Remifentanil Versus Dexmedetomidine For Controlled Hypotensive Anaesthesia In Middle Ear Surgery

Eyad Abu Nahleh MD, Ahmad Sbaihat MD*, Jawad M. F. Khassawneh MD**,Hamzah Kheir MD*, Fatin Bani-Ata MD**

ABSTRACT

Objective: Sufficent controlled hypotension is essential to control bleeding in order to improve 'dryness' of the surgical field during middle ear surgery.Remifentanil is a potent short acting synthetic opioid agonist. Dexmedetomidine is a selective short-acting central α_2-adrenergic agonist.This study was carried out to compare between remifentanil and dexmedetomidine, to evaluate their effectiveness to obtain hypotensive technique and controlling intra operative bleeding to obtain 'dry' operative field exposure during middle ear surgery.

Methods: This study included 60 patients planned for middle earsurgery under general anaesthesia. Patients were divided randomly into two groups (n=30) as Group R (remifentanil infusion0.25-0.50µg/kg/min.) and Group D (dexmedetomidine infusion 0.50µg/kg/hr.). Mean arterial blood pressure and heart rate were recorded upon arrival in the operating room, 1 minute after onset of the surgery, then every 20 minutes after onset of the surgery, 10 minutes after end of the infusion, and 15 minutes after extubation. Qualities of the surgical field were rated every10 minutes using a four-point scale.

Results: Demographic data, duration of anaesthesia and duration of hypotension did not differ among the two groups, ($P<0.001$). Heart rate and mean arterial pressure were significantly reduced at all time measurements in contrast with the 1st time measurement (t_0) in both groups. Heart rate and mean arterial pressure were significantly lower in Group R compared with Group D at all times after onset the surgery t_1-t_6, ($P<0.05$). The intra-operative bleeding score was significantly lower in Group R than in Group D ($P<0.05$).

Conclusion: Both remifentanil and dexmedetomidine have induced hypotension intra operatively in patients undergoing middle ear surgery. Remifentanil is more effective in achieving hypotension and better operative field than dexmedetomidine during middle ear surgery.

Key words: Controlled hypotension, Dexmedetomidine, Middle ear surgery, Remifentanil.

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Introduction

Surgical haemostasis is crucial in middle ear surgery owing to the small operating field and is necessary for visualization. Certain phases of microsurgical techniques require more meticulous haemostasis than others, but unfortunately it is not possible to provide such a degree of control over bleeding as to offer these fine variations.

An attempt must be made to produce a period of hypotension to a level of blood pressure that will produce haemostasis, extending it to include all the various microsurgical manipulations.[1] However, the use of hypotensive techniques is connected with the risk of reduced perfusion to vital organs and tissues of the body, mainly the brain, heart, and kidneys.[2, 3]

In hypotensive anaesthesia, the patient's baseline mean arterial blood pressure (MAP) is lowered by 30 %.[4]Therefore, the systolic blood pressure values are about 80-90 mmHg and the MAP is reduced to 50-65

