48 ± 4.25	0.72
T5	76.55 ± 5.52	78.35 ± 4.42	0.45

T0=base line, T1=after intubation, T2=5 min after drugs infusion, T3=15 min after drug infusion, T4=30 min after drugs infusion, T5=60 min after drugs infusion. All data expressed as mean ± SD

**Tables 4:** Changes in HR (beat/min) in both groups.

Time	Group D: N=35	Group E: N=35	P1
T0	62.65 ± 4.5	65.55 ± 5.60	0.53
T1	70.55 ± 5.35	72.25 ± 3.55	0.62
T2	60.55 ± 3.65	62.45 ± 5.42	0.52
T3	58.65 ± 4.45	60.55 ± 3.34	0.65
T4	60.42 ± 4.54	62.44 ± 3.33	0.45
T5	62.62 ± 5.52	60.44 ± 3.545	0.7

T0=base line, T1=after intubation, T2=5 min after drugs infusion, T3=15 min after drugs infusion, T4=30 min after drugs infusion, T5=60 min after drugs infusion. All data expressed as mean ± SD

**Table 5:** Changes in MABP (mmHg) in both groups.

Both groups were comparable with no statistically significant differences as regards to the quality of surgical field in all times of measurements  $p > 0.05$ , the score ranged between 1-3 with majority of patients had score 1 (Table 6).

Predefined scale	Group D: N=35	Group E: N=35	P
0	0	0	
1	22	20	0.5
2	12	13	0.7
3	1	2	0.4
4	0	0	
5	0	0	

**Table 6:** Quality of surgical field in both groups.

There were no statistically significant differences between the two groups as regards to pain score value at 2 h postoperatively,  $p > 0.05$  (Table 7).

At 4 h, 6 h and 8 h postoperatively the pain score values were statistically significant less in group D when compared to group E. ( $P < 0.05$ ), however it was comparable between both groups at 12 h and 18 hours postoperatively  $p > 0.05$  (Table 7).

Time	Group D: N=35	Group E: N=35	P1
2 h	1.42 ± 0.56	1.52 ± 0.64	0.573
4 h	1.32 ± 1.65	3.35 ± 0.45	0.03
6 h	2.54 ± 0.72	4.52 ± 0.55	0.01
8 h	3.45 ± 0.35	4.85 ± 0.82	0.04
12 h	4.54 ± 0.64	5.62 ± 0.65	0.5
18 h	4.35 ± 0.73	4.42 ± 0.74	0.2
All data expressed as mean ± SD			

**Table 7:** Pain score value in both groups.

As regards to the time of first analgesic request we found that, the time was statistically significant less in group E when compared to group D it was  $9.45 \pm 2.65$  h in group D while it was  $4.55 \pm 0.55$  h in group E ( $P < 0.05$ ), the amount of tramadol consumption was statistically significant less in group (D) than group (E) ( $P < 0.05$ ) (Table 3).

There were no differences in the postoperative values of blood urea, serum creatinine, AST, and ALT when compared to the baseline values in both groups (Table 8).

Values	Time	Group D: N=35	Group E: N=35	P
Blood Urea (mg/dL)	Baseline preoperative	15.52 ± 4.45	14.45 ± 3.65	0.3
	Day one postoperative	14.25 ± 4.42	15.35 ± 4.34	0.23
	Day two postoperative	13.45 ± 4.65	14.32 ± 5.55	0.43
Creatinine (mg/dL)	Baseline preoperative	0.65 ± 0.12	0.62 ± 0.15	0.42
	Day one postoperative	0.62 ± 0.15	0.65 ± 0.22	0.22
	Day two postoperative	0.64 ± 0.22	0.62 ± 25	0.45
AST Unites	Baseline preoperative	15.25 ± 2.45	16.32 ± 3.55	0.34
	Day one postoperative	18.55 ± 3.42	18.52 ± 4.65	0.52
	Day two postoperative	16.45 ± 4.65	18.55 ± 3.42	0.12
ALT Unites	Baseline preoperative	20.52 ± 4.45	19.55 ± 4.54	0.35
	Day one postoperative	19.54 ± 4.52	20.55 ± 5.65	0.23
	Day two postoperative	20.55 ± 5.62	20.5 ± 4.55	0.34
AST: Aspartate Amino Transferase; ALT: Alanine Amino Transferase. All data expressed as mean ± SD				

**Table 8:** Comparison of blood urea, serum creatinine, AST, ALT in both groups.

There was a significant reduction in volatile anaesthetic and fentanyl consumption in dexmedetomidine group compared to the esmolol group.

Total fentanyl consumption in esmolol group was  $80.5 \pm 12.6$  µg and  $30.45 \pm 6.52$  µg in dexmedetomidine group.

Total isoflurane concentration used in esmolol group was  $1 \pm 0.22\%$  and in dexmedetomidine group it was  $0.75 \pm 0.52\%$  (Table 9).

None of the patients in either group developed bradycardia less than 60 beats per minute.

It was observed that hypotension in 3 patients in dexmedetomidine group required intervention with ephedrine and IV fluid bolus.

