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Original Article

Effects of small-dose dexmedetomidine on hyperdynamic responses to electroconvulsive therapy

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Abstract

Background: Acute hemodynamic responses to electroconvulsive therapy (ECT) may increase the risk of cardiovascular complications in vulnerable patients. The aim of the current study was to assess the effect of small-dose dexmedetomidine on hyperdynamic responses to ECT.
Methods: Seventy-eight patients were enrolled and randomly allocated to receive either 0.2 μg/kg dexmedetomidine (Dex group, n = 39) or saline (Control group, n = 39) prior to ECT. Heart rate (HR) and mean arterial pressure (MAP) were recorded immediately after the administration of dexmedetomidine (T1), and 0, 1, 3, 5 and 10 min after the electrical stimuli ended (T2, T3, T4, T5 and T6). In addition, the peak HR after ECT, seizure duration, recovery time, and incidence rates of post-ECT adverse effects (agitation, headache and nausea) were also recorded.
Results: HR and MAP in the Dex group were significantly lower than those in the Control group from T2 to T5. In addition, peak HR was significantly lower in the Dex group compared with that in the Control group. Seizure length and time to spontaneous breathing, eye opening, and obeying commands in the Dex group were similar to those in the Control group. The incidence rates of post-ECT agitation and headache in the Dex group were significantly lower than that in the Control group.
Conclusion: The administration of 0.2 μg/kg dexmedetomidine to patients receiving ECT leads to a significant reduction in HR, MAP, and peak HR responses to ECT without altering seizure duration or delaying recovery. Furthermore, dexmedetomidine effectively reduced the incidence rates of post-ECT adverse effects such as agitation and headache.
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Keywords: Anesthesia; Dexmedetomidine; Electroconvulsive therapy

1. Introduction

Electroconvulsive therapy (ECT) is an effective non-pharmacological intervention for patients with severe and persistent psychiatric illnesses, and is recommended by the American Psychiatric Association as an alternative to ineffective pharmacotherapy.[1–3] However, hyperdynamic responses resulting from parasympathetic discharge coincident with ECT, followed by a sympathetic response, may increase the risk of cardiovascular complications in patients with ischemic heart disease, hypertension and cerebrovascular disease.[4] In recent decades, it has been customary to perform ECT under general anesthesia supplemented with a muscle relaxant. In addition, a number of anesthetic agents such as α-2 adrenergic agonists and β blockers have proven to be effective in reducing the incidence of hyperdynamic responses during ECT.[4,5]

As a full agonist of the α-2 adrenergic receptor, dexmedetomidine has traditionally been applied during ECT at the dose of 0.5 or 1.0 μg/kg, which effectively blunts the acute hemodynamic response to ECT.[4,6–9] However, some side effects

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have been reported. For example, delayed recovery was observed when 0.5 μg/kg dexmedetomidine was administrated during ECT.[9] Moreover, the effect of dexmedetomidine on parasympathetic activity may increase the risk of transient bradycardia or even asystole during ECT.[10,11] These side effects of dexmedetomidine may narrow its application for vulnerable patient populations. Recent studies have evaluated the effects of small-dose dexmedetomidine in clinical practice.[11–13] The present study explored whether the use of 0.2 μg/kg dexmedetomidine would effectively reduce the hyperdynamic response to ECT. In addition, the influence of small-dose dexmedetomidine on seizure duration, recovery time and incidence of post-ECT adverse effects were also assessed.

2. Methods

2.1. Participants

The present clinical trial was in accordance with the Declaration of Helsinki, approved by the Research Ethics Committee of the Third Affiliated Hospital of Sun Yat-Sen University (Guangzhou, China) and registered with the Chinese clinical trial registry (ChiCTR-IOR-15006463).