From departments of:
*otolaryngology,king hussein medical center(KHMC),Amman-Jordan.
**Anesthesia and intensive care, king hussein medical center(KHMC),Amman-Jordan.
Correspondance should be addressedto:Dr.Ahmad sbaihat @hotmail.com.
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mmHg.[5] Drugs that are used for hypotensive anaesthesia in middle ear surgery include sodium nitroprusside (SNP), [6] nitroglycerine (NTG) [7] , trimethaphan, calcium channel blockers (e.g. nifedipine) [7] , *B*-adrenergic blocking agents(e.g. propranolol and esmolol) [8] , α_2 – adrenoceptor agonists (e.g. dexmedetomidine). [9]
Side effects of these drugs include, reflex tachycardia and cyanotic toxicity often occurs with nitrates administration [10, 11] , resistance to vasodilators [7] , and esmolol may cause myocardial depression.[12]
Remifentanil is a potent, short acting synthetic opioid analgesic, used intra operatively to alleviate pain and used as an adjunct of general anaesthesia. It has a rapid onset and rapid recovery time compared to fentanil and alfentanil.[13] It is a μ- opioid agonist, its chemical design is 3-[4-methoxycarbonyl-4- [(1-oxopropyl) phenylamine] -1- piperidine] propanoic acid methyl ester. Its metabolism is rapid by hydrolysis of propanoic acid methyl ester, linkage by non-specific blood and tissue esterase. It has a rapid onset analgesic effect and also a rapid offset effect, its effects and side effects are dose dependant. Peak haemodynamic effect occurs within 3-4 minutes of single dose. It provides better intra operative haemodynamic stability than fentanil.[14]
Dexmedetomidine is a potent, selective α_2 – adrenoceptor agonist, used as adjuvant of general anaesthesia during surgery (sedation), and intra-operatively (analgesic and haemodynamic stability).[15] It is an anxiety reducing drug, provides sedation with no risk of respiratory depression, and also provides perioperative sympatholysis and cardiovascular stability effect.[16]
Our aim of the present study was to compare between remifentanil and dexmedetomidine to evaluate their effectiveness to obtain hypotensive technique and controlling intra operative bleeding to obtain ˊ dry ˋ surgical field exposure during middle ear surgery.

Methods

The study was conducted at the King Hussein Medical Centre (KHMC)-Amman, and Prince Rashid Hospital (PRH)-Irbid, between April 2015 and December 2016. The local ethical committee of the Royal Jordanian Medical Services approved our present study.
A total of 60 patients planned for middle ear surgery under general anaesthesia, aged 16- 54 year was included in this prospective, randomized, double blind study. All of the patients had no history of alcohol consumption or history of frequent use of sedatives, also has no history of renal problem, liver disease haematological disorder, cardiovascular disease or heart disease. The patients included have systolic blood pressure of less than 160 mmHg, and have heart rate of more than 50 beat/ minute.
Controlled hypotension was planned for these patients undergoing middle ear surgery. No medications were given preoperatively, and the patients were fasted at least for seven hours before the beginning of the operation. Patients were chosen randomly to receive either remifentanil (Group R, n=30), or dexmedetomidine (Group D, n=30), intra operatively. Infiltration of 10 ml. diluted Adrenaline (1:100,000) were injected for post auricular area, walls of ear canal and incisura in all patients of both groups. The surgeon was blinded to the study records, and the data were recorded by an observer anaesthesia resident. The patients were monitored by electrocardiogram, pulsoximeter, and blood pressure measurements.
Anaesthesia induction was similar in both two groups. Beginning by preoxygenation, induction with Propofol 1-3 mg/kg and Tracurium 0.05 mg/kg. Tracheal intubation was performed and then maintenance of anaesthesia was performed by nitrous oxide 50% and Isoflurane 1.0-2.0% MAC. Respiratory rate of 10-12 breaths/ minute was settled by controlled mechanichal ventilator support to keep the end-tidal CO_2 level at 35 - 40 mmHg. Body temperature was preserved in normal range, and the patients were kept in supine, head tilted to other side position throughout the operation.
Remifentanil prepared by 2mg diluted in 100ml normal saline. Dexmedetomidine was prepared by 2 ml ampoule in a concentration of 100 μg/ml diluted with 48 ml normal saline to get a concentration of 4 μg/ml.
Patients assigned to remifentanil (Group R) received 1 μg/kg remifentanil i.v. over 60 seconds, followed by a continuous infusion of 0.25-0.50 μg/kg/min., until mean arterial pressure was brought to 60 mmHg., then infusion rate was adjusted to keep the mean arterial pressure around this level.
Patients assigned to dexmedetomidine received 1 μg/kg as a loading dose over 10 minutes followed by 0.50 μg/kg/hr. infusion for maintenance. Patients whose mean arterial blood pressure decreased below 60 mmHg were treated with ephedrine 10 mg i.v., and whose heart rate (HR) decreased below 50 beats per minute were treated with atropine 0.01mg/kg.
Mean arterial blood pressure and heart rate were measured and recorded upon arrival the operating room before induction of anaesthesia (t_0), 1 minute after onset of the surgery (t_1), then every 20 minutes after onset the surgery (t_2,t_3,& t_4), 10 minutes after end of the infusion(t_5), and 15 minute after extubation (t_6).
Assessment of bleeding and quality of the operative field were evaluated every 10 minutes by the main surgeon using a Four-point scale:

