IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 14, Issue 10 Ver.VII (Oct. 2015), PP 126-131
www.iosrjournals.org

Comparison of Dexmedetomidine, Esmolol and Sodium Nitroprusside for Hypotensive Anaesthesia in Functional Endoscopic Sinus Surgery

Mushtaq Ahmad Rather, Farhana Bashir and Saba Ahad
[1,2]*Department of anesthesiology and critical care GMC Srinagar, 190006.*

Abstract:
Background: *This study has been designed to compare the controlled hypotensive effects of Dexmedetomidine (DEX), Sodium Nitroprusside (SNP) and Esmolol (ESM) during functional endoscopic sinus surgery (FESS).*
Method: *In a prospective, double-blind study; we randomized 45 (15 in each group) ASA physical status I and II patients in the age group 18-60 years scheduled for FESS to receive either DEX (group 1) loading dose of 1µg/kg 10 mins before induction of anaesthesia followed by infusion at the rate of 0.4-0.8µg/kg/hr during maintenance of anaesthesia or SNP (group 2) 0.5-10µg/kg/min infusion after induction of anaesthesia or ESM group loading dose of 1mg/kg infused over 1 min followed by maintenance rate of 0.4-0.8mg/kg/hr. All the infusion rates were titrated to maintain the mean arterial pressure (MAP) between 60-70 mmHg so as to minimise the intraoperative bleeding.*
Results: *DEX resulted in significant reduction in MAP, heart rate, better intraoperative field conditions and the time required for first rescue analgesia was longer. ESM and SNP were associated with significantly shorter extubation and recovery time than DEX. SNP provided a relatively poor surgical condition than observed in ESM/DEX.*
Conclusion: *DEX is relatively safe and effective agent followed by ESM than SNP for controlled hypotension in patients undergoing FESS.*
Key-words: *Anaesthesia,Dexmedetomidine, Esmolol, Sodium Nitroprusside, controlled hypotension, Functional endoscopic sinus surgery*

I. Introduction

FESS is most commonly performed for inflammatory and infectious sinus diseases like chronic sinusitis, nasal polyposis,sinus mucoceles,antrochoanal polyps etc.Typically FESS is reserved for patients with documented rhinosinusitis in whom appropriate medical treatment has failed[1].The major complications of FESS like optic nerve damage ,meningitis and damage to duraresult from impaired visibility due to excessive bleeding in the surgical field[2].Deliberate hypotension is a common technique to decrease blood loss and improve the operative field visualisation during different types of surgical procedures[3].Deliberate hypotension involves reducing arterial blood pressure 40-50% below its normal range or reducing mean arterial blood pressure to 60mmhg intentionally and recoverably and maintaining it at this level throughout the operative process[4].

Various agents like sodium nitroprusside,esmolol,nitroglycerine,dexmedetomidine etc. have been used for deliberate hypotension in various surgeries to control bleeding.Present study has been conducted to compare theefficacy of dexmedetomidine,esmolol and sodium nitroprusside for inducing hypotension in FESS.

II. Material And Method

After seeking approval from institutional ethical committee, 45 ASA I and II patients scheduled for FESS were enrolled in the study. Participants were in the age group 18 to 60years. Patients less than 18 years, those preferring local anaesthesia, those who were on cardiovascularly active drugs or drugs influencing blood coagulation (Warfarin, heparin, enoxaparin, or aspirin) were excluded from the study. Patients were randomly distributed in three groups DEX (group 1), SNP (group 2) and ESM (group 3); 15 patients in each group.

All the patients received premedication according to the hospital protocol; midazolam 0.5-1mg intravenously followed by fentanyl 0.5-2µg/kg intravenously (IV) 2-3 mins before induction of anaesthesia which was done by 2mg/kg propofol IV and rocuronium 0.6-1.2mg/kg IV was used to facilitate tracheal intubation with oral cuffed tracheal tube. Anaesthesia was maintained by 50% nitrous oxide with oxygen and 1% isoflurane. IV fluid lactated Ringer was used for hydrating the patients at approximately 3ml/kg/hr. Patients were placed in 5º reverse trendelenbergs position to improve venous drainage. All patients received paracetamol 15-20mg/kg infusion IV over 20mins as an additional analgesic intraoperatively.

Monitoring included MAP using 20G arterial cannula for direct blood pressure measurement, heart rate with electrocardiogram (ECG), and to assess the amount of bleeding in operative field we used 6 point category scale:

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.