Patients who were scheduled to undergo ECT as a treatment for a psychiatric condition at the Third Affiliated Hospital of Sun Yat-Sen University between June 2015 and March 2016 were recruited for the study. Inclusion criteria were that patients be between 16 and 55 years of age, and have an American Society of Anesthesiologists' (ASA) Physical Status class of I-II. Patients who declined to participate or suffered any of the following symptoms or diseases were excluded from the study: severe hepatic and/or renal insufficiency, brain organic disease, cardiac insufficiency, sick sinus syndrome, bradycardia, atrioventricular block of degree II and III, and any contraindications of dexmedetomidine. Written informed consent was obtained from each participant and their legal guardian.

All participants were randomly allocated to the dexmedetomidine group (Dex group) or the control group (Control group) using a computer-generated random number with a 1:1 allocation. An independent investigator, not involved in the clinical management or data collection, maintained allocation data. The allocation details were stored in a sealed, opaque envelope in order to enable patients and data collectors to remain blinded to group allocation. Prior to ECT, the allocation details were shown to the anesthesiologists who did not participate in data analysis, and the related data were collected during ECT by an independent staff blinded to allocation details. The allocation was not revealed until final statistical analysis was completed.

2.2. Procedures

After routine monitoring of electrocardiogram (ECG), pulse oxygen saturation (SpO_2) and blood pressure (BP), all patients received 0.006 mg/kg atropine in order to counter the initial parasympathetic effects of ECT.[14] After atropine was administered, patients in the Dex group were infused with 0.2 μg/kg dexmedetomidine (diluted to 10 ml with 0.9% saline) at a steady rate of 2 ml/min, while patients in the Control group were infused with 10 ml of 0.9% saline at the same rate. Our choice of 0.2 μg/kg as the dose for dexmedetomidine was consistent with previous studies that added 0.2 μg/kg dexmedetomidine to intravenous anesthetics for attenuating the hemodynamic stress response during surgeries.[15,16] All patients were oxygenated with 100% oxygen before anesthesia induction. After completion of dexmedetomidine (or saline) administration, anesthesia induction was performed with intravenous 1.5 mg/kg propofol. Subsequent to loss of consciousness, 0.7 mg/kg succinylcholine was administered. Assisted ventilation via face mask was performed using 100% oxygen at a flow rate of 4 L/min for all patients during the ECT procedure. A bite block was used to protect the patients' teeth, lips, and tongue from injury caused by the contraction of facial muscles. The ventilation method was in accordance with previous studies.[4,7,8,17]

When neuromuscular response was completely blocked, ECT was performed by Thymatron System IV (Somatics Inc., Lake Bluff, IL, USA) bitemporal electrode stimulation. The dose of electrical charge was titrated to approximately 50% above each individual's seizure threshold and adjusted as needed according to seizure quality throughout the ECT course. There was an interval of two or three days between each ECT sessions.

Age, weight, gender, HR and mean arterial pressure (MAP) were recorded at baseline for all participants. It was reported that the hemodynamic effect is usually due to a sympathetic response occurring within approximately 10 min of electrical stimulation during ECT procedures, and increasing hemodynamic variables during ECT was most significant during the first 5 min post electrical stimulation. We therefore recorded hemodynamics variables at 10 min post electrical stimulation and performed more frequent observations (1–2 min) for the first 5 min.[4,8,18] The HR and MAP were recorded immediately after administration of dexmedetomidine (Dex group) or saline (Control group) (T1) and at 0, 1, 3, 5 and 10 min after the electrical stimulation ended (T2, T3, T4, T5 and T6, respectively). The selection of time points was in line with the previous studies.[4,8] In addition, the values of peak HR immediately after the electrical stimuli were recorded from the ECG.

Recovery time, seizure duration and incidence rates of post-ECT adverse effects (agitation, headache and nausea) were measured. Recovery time was measured as the time from the end of succinylcholine administration until spontaneous breathing, eye opening, and obeying commands were observed. Seizure duration was measured by electroencephalography (EEG) trace. The incidence rate of post-ECT adverse effects was measured as the proportion of ECT sessions that occurred with adverse effects. Agitation score was recorded after full recovery, and conducted according to the following scale: 1 = sleepy, 2 = awake and peaceful, 3 = irritable and noisy, 4 = disconsolate noisy, and 5 = severe blenched or sitting on the bed and shrieking.[19] The incidence rates of bradycardia (HR < 50 bpm) and hypotension (SAP < 90 mmHg) were

recorded as the proportion of ECT sessions that occurred with these two events.