0 = dry surgical field (no use of the suction), 1 = good surgical field (intermittent "occasional" use of the suction), 2 = widespread blood (common use of the suction), and 3 = disturbing bloody surgical field (constant use of the suction).[17]

Statistical analysis data were recorded as mean ±SD (standard deviation) or fixed values for demographic data (sex, age, height and weight).

The paired- sample t-test was used for comparison of repeated measurements within groups and the independent-sample t-test for comparison between the two groups. The threshold for statistical significance was relied on $P< 0.05$.

Results

Demographic data, duration of anaesthesia and duration of hypotension did not differ among the two groups, ($P<0.001$). (Table I).

Table I: Demographic data of patients, duration of hypotension and duration of anaesthesia in the two groups.

Patients	Group R	Group D	P
- Sex (M/F)	16/14	16/14	NS
- Age (yr.)	29±10	27±10	NS
- weight(Kg.)	66±8	68±11	NS
Duration of anaesthesia (min.)	68±11	70±11	NS
Duration of Hypotension	45±5	45±7	NS

-NS = not significant in comparison between two the groups
-Results are mean values ± SE

Heart rate (HR) was significantly decreased at all time measurements when compared with (t_0) in the both two groups P within groups = 0.006.

Heart rate (HR) was significantly lower in Group R compared with Group D at all times from t_1 to t_6. $P= 0.037$ between the two groups, (Table II, Figure 1)

Table II: Comparison of HR between the two groups, group R and group D.

Time (min.)	Group R(Beat /min)	Group D (Beat /min)
t0	76±6	75±9
t1	67±6	70±7
t2	61±5	68±9
t3	54±2	59±6
t4	51±8	58±3
t5	55±6	60±7
t6	68±4	72±4