Above monitoring parameters were in addition to the other routine parameters like oxygen saturation (SPO2) and end tidal CO2 (ETCO2).

Group 1 received a loading dose of DEX 1µg/kg 10 mins before induction of anaesthesia followed by infusion at the rate of 0.4-0.8µg/kg/hr during maintenance of anaesthesia and titrated till the desired MAP of 60-70mmHg was achieved.

Group 2 received 0.5-10µg/kg/min infusion of SNP after induction of anaesthesia and titrated accordingly to achieve target MAP.

Group 3 received loading dose of 1mg/kg of ESM infused over 1 min followed by maintenance rate of 0.4-0.8mg/kg/hr and titrated till target MAP achieved.

MAP and heart rate were measured and monitored by the anaesthetist who was blinded to the use of hypotensive drug and surgical field bleeding was measured by the surgeon by the 6 point category scale. The surgeon was blinded to the use of hypotensive agent as well as to the hemodynamic variables.

In all the 3 groups signs of inadequate anaesthesia (eg. increase in arterial pressuregreater than the targeted MAP) or somatic responses (eg. movement, tearing, orsweating) were treated with additional fentanyl.

Infusion of the study drugs was stopped 5 minutes before the anticipated end of surgery and isoflurane was stopped after skin closure. After the surgery was finished, each patient received neostigmine (50-70µg/kg) with atropine (20µg/kg). Extubation time along with time to recovery was recorded in each group using Aldrete score**.** Aldrete score ≥9 on a scale of 0–10. Each variable was scored on a 3-point scale—consciousness[2 = fully awake; 1 = able to be roused on calling; 0 = not responding], activity [ableto move voluntarily or on command: 2 = 4 extremities; 1 = 2 extremities; 0 = 0 extremities],respiration [2 = able to breathe deeply and cough freely; 1 = dyspnoea, shallowor limited breathing; 0 = apnoeic], circulation [2 = blood pressure (BP) }<20 mmof Preanaesthestic level; 1 = BP }20–50 mm of Preanaesthestic level; 0 = BP }>50 mmof Preanaesthestic level], and SpO2 [2 = >92% on room air; 1 = needs oxygen inhalationto maintain SpO2 >90%; 0 = SpO2 <90% even with oxygen supplementation]–with a maximum achievable score of 10).

Post recovery patients were shifted to the post anaesthesia care unit and were monitored for any adverse effect if any like intraoperative hypotension [MAP<60 mm Hg], bradycardia [HR <50 beats/min], postoperativefentanyl consumption, and postoperative nausea and vomiting. The sedation score was measured using the following scale at 15, 30, and 60 minutes after tracheal extubation: 1 = anxious,agitated, or restless; 2 = cooperative, oriented, and tranquil; 3 = responsive to commands;4 = asleep, but with brisk response to light, glabellar tap, or loud auditorystimulus; 5 = asleep, sluggish response to glabellar tap or auditory stimulus; and 6 =asleep, no response.

III. Results

Forty five patients were enrolled in this study undergoing a FESS (15 each in the DEX, SNP and ESM group). All patients were able to complete the entire study and their data were included in the final analysis. The demographic data, duration of surgery, intraoperative blood loss, and duration of anesthesia were compared between the two groups. All the groups were comparable in terms of age, sex, weight, duration of surgery, and duration of anesthesia (Table 1).

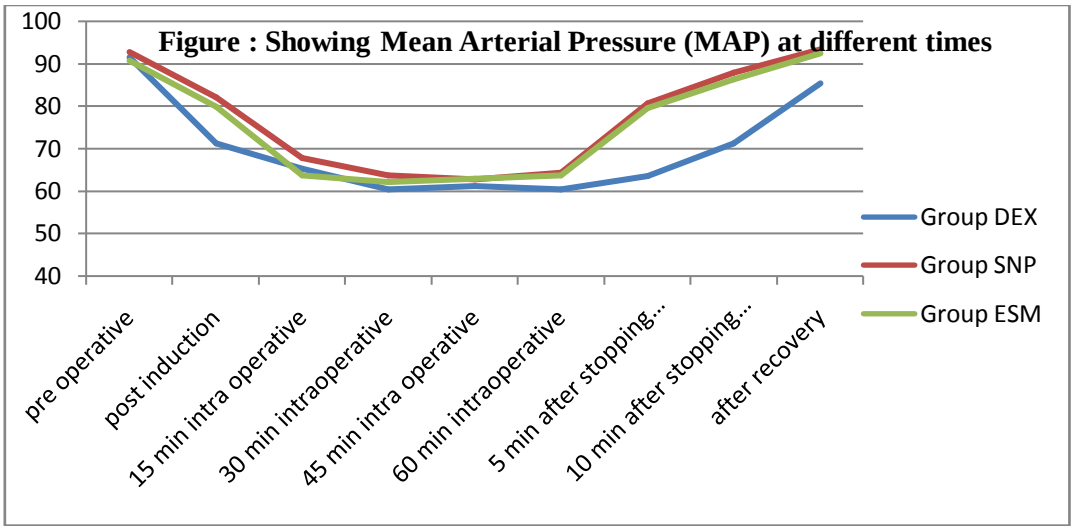
Table 1:- Demographic and operative data.