The primary measurements were: 1) HR and MAP from T1 to T6, and 2) the peak HR immediately after electrical stimulation. The secondary measurements were: 1) recovery time, 2) EEG based seizure duration, and 3) incidence rate of post-ECT agitation, headache and nausea.

In a preliminary study, the peak HR for patients who received 0.2 μg/kg dexmedetomidine was 97.13 ± 13.74 bpm, while for those who received 0.9% saline peak HR was 107.80 ± 13.38 bpm. For a two-sided type I error of 0.05 with a statistical power of 80%, 34 patients in each group was required. With an expected 15% dropout rate, we included 40 patients in each group.

Statistical analysis was performed using the software SPSS for Windows (version 16.0, SPSS, Chicago, IL, USA). Continuous variables were expressed as mean ± SD values, while the qualitative variables were expressed as number (n) and percent (%). Multiple measurements were analyzed using repeated-measures analysis of variance. Other continuous variables were assessed by the independent samples t-test. Additionally, Pearson's χ^2 test or a Fisher's exact test was used to examine the differences between qualitative variables. A p-value of 0.05 or less was considered statistically significant.

3. Results

A total of 80 patients were randomly assigned to the Dex or Control group. After excluding two patients who refused to continue with subsequent ECT sessions after the first session, 78 patients with a total of 468 ECT sessions (six sessions for each patient) were included in the final analyses (n = 39 for each group). A CONSORT[20] flow diagram is depicted in Fig. 1. There were no differences between the groups in terms of demographics (Table 1).

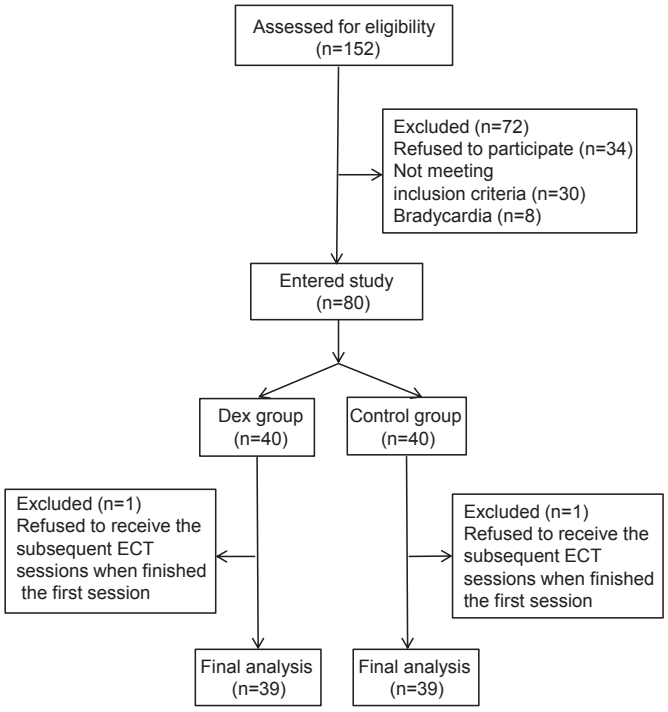

Fig. 1. Study flow diagram.

Baseline HR and MAP values did not differ significantly between the Dex and Control group (HR: $p = 0.859$; MAP: $p = 0.705$) (Table 1). After ECT, the HR and MAP values in the Control group were significantly higher than those in the Dex group at T2 (HR: $p < 0.001$; MAP: $p < 0.001$), T3 (HR: $p < 0.001$; MAP: $p < 0.001$), T4 (HR: $p < 0.001$; MAP: $p < 0.001$) and T5 (HR: $p < 0.001$; MAP: $p = 0.002$) (Fig. 2). HR and MAP values were reduced to baseline levels at T4 in the Dex group (HR: $p = 0.474$; MAP: $p = 0.278$) and at T6 in the Control group (HR: $p = 0.573$; MAP: $p = 0.353$) (Fig. 2). In addition, the peak HR in the Dex group was significantly higher than that in the Control group ($p < 0.001$) (Fig. 2A and Table 1).