- Results are mean ± SE
- P = 0.037 between groups
- P = 0.006 within groups

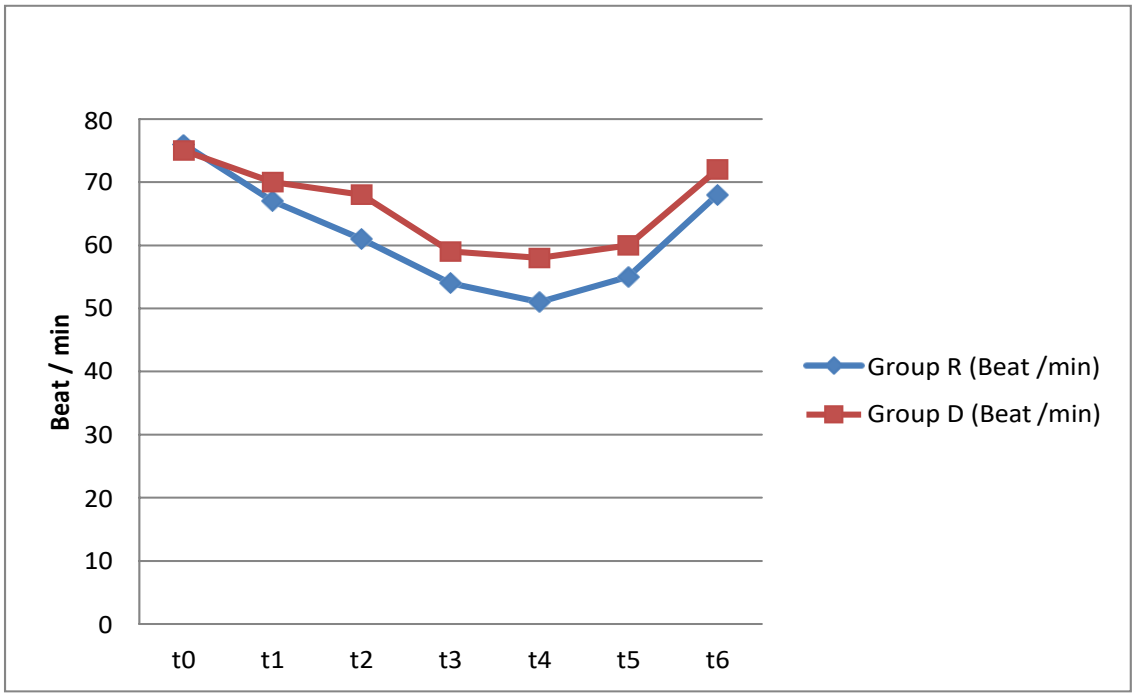

Fig 1: HR for the two groups

Mean arterial pressure (MAP) was also significantly decreased at all time measurements when compared with (t_0) in the both two groups, *P* within groups= *0.007*.

Mean arterial pressure (MAP) was significantly lower in Group R compared with Group D, at all times from t_1 to t_6 , *P= 0.032* between the two groups. (Table III, Figure 2).

Table III: Comparison of MAP between the two groups

Time	Group R(mmHg)	Group D (mmHg)
t0	90.3 ±10.1	92.2±11.8
t1	78.7±7.3	80.7±7.6
t2	62.6±5.5	72.6±3.4
t3	60.7±4.9	67.8±6.5
t4	58.4±9.2	66.1±9.2
t5	64.3±7.3	68.7±10.7
t6	76.1±2.0	78.2±10.2