Parameter	Group 1(DEX)	Group 2(SNP)	Group 3(ESM)	P-Value
Age(yrs)	40.12±11.9	42.12±10.07	39.12±12.77	0.190
Male : Female	9:6	8:7	7:8	0.980
Weight(kg)	64.58±9.20	63.12±8.92	60±8.95	0.582
ASA I: ASA II	8:7	9:6	7:8	0.791
Duration of Anaesthesia(min)	91.12±10.03	94.08±9.55	93.03±8.65	0.910
Duration of surgery(min)	80.12±11.50	83.08±9.45	81.03±10.45	0.139

Blood loss was significantly less in the DEX group than in the SNP and ESM group. The changes in MAP between the three groups were statistically insignificant at preoperative, 15 min, 30min,45min and 60 min intraoperative, and after recovery, but were significantly lower in the DEX group than the SNP, ESM group at post-induction, 5 min and 10 min after stopping of hypotensive agents (Table 2 and Fig. 1).

Table 2:- Mean arterial pressure values (mmHg) in the dexmedetomidine (DEX), sodium Nitroprusside (SNP) and esmolol (ESM) groups at different times

	Group 1(DEX)	**Group 2(SNP)**	**Group 3(ESM)**	p-value
preoperative	91.5±9.3	92.8±9.5	90.7±9.2	1 vs 2 Ns 1 vs 3 Ns 2 vs 3 Ns
post induction	71.3±6.7	82.1±6.5	79.9±6.7	1 vs 2 S 1 vs 3 S 2 vs 3 S
15 min intra operative	65.2±6.4	67.8±5.9	63.7±6.2	1 vs 2 Ns 1 vs 3 Ns 2 vs 3 Ns
30 min intraoperative	60.4±5.8	63.7±6.0	62.1±5.7	1 vs 2 Ns 1 vs 3 Ns 2 vs 3 Ns
45 min intra operative	61.2±5.5	62.8±5.5	62.9±6.5	1 vs 2 Ns 1 vs 3 Ns 2 vs 3 Ns
60 min intraoperative	60.4±4.5	64.4±4.5	63.7±5.3	1 vs 2 Ns 1 vs 3 Ns 2 vs 3 Ns
5 min after stopping hypotensive agent	63.5±6.4	80.7±5.3	79.5±6.5	1 vs 2 S 1 vs 3 S 2 vs 3 S
10 min after stopping hypotensive agent	71 ± 9.4	87.9±8.9	86.3±9.0	1 vs 2 S 1 vs 3 S 2 vs 3 S
after recovery	85.4±8.5	93.4±7.9	92.5±8.3	1 vs 2 Ns 1 vs 3 Ns 2 vs 3 Ns



The changes in HR between the two groups werestatistically insignificant at preoperativeand after recover, but weresignificantly lower in the DEX and ESM group than theSNP group at post induction, 15 min intra operative,30 min intraoperative, 45 min intra operative, 60 min intraoperative. However the heart rate increased significantly in ESM group than in DEX groupat 5 and 15 min after stopping of hypotensive agents (Table 3and Fig. 2).

There were no episodes of severe hypotension (MAP of 60mmHg) or severe bradycardia (HRof 50beats/min) duringinfusion of the hypotensive agents in both groups.