Although the HR and MAP values were lower in the Dex group than those in the Control group immediately after dexmedetomidine administration (T1), the differences were not statistically significant between the two groups (HR: $p = 0.113$; MAP: $p = 0.170$) (Fig. 2). No significant differences in the occurrence of bradycardia or hypotension between the groups were observed (Table 1). There were no episodes of bradycardia (HR < 45 bpm) requiring atropine or hypotension (systolic arterial pressure [SAP] < 80 mmHg) requiring ephedrine during the study in either group.

There was no difference between the groups ($p = 0.214$) in EEG seizure length (Table 1). Recovery time also did not

Table 1
Baseline demographic and peri-ECT clinical variables.

Variables	Dex group (n = 39)	Control group (n = 39)	p
No. of ECT sessions (N)	234	234	
Pre-ECT characteristics			
Age (year)	29.97 ± 10.56	28.28 ± 11.09	0.492
Weight (Kg)	59.33 ± 10.46	59.29 ± 11.90	0.988
Gender (male/female)	21/18	25/14	0.357
HR (bpm)	82.41 ± 10.44	82.23 ± 11.31	0.859
MAP (mmHg)	86.38 ± 10.42	86.02 ± 10.18	0.705
Intra- and post-ECT variables			
Values of peak HR (bpm)	100.01 ± 16.83	117.30 ± 18.22	<0.001
EEG seizure length (s)	30.09 ± 3.17	31.32 ± 5.23	0.214
Recovery time			
Spontaneous breathing (min)	4.43 ± 0.55	4.28 ± 0.51	0.226
Open eyes (min)	7.43 ± 0.72	7.42 ± 0.67	0.977
Obey commands (min)	10.45 ± 0.98	10.35 ± 1.05	0.677
Incidence rate of bradycardia (N [%])	4 (1.71)	1 (0.43)	0.177
Incidence rate of hypotension (N [%])	5 (2.14)	3 (1.28)	0.476
Incidence rates of post-ECT adverse effects			
Agitation (agitation score ≥ 3, N [%])	36 (15.38)	58 (24.79)	0.011
Headache (N [%])	14 (5.98)	27 (11.54)	0.034
Nausea (N [%])	7 (2.99)	12 (5.13)	0.242

Values are means ± SD except for gender (male/female) and incidence rates of bradycardia (N [%]), hypotension (N [%]) and post-ECT adverse effects (N [%]).

Dex = dexmedetomidine; ECT = electroconvulsive therapy; HR = heart rate; MAP = mean arterial pressure; EEG = electroencephalography.