None of the patients in either group needs addition of nitroglycerine.



Types of surgery	Group D: N=35	Group E: N=35	p
FESS	21	22	
Rhinoplasty	2	3	
Septoplasty	7	6	
Unilateral Choanal atresia	5	4	
Total fentanyl consumption (µg)	30.45 ± 6.52	80.5 ± 12.6	0.02
Total isoflurane concentration (%)	0.75 ± 0.52 %	1 ± 0.22%	0.034

FESS: Functional Endoscopic Sinus Surgery

**Tables 9:** Types of nasal surgery, total fentanyl consumption, total isoflurane concentration.

## Discussion

Our study demonstrated that, both dexmedetomidine and esmolol were effective in optimizing the surgical condition for patients underwent nasal surgery under general anesthesia by reducing heart rate and blood pressure which minimizing surgical site bleeding, allows better visualization, decrease operative time with no reported adverse events. Also there were no significant changes in renal and liver function postoperatively.

The present study shows using dexmedetomidine or esmolol anesthesia, controlled hypotension could be achieved without using additional antihypertensive agents in all patients.

Dexmedetomidine was associated with prolonged postoperative analgesia, decrease opioid consumption, and less postoperative adverse events.

Induced hypotension was probably not used in children in the early years although it is safer in them because their circulation is not compromised by atherosclerosis.

Controlled hypotensive anesthesia was used in pediatric surgery since 1953. After that it became a popular technique in many pediatric surgical operations which associated with major bleeding include scoliosis surgery, vascular surgery, nasal surgery, middle ear surgery and neurosurgery.

Advances in the understanding of the physiology, pharmacology of induced hypotensive anesthesia, and the advances in the monitoring techniques, lead to the evolution and safety of the technique.

The desired level of hypotension depends on the age, condition, and position of the patient, and on the surgical requirement. In young children placed in the supine position, a systolic pressure of 55 or 60 mm Hg can be safely used to induce a dry surgical field [4].

With hypotension, the operating time for Harrington rod insertion was reduced from 3 to 1½ h because blood loss was reduced from 3 to 4 units on average to one or less and the surgeons could see more clearly what they were doing [10].

The nasal surgery in pediatric patients carries a major challenge to both anesthesiologist and surgeon. The surgeon face small nostrils, narrow nasal passages, the anatomical landmark may not be clearly developed, and small, thin bony structure of nasal septum and paranasal structure.

The anesthesiologist has to produce condition which facilitate the surgery, avoid the serious complications, decrease the operative time, by minimize the intraoperative bleeding and allow better visualization, this can be achieved by controlled hypotensive anesthesia which is the key issue in the success of nasal surgery in pediatric age group under general anesthesia.

the main advantages of hypotensive anesthesia are decrease of blood loss, decrease blood transfusion, improve quality of surgical field, decrease in operation time, no significant changes in the vital organs functionality provided that patient selection and adequate monitoring are used.

The complications of hypotensive anesthesia are secondary hemorrhage, renal impairment, thromboembolic complications (cerebral, coronary), rebound hypertension, cardiac arrest, increased ICP, and impaired cognitive function.

Contraindications of hypotensive anesthesia are, cerebrovascular disease, cardiovascular diseases (MI, HT, and Aortic stenosis), renal dysfunction, increased ICP, pregnancy, severe pulmonary disease, and severe hypovolemia.

The risk hypotensive anesthesia is inadequate tissue perfusion of vital organs, when the patient is not appropriately selected or the MAP drops below the accepted limit.

The present study was in line with the following studies:

Amin et al., concluded that, both dexmedetomidine and esmolol are safe and effective in inducing controlled hypotension which decrease the surgical area bleeding score and provide ideal surgical condition in children undergoing cochlear implant surgery under general anesthesia [11]. Shams et al. reported that, both dexmedetomidine and esmolol were used in patients undergoing FESS and it was found to be safe agents for inducing controlled hypotension and effective in providing better surgical field. Dexmedetomidine has advantage as analgesic, sedative and decrease the anesthetic requirements [12].

Erbesler et al. compared the effects of esmolol and dexmedetomidine for the controlled hypotensive anesthesia and found that the groups were comparable as regards to hemodynamics, quality of surgical field and surgeon satisfaction. Dexmedetomidine was associated with a prolonged time of muscle relaxant, however esmolol was associated with higher costs [13].

Both esmolol and dexmedetomidine, was used in previous study and proved to be effective and safe method to reduce the intraoperative blood loss in patients undergoing scoliosis surgery [14].

Dexmedetomidine was evaluated in patients underwent FESS with either conscious sedation or local anesthesia and found to be effective in inducing dry surgical field with hemodynamic stability and reduce the postoperative analgesic use [15,16].

Dexmedetomidine is a highly specific and selective alpha-2-adrenergic agonist with sedative, anxiolytic, and organ protective effects. The clinical applications of dexmedetomidine in children include premedication, prevention of emergence delirium, as part of multimodal anesthetic regimen and sedation in the pediatric intensive care unit [17].