Table 2:- Heart rate values (BPM) in the dexmedetomidine (DEX), odium Nitroprusside (SNP) and esmolol (ESM) groups at different times

	Group 1(DEX)	**Group 2(SNP)**	**Group 3(ESM)**	p-value
preoperative	80.3±8.5	83.4±8.6	81.6±8.9	1 vs 2 Ns 1 vs 3 Ns 2 vs 3 Ns
post induction	63.2±7.4	70.2±7.9	66.6±8.0	1 vs 2 S 1 vs 3 Ns 2 vs 3 S
15 min intra operative	60.7±5.4	89.4±5.9	62.2±6.0	1 vs 2 S 1 vs 3 Ns 2 vs 3 S
30 min intraoperative	59.7±6.6	88.1±5.9	60.0±6.0	1 vs 2 S 1 vs 3 Ns 2 vs 3 S
45 min intra operative	61.7±4.5	90.5±4.7	63.2±5.0	1 vs 2 S 1 vs 3 Ns 2 vs 3 S
60 min intraoperative	62.8±5.4	92.9±4.5	64.7±5.5	1 vs 2 S 1 vs 3 Ns 2 vs 3 S
5 min after stopping hypotensive agent	63.2±4.8	79.6±5.7	76.3±6.8	1 vs 2 S 1 vs 3 S 2 vs 3 NS
10 min after stopping hypotensive agent	72.6±8.5	78.2±8.1	80.8±8.9	1 vs 2 S 1 vs 3 S 2 vs 3NS
after recovery	73.3±8.8	80.9±9.0	83.6±7.9	1 vs 2 Ns 1 vs 3 Ns 2 vs 3 Ns

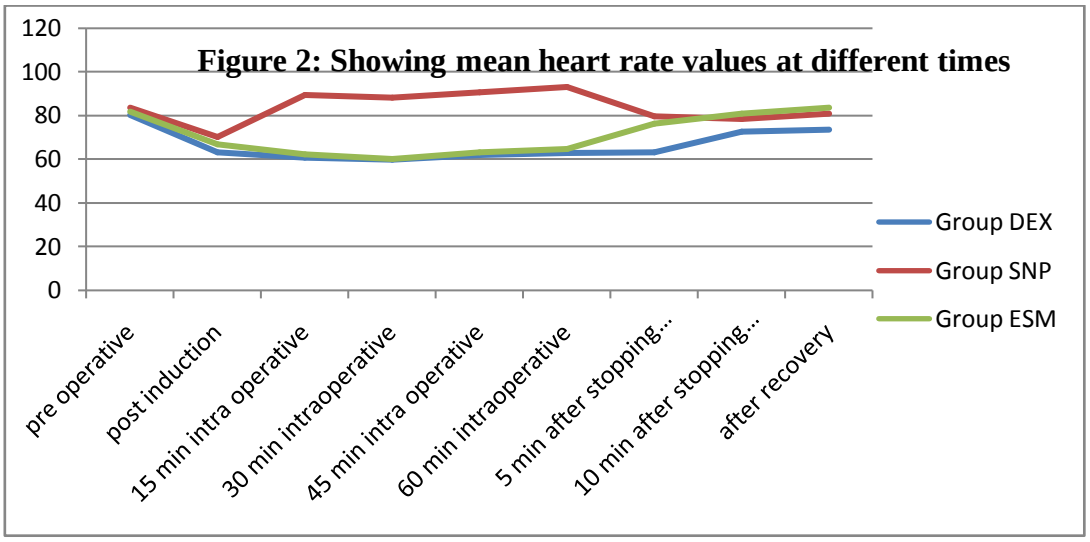
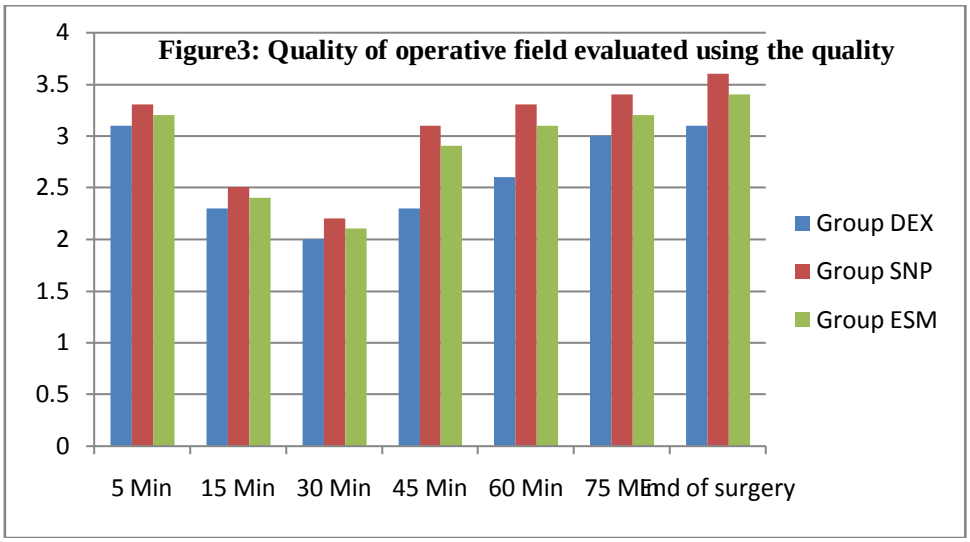