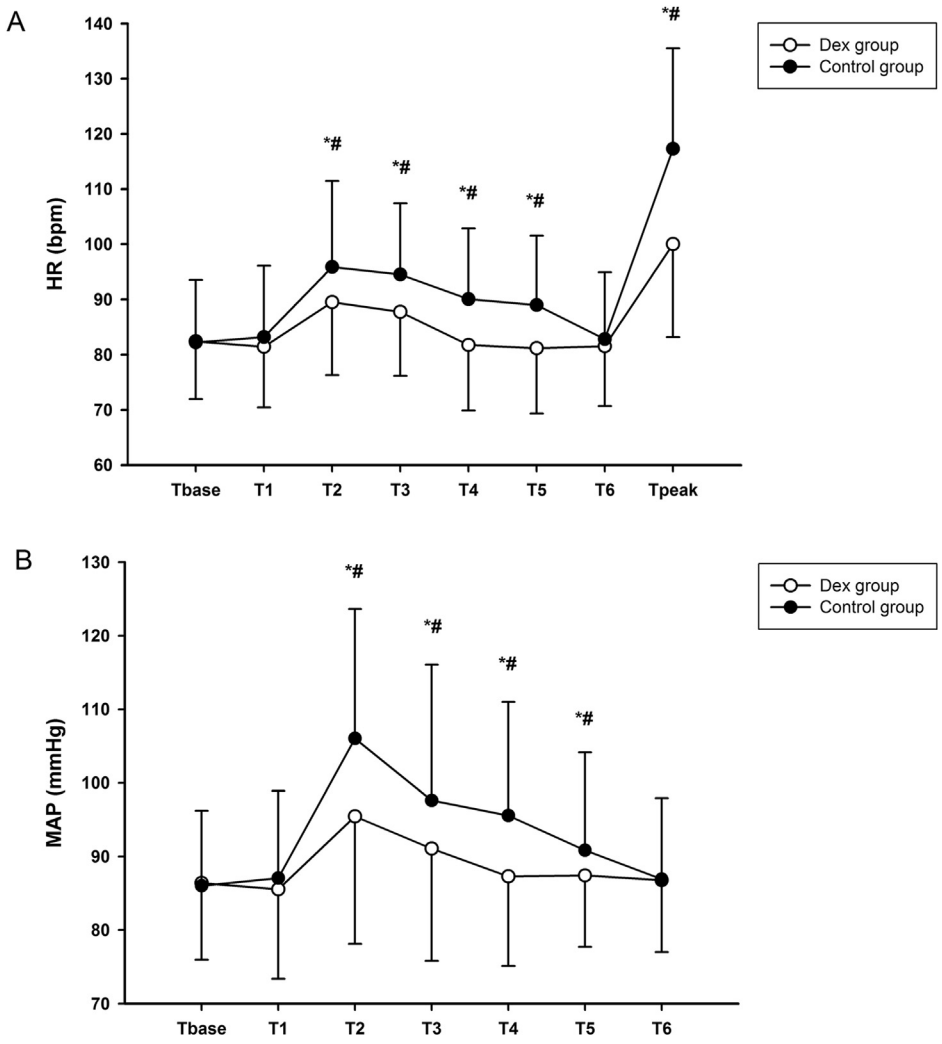

Fig. 2. Hemodynamics of different time points during ECT. (A) HR from baseline to T6, (B) MAP from baseline to T6 (Dex = dexmedetomidine; ECT = electroconvulsive therapy; HR = heart rate; MAP = mean arterial pressure; *$p < 0.05$ versus the Control group; #$p < 0.05$ versus the baseline value).

differ between the Dex and the Control group ($p = 0.226$ for time of spontaneous breathing, $p = 0.977$ for time of eye opening, $p = 0.677$ for time of obeying commands) (Table 1). The incidence rates of post-ECT agitation (score ≥ 3) and headache were both significantly lower in the DEX group compared to the Control group ($p = 0.011$ for agitation and $p = 0.034$ for headache) (Table 1). There were no significant differences in the incidence rate of nausea ($p = 0.242$) between the groups (Table 1).

4. Discussion

The current study demonstrated that the administration of 0.2 μg/kg dexmedetomidine reduced the hemodynamic response to ECT without altering seizure duration or delaying recovery. In addition, 0.2 μg/kg dexmedetomidine effectively reduced the incidence of post-ECT adverse effects such as agitation and headache.

ECT stimulation leads to parasympathetic discharge followed by a sympathetic response, which can result in a 30–40% increase in systolic blood pressure (SBP) and an over 20% increase in HR.[21] In addition, ECG ischemia and 50–400% increases in the rate pressure product have also been observed.[22,23] It is difficult to perform a comprehensive screen for aneurysms and structure blood vessel abnormalities prior to ECT[24] and thus, transient changes in circulatory dynamics remain one of the major risks in ECT.