- Results are mean ± SE
- *P* = 0.032 between groups
- *P* = 0.007 within groups

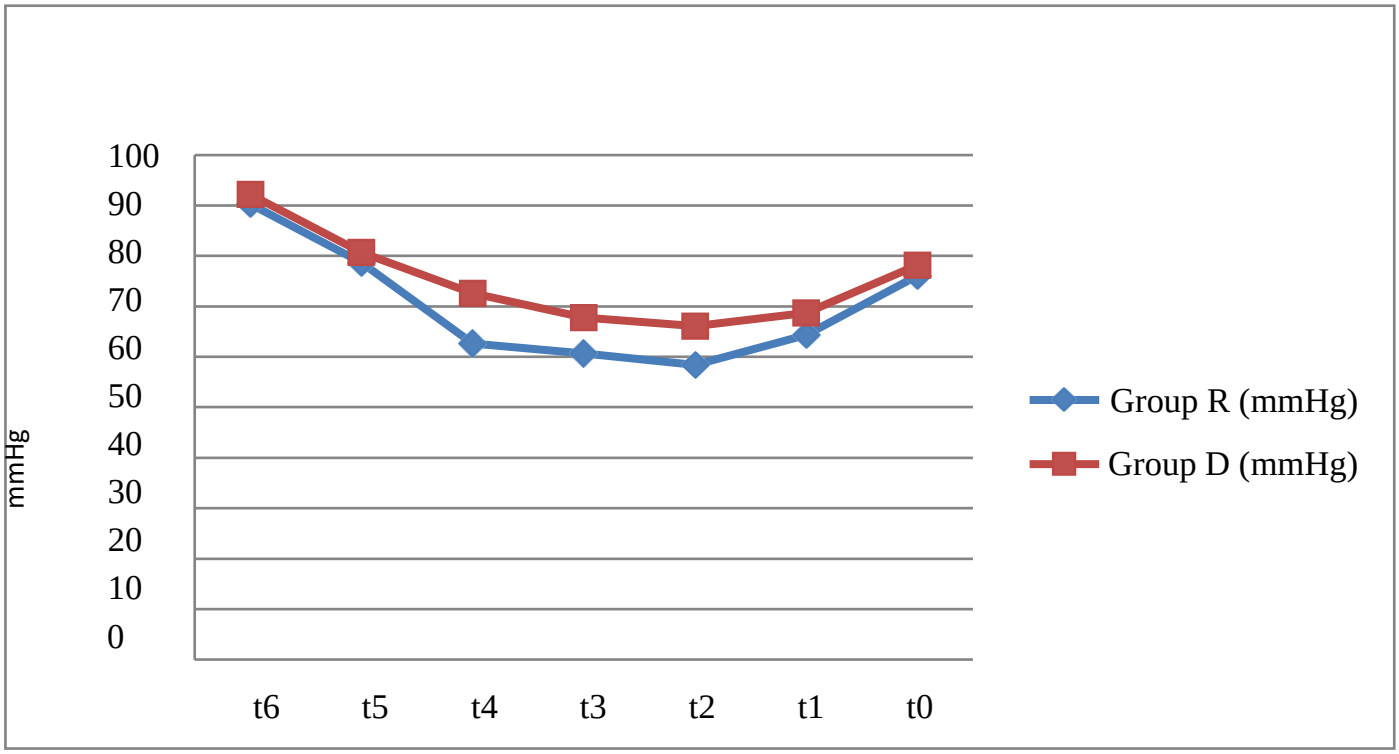

Fig 2: MAP of the two groups

The intra operative bleeding score was significantly lower in Group R than in Group D in our present study, (*P<0.05)*. (Figure 3).

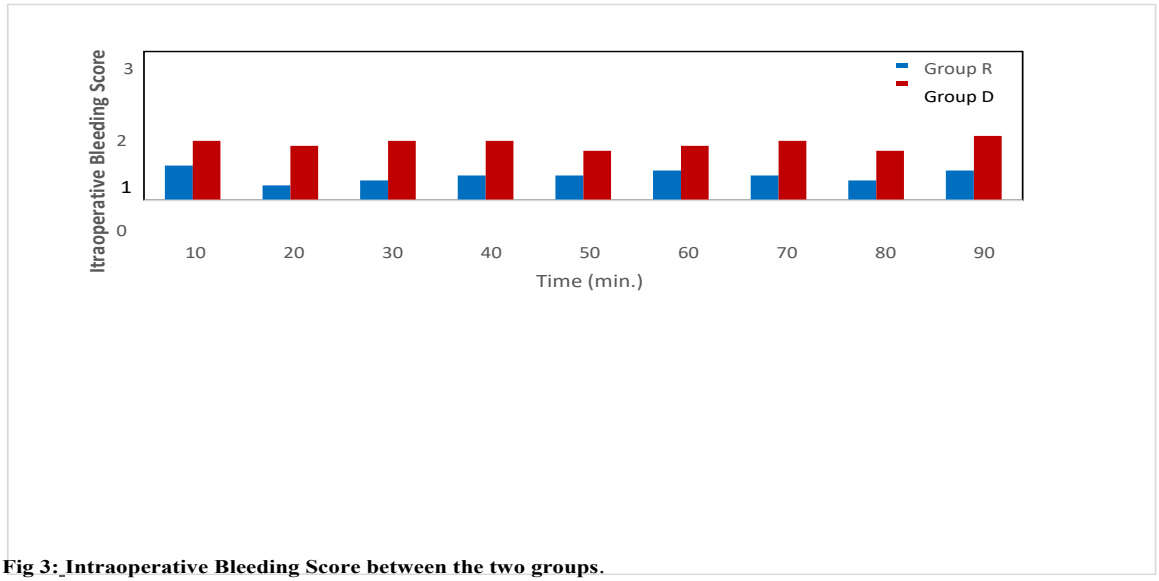

Fig 3: Intraoperative Bleeding Score between the two groups.
0: dry surgical field (no use of the suction).
1: good surgical field (intermittent use of the suction)
2: widespread blood (common use of the suction)
3: disturbing bloody surgical field (constant use of the suction)

There was no difference within and between the two groups in oxygen saturation (Spo_2) and $PaCo_2$ during hypotension and after extubation.

There were no post operative complications in any group, and all patients were discharged one day post operatively.