Figure 2: Showing mean heart rate values at different times

The operative field conditions were significantly better in the DEX group than the SNP and ESM group (though better in ESM group than SNP group) at 15, 30, 45 and 60 min after beginning of the surgery (Fig. 3).



The total dose of fentanyl was significantly lower in theDEX group in comparison with the SNP and ESM groups[2.4 (0.31) vs. 4.4(0.40) vs4.3 (0.37) mg/kg,) respectively, P =0.001] (Table 4).

Time to first rescue analgesia was statistically significant shorter in the SNP and ESM groups than in the DEX group (P = 0.001) (Table 4).

Table 4:- Total dose of intraoperative fentanyl and postoperativetime of rescue analgesia in each group

	Group 1(DEX)	Group 2(SNP)	Group 3(ESM)	P value
Fentanyl µg/kg	2.3(0.31)	4.4(0.40)	4.3(0.37)	0.001
Time of first rescue analgesia (min)	49.50(8.74)	23.47(9.54)	25.32(8.76)	0.001

The mean postoperative sedation scores were significantly lower in SNP and ESM groups than in DEX group at 15 min and at 30 min. (P<0.01). No significant difference was observed in sedation score at 60 min in all the groups and in all the groups no patient complained of any sign of awareness.

Table 5:-Recovery characteristics and sedation scores

	Group 1(DEX)	Group 2(SNP)	Group 3(ESM)
Emergence time min	7.0±2.0**	4.3±1.6	4.6±2.4
Time to modified Aldrete score 9 min	10.0±1.9**	8.1±1.5	8.2±1.3
Sedation score 15 min after surgery	3.9±0.6**	2.4±0.5	2.3±0.6
Sedation score 30 min after surgery	3.3±0.3**	2.3±0.6	2.1±0.3
Sedation score 60 min after surgery	2.7±0.2	2.1±0.3	2.0±0.5

**** highly significant**

IV. Discussion

Numerous studies have been performed till date to compare the efficacy of hypotensive agents of different classes in FESS. In our study it was observed that the efficacy of dexmedetomidine as hypotensive agent was better esmolol and sodium nitroprusside in FESS.

Sodium nitroprusside is a direct acting vasodilator which acts as vascularsmooth muscles.The net result of vasodilatation and increased cardiac output is increased blood flow through the mucous membrane capillaries and increased bleeding during surgery on mucous membranes therefore not improving surgical conditions.

Esmolol is a short acting β1 adrenoceptor antagonist[5]and hypotension caused by it results in increased sympathetic tone of the mucous membrane arterioles that exert unopposed α adrenergic effects on the mucous membrane vasculature,causing capillary vasoconstriction and reduced bleeding[6].

Dexmedetomidine, an S-enantiomer of medetomidine is anα2 adrenergic agonist[7].Ithas got sedative,analgesic, anxiolytic and sympatholytic effects that blunt many of the responses in perioperative period.It reduces the requirements for volatile anaesthetics,sedatives and analgesicswithout causing significant respiratory depression[8].It causes hypotension due toits sympatholytic effect.It decreases heart rate,cardiac

output,mean arterial pressure and norepinephrine release.All these parameters together lead to significantly reduced bleeding and better surgical conditions.

In our study it was observed that bleeding was much less with better hemodynamic in dexmedetomidine group as compared to esmolol and sodium nitroprusside group.The efficacy of dexmedetomidine in providing better surgical field and less blood loss in controlled hypotension has been observed in other studies[9,10].

Richa et al.,[11] reported that extubation time was significantly slower in patients receiving dexmedetomidine compared with those receiving remifentanyl for controlled hypotension. In the present study patients of DEX group had significant higher postoperative sedation scores than those in SNP and ESM groups. Dexmedetomidine has sedative and analgesic sparing effects via central actions in the locus ceruleus and in the dorsal horn of the spinal cord.[12]

The less intraoperative need for fentanyl in the DEX group than the SNP group is in agreement with the result of Gurbet et al. [13], who reported that an intraoperative infusion of DEX reduces the perioperative analgesic requirement. The delayed requirement of postoperative rescue analgesia in the DEX group in comparison with the SNP group is because of the analgesic effect of DEX, which has been reported in another study of Dogan et al. [14], who found less postoperative pain in septoplasty performed under local anesthesia and DEX sedation than general anesthesia.