Dexmedetomidine is a highly specific α<sub>2</sub> agonist with anesthetic, analgesic, and sympatholytic properties [18-20]. The sympatholytic effect is associated with decreases in arterial blood pressure, heart rate,

and noradrenaline secretion. So, dexmedetomidine can prevent perioperative rise in arterial blood pressure and heart rate [21,22].

The probable mechanism by which the dexmedetomidine reduce blood pressure is due to stimulation of peripheral alpha 2 adrenoceptors of vascular smooth muscle and inhibition of central sympathetic out flow this results in decrease in blood pressure and heart rate.

Dexmedetomidine was found to be a useful and effective adjuvant to minimize bleeding and induce dry surgical field in both ear and nasal surgery [23-28].

Tobias et al. found that, Dexmedetomidine was proved to be an effective agent used alone without need for beta blockers for controlled hypotensive anesthesia during anterior spinal fusion [29].

Ülger et al. concluded that dexmedetomidine was found to be better in maintaining hemodynamic stability, dry surgical field without reflex tachycardia or rebound hypertension. Liver and renal functions were not affected by dexmedetomidine [30].

Surgical bleeding can result from cut in capillary so; the amount of blood loss will depend on blood flow in the capillary bed. The blood loss results from the arterial injury depend on MABP. Venous blood loss will be dependent on venous return and venous tone [5].

Esmolol is an ultra-short acting intravenous cardioselective beta-antagonist. It has an extremely short elimination half-life (mean:9 minutes; range 4-16minutes) and a total body clearance approaching 3 times of cardiac output and 14 times of hepatic blood flow [6].

The hypotensive anesthesia induced with beta blocker results in increase in the sympathetic tone due to increase norepinephrine release, enhance endocrinal and metabolic responses, which leads to vasoconstriction of arterioles and precapillary sphincters that result from unopposed alpha-adrenergic effects. Beta blockers decrease CO and therefore decrease the blood flow to the tissue. So, beta blocker would be appropriate for decreasing the bleeding which result from capillary injury [31-35].

The time to first analgesic requirements was shorter in esmolol group and amount of analgesic requirements were less in dexmedetomidine group. Pain score was significantly better in dexmedetomidine group. Also, dexmedetomidine decreased the need for pain medication in the PACU.

In line with our result, El Saied et al. reported that dexmedetomidine infusion in pediatric patients allowed rapid recovery from anesthesia and reduced need for analgesic requirements in the postoperative period [36].

Moreover, Feld et al. [37] found that dexmedetomidine provided good postoperative analgesia and decreasing the need of morphine consumption postoperatively.

Also, Ibraheim et al. found that dexmedetomidine was significantly reduces fentanyl consumption when compared to the esmolol and control groups [38].

In addition, Unlugenc et al. found that dexmedetomidine (1 µg/kg) given 10 min before induction of anesthesia significantly decreases postoperative morphine requirements without effect on recovery time [39].

Additionally, dexmedetomidine significantly reduces the requirements for rescue sedation by 80% and analgesia by 50% in

postoperative patients for up to 24 h. Its sedative properties differ from other sedative drugs as patients being more easily arousal without respiratory depression [40].

Also, Gurbet et al. reported that, continuous dexmedetomidine infusion during abdominal surgery associated with effective postoperative analgesia, and decreases postoperative opioids consumption without increasing the adverse effects [41].

Moreover, Amin et al. concluded that, dexmedetomidine decrease postoperative opioid consumption in children undergoing cochlear implant surgery when compared to patients received esmolol [11].

Our study demonstrated that, both renal and liver functions were not affected by hypotensive anesthesia or drugs used for inducing controlled hypotension.

Our result in agreement with Ulger et al. who reported that, both liver and renal functions were not affected by dexmedetomidine [30].

Also Ozcan et al. reported that, there were no significant differences between AST, ALT, blood urea and creatinine values before surgery, and in postoperatively [29].

Our study found no significant difference between both groups as regard postoperative nausea and vomiting.

However, previous studies [42,43] reported that, the incidence of postoperative nausea and vomiting was less in children receiving dexmedetomidine in comparison with those receiving fentanyl during extracorporeal shock wave lithotripsy. This could explained by that fentanyl may the cause of increased in the incidence of PONV.

the present study has some limitations include the following: we didn't use control group because it is not ethically to expose the patients to unnecessary bleeding, the amount of blood loss not measured, subjective scale was used by surgeon to assess the quality of surgical field, and we did not measure the depth of anesthesia. Further study was needed to compare the dexmedetomidine with other agent used for controlled hypotensive anesthesia in children.

## Conclusion

Our study demonstrated that both dexmedetomidine and esmolol are safe and effective agents for inducing controlled hypotension and both drugs are effective in optimizing surgical condition and induce dry surgical field allow better visualization, and reduce operative time in pediatric patients undergoing nasal surgery with no reported complications. Dexmedetomidine offers the advantage over esmolol it prolongs postoperative analgesia and decrease the opioid used postoperatively.

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