Discussion

The results of this study have shown that both remifantanil, a potent, short acting synthetic opioid analgesic, and dexmedetomidine, and α_2-adrenoceptor agonist, were effective in decreasing heart rate and blood pressure during middle ear surgery, and thus successful to cause regular and sustained hypotensive technique, without requirement for use of another hypertensive drugs. Infusion of remifentanil is more effective than dexmedetomidine in achieving controlled hypotension and lower intraoperative bleeding scores and better operative field conditions during middle ear surgery.

Davies M J., Shander A. and Hultcantz E. studied intraoperative bleeding, and they found that, bleeding may impair surgical field and cause surgical problems and the reduction in vascular tone is the principal mechanism on bleeding during surgery. [18, 19, 20]

Inhaled anaesthesia affects the peripheral tissues vasodilatation and may increase more bleeding if used in controlled hypotension.[21]

Lawrence & colleagues [22] studied the peripheral vasoconstrictive effects of dexmedetomidine and in reducing bleeding.

Degoute & colleagues [23, 24] found that remifentanil combined with propofol reduces blood pressure and reduces middle ear blood flow and provides good surgical operative field during tympanoplasty without using another hypotensive drug.

Ülger et al. [25] was compared dexmedetomidine with nitroglycerine in patients undergoing tympanoplasty and tympanomastoidectomy during a hypotensive techniques, they found that dexmedetomidine had better dry operative, haemodynamically stable for patients, and with no side effects according reversal increase in heart rate or blood pressure.

Abdullah A. Özen & his colleagues [26], compared the effects of remifentanil and dexmedetomidine during hypotensive technique in functional endoscopic sinus surgery (FESS), and they found that mean arterial pressure (MAP) values were similar when using remifentanil and dexmedetomidine, heart rate (HR) were higher when using remifentanil than when using dexmedetomidine at the time of extubation and 30 minute after extubation, and also they found that intra operative bleeding score didn't change between remifentanil and dexmedetomidine.

J. - H. Ryu and colleagues [27], compared between remifentanil and magnesium sulphate during middle ear surgery,and they found that combination of sevoflurane with magnesium sulphate or remifentanil leaded to appropriate hypotensive measures and suitable operative situations during middle ear surgery.

In our present surgery, we didn't add another drug in both groups to decrease the blood pressure.

Conclusion

Both remifentanil and dexmedetomidine have induced hypotensive anaesthesia intra operatively in patients undergoing middle ear surgery. Remifentanil is more effective in achieving controlled hypotension and better surgical field than dexmedetomidine in relation to haemodynamic stability during middle ear surgery.

References

1- **W. R. MacRae**, Anesthesia for Middle Ear Surgery. *Proc. roy Soc. Med*. Vol.64, 41-42; December 1971.

2- **L. Strunin**, "Organ perfusion during controlled hypotension," *British Journal of Anaesthesia*, vol. 47, no. 7, pp. 793–798, 1975.

3- **M. J. Lindop**, "Complications and morbidity of controlled hypotension," *The British Journal of Anaesthesia*, vol. 47, no. 7, pp. 799–803, 1975.

4- **C. Rodrigo**, "Induced hypotension during anesthesia, with special reference to orthognathic surgery," *Anesthesia Progress*, vol. 42, no. 2, pp. 41–58, 1995.

5- **C.-S. Degoute**, "Controlled hypotension: a guide to drug choice," *Drugs*, vol. 67, no. 7, pp. 1053–1076, 2007.

6- **Saarnivaara L, Brander P**. Comparison of three hypotensive anaesthetic methods for middle ear microsurgery. *Acta Anaesthesiol Scand* 1984; 28: 435–42.

7- **Degoute CS, Dubreuil C, Ray MJ, et al**. Effects of posture, hypotension and locally applied vasoconstriction on the middle ear microcirculation in anaesthetized humans. *Eur J Appl Physiol* 1994; 69: 414–20.

8- **Newton MC, Chadd GD, O'Donoghue B, Sapsed-Byrne SM, Hall GM**. Metabolic and hormonal responses to induced hypotension for middle ear surgery. *Br J Anaesth* 1996; 76: 352–7.