It was also observed that among sodium nitroprusside and esmolol group, esmolol resulted in lesser blood loss than sodium nitroprusside.

V. Conclusion

It can be concluded from our study that dexmedetomidine is an effective hypotensive agent and results in stable hemodynamics than esmolol and sodium nitroprusside in FESS.Compared with SNP and ESM, it has the advantage of reduced blood loss and more stable hemodynamics. In addition, it exerts inherent analgesic and anaesthetic effects. Further studies of the hypotensive effect, intraoperative and postoperative antalgic effects of DEX during various types of surgery are required.

References

[1]. Ankit Patel, MD; Chief Editor: Arlen D Meyers, MD, MBA;Functional endoscopic sinus surgery overview Updated December 14,2014

[2]. Andre P.Boezaart,Johan van der Merwe,AndreCoetzee.Comparison of sodium nitroprusside and esmolol-induced controlled hypotension for functional endoscopic sinus surgery.Canadian journal of anaesthesia 1995/42:5/pp 373-6

[3]. ATobias JD. Controlled hypotension in children: A critical review of available agents.PaediatrDrugs.2002;4:439–453.

[4]. ElGohary MM, Arafa AS. Dexmedetomidine as a hypotensive agent: efficacyand hemodynamic response during spinal surgery for idiopathic scoliossis inadolescents. Egypt J Anesth 2010; 26:305–311.

[5]. Blowey DL. Antihypertensive agents: Mechanisms of action, safety profiles, and current uses inchildren. CurrTher Res Clin Exp. 2001;62:298–313.

[6]. IclalOzdemirKol, MD1; KenanKaygusuz, MD1; AltanYildirim, MD2;

[7]. Mansur Dogan, MD2; SinanGursoy, MD1; EvrenYucel, MD1; andCaner Mimaroglu, MD1Controlled Hypotension WithDesflurane CombinedWith Esmolol or Dexmedetomidine DuringTympanoplasty in Adults: A Double-Blind,Randomized, Controlled Trial;currentthereupetic researchVolume 70, Number 3, June 2009

[8]. Cormack JR, Orme RM, Costello TG (2005). "The role of alpha2-agonists in neurosurgery". Journal of Clinical Neuroscience 12 (4): 375–8. doi:10.1016/j.jocn.2004.06.008. PMID 15925765

[9]. Paris A, Tonner PH (2005). "Dexmedetomidine in anaesthesia". Current Opinion in Anaesthesiology 18 (4): 412–8. doi:10.1097/01.aco.0000174958.05383.d5.PMID 16534267.

[10]. Durmus M, But AK, Dogan Z, Yucel A, Miman MC, Ersoy MO. Effect ofdexmedetomidine on bleeding during tympanoplasty or septorhinoplasty. EurJ Anaesthesiol 2007; 24:447–453.

[11]. Ayoglu H, Yapakci O, Ugur MB, Uzun L, Altunkaya H, Ozer Y, et al. Effectivenessof dexmedetomidine in reducing bleeding during septoplasty andtympanoplasty operations. J ClinAnesth.

[12]. Richa F, Yazigi A, Sleilaty G, Yazbeck P. Comparison between dexmedetomidine and remifentanil for controlled hypotension during tympanoplasty. Eur J Anaesthesiol. 2008;25:369–74. [PubMed]

[13]. Guo TZ, Jiang JY, Buttermann AE, Maze M. Dexmedetomidine injection into the locus coeruleus produces antinociception. Anesthesiology. 1996;84:873–81. [PubMed]

[14]. Gurbet A, Basagan-Mogol E, Turker G, Ugun F, Kaya FN, Ozcan B. Intraoperative infusion of dexmedetomidine reduces perioperative analgesic requirements. Can J Anaesth 2006; 53:646–652.

[15]. Dogan R, Erbek S, Gonencer HH, Erbek HS, Isbilen C, Arslan G. Comparison of local anaesthesia with dexmedetomidine sedation and general anaesthesia during septoplasty. Eur J Anaesthesiol 2010; 27:960–964.