Dexmedetomidine is a highly selective a2 receptor agonist. It possesses a number of other properties during surgery such as analgesic, sedative, anesthetic-sparing, sympatholytic, and hemodynamic-stabilizing, making it a useful and safe adjunct during anesthesia.[25] For example, administration of dexmedetomidine prior to the administration of propofol may significantly reduce the incidence of injection pain.[26] In addition, dexmedetomidine may decrease intra-operative consumption of anesthetics and decrease sympathetic tone, both of which are helpful for decreasing the risk of post-operative nausea and vomiting (PONV).[27]

Recently, dexmedetomidine has also been increasingly used as an adjunct regimen to anesthesia in ECT because of its benefits including maintaining hemodynamic stability. In the present study, it appeared that the effect of 0.2 μg/kg

dexmedetomidine on blunting acute hemodynamic response to ECT was comparable to that of 0.5 or 1.0 ug/kg dexmedetomidine which was typically used in previous studies.[6−9]

In addition to the effective modifications on hyperdynamic response evoked by ECT, small-dose dexmedetomidine did not alter seizure duration or delay recovery after ECT. Seizure duration is considered an indicator of ECT efficacy. A very short seizure (≤15s) may be associated with lack of treatment efficacy.[28] In the present study, the administration of 0.2 μg/kg dexmedetomidine did not shorten seizure duration. Previous studies have also demonstrated that the anticonvulsant effects of intravenous anesthetics on seizure activity may be weakened with reduced dosages.[24,29]

As ECT procedures are usually performed in an outpatient setting, it is necessary to use anesthetic agents with rapid recovery profiles.[30] Moreover, delayed recovery increases the risks of difficult mask ventilation and airway obstruction, which have been related to the mortality and morbidity of anesthesia in ECT.[31] In the current study, the infusion of a reduced dose of dexmedetomidine during ECT may minimize its sedative properties and decrease the duration of action, which may ultimately be helpful in shortening recovery time, and further reducing the risks associated with delayed recovery.

Post-ECT adverse effects such as agitation, headache and nausea generally occur during or shortly after an ECT session, limiting the use of ECT.[32] It has been suggested that post-ECT agitation occurs in up to 12% of ECT treatments and is associated with patient safety.[33] The serious and severe characters of agitation such as disorientation, panic-like behaviors and even combativeness place both the patient and medical staff at risk of injury.[34] The current study found that a small dose of dexmedetomidine effectively alleviated post-ECT agitation, similar to doses of 0.5 or 1.0 μg/kg dexmedetomidine on post-ECT agitation in previous studies.[6,7] Furthermore, headache is also common post ECT, occurring in 26%−85% of patients.[35] It has been suggested that post-ECT headache may be associated with elevated cerebral blood flow and blood pressure after electroshock.[36] Here, the administration of 0.2 μg/kg dexmedetomidine significantly reduced the incidence rate of post-ECT headache, due in part to reduced effects of the acute hyperdynamic response to ECT.

The current study used a dexmedetomidine infusion duration of 5 min, which is in accordance with infusion durations reported in previous studies.[12] It is possible that a more rapid infusion of dexmedetomidine may increase the risk of severe sinus bradycardia during anesthetic induction. In the current study, the intravenous injection of atropine prior to dexmedetomidine administration may lead to a more rapid return to baseline HR levels. No significant differences in the occurrence of bradycardia or hypotension were found between the Dex and Control groups. In addition, there were no episodes of bradycardia (HR < 45 bpm) or hypotension (SAP < 80 mmHg) requiring medication during the study, indicating that the infusion duration was effective and safe.

While the present study reported valuable results on the use of low-dose dexmedetomidine in ECT, there were some limitations. First, the study was performed as a single-center clinical trial. The results need further confirmation through multi-center studies with large sample sizes. Second, the specific diagnoses of patients were not taken into consideration in this study. Future studies should use a randomized controlled design to investigate the efficiency of low-dose dexmedetomidine for patients with specific psychiatric illnesses.

In conclusion, the current study provides new insights into the clinical use of low-dose dexmedetomidine in ECT. Administration of 0.2 μg/kg dexmedetomidine leads to a significant reduction in MAP, HR and peak HR responses to ECT without altering seizure duration or delaying recovery. In addition, low-dose dexmedetomidine effectively reduced the incidence rates of post-ECT agitation and headache.