9- **Haselman MA**, Dexmedetomidine: a useful adjunct to consider in some high-risk situations, *AANA Journal*. 2008 Oct; 76(5):335-9.
10- Amaranath **L, Kellermeyer WF Jr**. Tachyphylaxis to sodium nitroprusside. *Anesthesiology* 1976; 44: 345–8.
11- **Tinker JH, Michenfelder JD**. Sodium nitroprusside: pharmacology, toxicology and therapeutics. *Anesthesiology* 1976; 45: 340–54.
12- **Blau WS, Kafer ER, Anderson JA**. Esmolol is more effective than sodium nitroprusside in reducing blood loss during orthognathic surgery. *Anesth Analg* 1992; 75: 172–8.
13- **Philip BK, Scuderi PE, Chung F, et al**. Remifentanil compared with alfentanil for ambulatory surgery using total intravenous anesthesia. *Anesth Analg* 1997; 84: 515–21.
14- **Guy J, Hindman BJ, Baker KZ, et al**. Comparison of remifentanil and fentanyl in patients undergoing craniotomy for supratentorial space-occupying lesions. *Anesthesiology* 1997; 86:514–24.
15- **Bloor BC, Ward DS, Belleville JP et al**. Effects of intravenous dexmedetomidine in humans. II. Hemodynamic changes. *Anesthesiology* 1992; 77: 1134–1142.
16- **Guo T-Z, Jiang J-Y, Buttermann AE, Maze M**. Dexmedetomidine injection into the locus coeruleus produces antinociception. *Anesthesiology* 1997; 84: 873–881.
17- **Maze M, Segal IS, Bloor BC**. Clonidine and other alpha2 adrenergic agonists: strategies for the rational use of these novel anesthetic agents. *J Clin Anesth* 1988; 1: 146–157.
18- **Shander A**. Surgery without blood. *Crit Care Med* 2003; 31(Suppl): 708–714.
19- **Davies MJ**. Minimising intra-operative blood loss. *Transfus Apher Sci* 2002; 27: 55–57.
20- **Hultcrantz E, Linder J, Angelborg C**. Sympathetic effects on cochlear blood flow at different blood pressure levels. Portmann M, *Aran JM* (Eds,). INSERM,1977; 68: 271–8.
21- **Simpson P**. Perioperative blood loss and its reduction: the role of the anaesthetist. *Br J Anaesth* 1992; 69: 498–507.
22- **Lawrence CJ, Prinzen FW, de Lange S**. Effect of dexmedetomidine on nutrient organ blood flow. *Anesth Analg* 1996; 83: 1160–1165.
23-**Degoute CS, Ray MJ, Gueugniaud PY et al**. Remifentanil induces consistent and sustained controlled hypotension in children during middle ear surgery. *Can J Anesth* 2003;50: 270–276.
24- **Degoute CS, Ray MJ, Manchon M et al**. Remifentanil and controlled hypotension; comparison with nitroprusside or esmolol during tympanoplasty. *Can J Anesth* 2001; 48: 20–27.
25- **Ülger MH, Demirbilek S, Köroğlu A, Borazan H, Ersoy MÖ**. Controlled Hypotension with Dexmedetomidine for Middle Ear Surgery. *J Turgut Ozal Med Cent*. 2004; 11(4): 237-241.
26- **Abdullah Aydın Özcan, Yaman Özyurt, Ayten Saraçoğlu, Hakan Erkal, Hüsnü Süslü, Gülten Arslan, Feriha Temizel**. Dexmedetomidine versus Remifentanil for Controlled Hypotensive Anesthesia in Functional Endoscopic Sinus Surgery. *Turk J Anesth Reanim*, 2012; 40(5): 257-61.
27- **J.-H. Ryu, I.-S. Sohn and S.-H**. Do. Controlled hypotension for middle ear surgery: a comparison between remifentanil and magnesium sulphate. *British Journal of Anaesthesia*, 103 (4): 490–5 (2009).