References

1. Tor PC, Bautovich A, Wang MJ, Martin D, Harvey SB, Loo C. A systematic review and meta-analysis of brief versus ultrabrief right unilateral electroconvulsive therapy for Depression. *J Clin Psychiatry* 2015;**76**:e1092−8.
2. Pawelczyk T, Kolodziej-Kowalska E, Pawelczyk A, Rabe-Jablonska J. Effectiveness and clinical predictors of response to combined ECT and antipsychotic therapy in patients with treatment-resistant schizophrenia and dominant negative symptoms. *Psychiatry Res* 2014;**220**:175−80.
3. Erdil F, Begec Z, Kayhan GE, Yologlu S, Ersoy MO, Durmus M. Effects of sevoflurane or ketamine on the QTc interval during electroconvulsive therapy. *J Anesth* 2015;**29**:180−5.
4. Aydogan MS, Yucel A, Begec Z, Colak YZ, Durmus M. The hemodynamic effects of dexmedetomidine and esmolol in electroconvulsive therapy: a retrospective comparison. *J Ect* 2013;**29**:308−11.
5. Nomoto K, Suzuki T, Serada K, Oe K, Yoshida T, Yamada S. Effects of landiolol on hemodynamic response and seizure duration during electroconvulsive therapy. *J Anesth* 2006;**20**:183−7.
6. Mizrak A, Koruk S, Ganidagli S, Bulut M, Oner U. Premedication with dexmedetomidine and midazolam attenuates agitation after electroconvulsive therapy. *J Anesth* 2009;**23**:6−10.
7. Shams T, El-Masry R. Ketofol-Dexmedetomidine combination in ECT: a punch for depression and agitation. *Indian J Anaesth* 2014;**58**:275−80.
8. Begec Z, Toprak HI, Demirbilek S, Erdil F, Onal D, Ersoy MO. Dexmedetomidine blunts acute hyperdynamic responses to electroconvulsive therapy without altering seizure duration. *Acta Anaesthesiol Scand* 2008;**52**:302−6.
9. Moshiri E, Modir H, Bagheri N, Mohammadbeigi A, Jamilian H, Eshrati B. Premedication effect of dexmedetomidine and alfentanil on seizure time, recovery duration, and hemodynamic responses in electroconvulsive therapy. *Ann Card Anaesth* 2016;**19**:263−8.
10. Anastasian ZH, Khan N, Heyer EJ, Berman MF, Ornstein E, Prudic J, et al. Effect of atropine dose on heart rate during electroconvulsive therapy. *J Ect* 2014;**30**:298−302.
11. Park HY, Kim JY, Cho SH, Lee D, Kwak HJ. The effect of low-dose dexmedetomidine on hemodynamics and anesthetic requirement during bis-spectral index-guided total intravenous anesthesia. *J Clin Monit Comput* 2016;**30**:429−35.
12. Sun S, Huang SQ. Effects of pretreatment with a small dose of dexmedetomidine on sufentanil-induced cough during anesthetic induction. *J Anesth* 2013;**27**:25−8.
13. Jung SH, Lee SK, Lim KJ, Park EY, Kang MH, Lee JM, et al. The effects of single-dose intravenous dexmedetomidine on hyperbaric bupivacaine spinal anesthesia. *J Anesth* 2013;**27**:380−4.
14. Rasmussen KG, Jarvis MR, Zorumski CF, Ruwitch J, Best AM. Low-dose atropine in electroconvulsive therapy. *J Ect* 1999;**15**:213−21.
15. Tufanogullari B, White PF, Peixoto MP, Kianpour D, Lacour T, Griffin J, et al. Dexmedetomidine infusion during laparoscopic bariatric surgery: the effect on recovery outcome variables. *Anesth Analg* 2008;**106**:1741−8.

16. Manne GR, Upadhyay MR, Swadia V. Effects of low dose dexmedetomidine infusion on haemodynamic stress response, sedation and postoperative analgesia requirement in patients undergoing laparoscopic cholecystectomy. *Indian J Anaesth* 2014;**58**:726−31.
17. Saito S. Anesthesia management for electroconvulsive therapy: hemodynamic and respiratory management. *J Anesth* 2005;**19**:142−9.
18. Weinger MB, Partridge BL, Hauger R, Mirow A, Brown M. Prevention of the cardiovascular and neuroendocrine response to electroconvulsive therapy: II. effects of pretreatment regimens on catecholamines, ACTH, vasopressin, and cortisol. *Anesth Analg* 1991;**73**:563−9.
19. Vishne T, Amiaz R, Grunhaus L. Promethazine for the treatment of agitation after electroconvulsive therapy: a case series. *J Ect* 2005;**21**:118−21.
20. Moher D, Hopewell S, Schulz KF, Montori V, Gotzsche PC, Devereaux PJ, et al. CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. *BMJ* 2010;**340**:c869.
21. Ding Z, White PF. Anesthesia for electroconvulsive therapy. *Anesth Analg* 2002;**94**:1351−64.
22. Nishihara F, Saito S, Tobe M, Harada N, Kadoi Y, Goto F. Hemodynamic changes during electroconvulsive therapy under propofol anesthesia. *J Anesth* 2002;**16**:332−5.
23. Dolinski SY, Zvara DA. Anesthetic considerations of cardiovascular risk during electroconvulsive therapy. *Convuls Ther* 1997;**13**:157−64.
24. Takekita Y, Suwa T, Sunada N, Kawashima H, Fabbri C, Kato M, et al. Remifentanil in electroconvulsive therapy: a systematic review and meta-analysis of randomized controlled trials. *Eur Arch Psychiatry Clin Neurosci* 2016;**266**:703−17.
25. Chrysostomou C, Schmitt CG. Dexmedetomidine: sedation, analgesia and beyond. *Expert Opin Drug Metab Toxicol* 2008;**4**:619−27.
26. He L, Xu JM, He T, Liu L, Zhu R. Dexmedetomidine pretreatment alleviates propofol injection pain. *Ups J Med Sci* 2014;**119**:338−42.
27. Geng ZY, Liu YF, Wang SS, Wang DX. Intra-operative dexmedetomidine reduces early postoperative nausea but not vomiting in adult patients after gynaecological laparoscopic surgery: a randomised controlled trial. *Eur J Anaesthesiol* 2016;**33**:761−6.
28. Sackeim HA, Devanand DP, Prudic J. Stimulus intensity, seizure threshold, and seizure duration: impact on the efficacy and safety of electroconvulsive therapy. *Psychiatr Clin North Am* 1991;**14**:803−43.
29. Miyazaki Y, Adachi T, Kurata J, Utsumi J, Shichino T, Segawa H. Dexmedetomidine reduces seizure threshold during enflurane anaesthesia in cats. *Br J Anaesth* 1999;**82**:935−7.
30. Liu FL, Cherng YG, Chen SY, Su YH, Huang SY, Lo PH, et al. Postoperative recovery after anesthesia in morbidly obese patients: a systematic review and meta-analysis of randomized controlled trials. *Can J Anaesth* 2015;**62**:907−17.
31. Saarni SE, Saarni SI, Fogelholm M, Heliovaara M, Perala J, Suvisaari J, et al. Body composition in psychotic disorders: a general population survey. *Psychol Med* 2009;**39**:801−10.
32. Andrade C, Arumugham SS, Thirthalli J. Adverse effects of electroconvulsive therapy. *Psychiatr Clin North Am* 2016;**39**:513−30.
33. Shahriari A, Khooshideh M, Sheikh M. Amlodipine and the successful management of post-Electroconvulsive therapy agitation. *Case Rep Psychiatry* 2016;**2016**:3962491.
34. Tzabazis A, Schmitt HJ, Ihmsen H, Schmidtlein M, Zimmermann R, Wielopolski J, et al. Postictal agitation after electroconvulsive therapy: incidence, severity, and propofol as a treatment option. *J Ect* 2013;**29**:189−95.
35. Drew BI, King ML, Callahan L. Cryotherapy for treatment of ECT-induced headache. *J Psychosoc Nurs Ment Health Serv* 2005;**43**:32−9.
36. Dinwiddie SH, Huo D, Gottlieb O. The course of myalgia and headache after electroconvulsive therapy. *J Ect* 2010;**26**:116−20.