ORIGINAL ARTICLE

Use of bispectral index monitoring for determination of sedation depth in 50 patients undergoing cardioversion

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Abstract

Objectives: To investigate the contribution of Bispectralindex monitoring on the amount of used anaesthetic substance and the quality of anaesthesia in patients with persistent atrial fibrillation who would undergo cardioversion.

Methods: The prospective, randomised, controlled clinical study was conducted at Akdeniz University, Antalya, Turkey from October 2010 to November 2011 Sedation was performed on 50 adult patients using midazolam and fentanyl. Patients were randomised to group 1 and 2. In group 1 cardioversion was performed when the BispectralIndex value was seen to have decreased to <80 and the Ramsay sedation score was 5-6. In Group 2, BispectralIndex monitor was blinded to the investigator, and cardioversion was performed when Ramsay sedation score was 5-6. In both groups, blood pressure, heart rate and Bispectral index values were recorded. Total anaesthetic amount, awareness and pain were also assessed. SPSS 13 was used for statistical analysis.

Results: Overall, 23(46%) patients were male and 27(54%) were female and there was no significant difference in the two groups in terms of age (p>0.05). No statistically significant difference was detected between the groups in terms ofinduction time, anaesthetic need and Bispectral Index values (p>0.05). In both groups, 2(8%) patients perceived pain and 2(8%) perceived the procedure.

Conclusion: In the presence of anaesthetist in the team, Bispectral Index monitoring did not contribute to the determining of anaesthetic drug dosage and the depth and quality of anaesthesia in patients with persistent atrial fibrillation during cardioversion.

Keywords: Cardioversion, Sedation, Bispectral index, Midazolam. (JPMA 64: 1370; 2014)

Introduction

Atrial fibrillation (AF) is the most common arrhythmia in the elderly. Direct current (DC) cardioversion (CV) is recommended in order to provide sinus rhythm, especially in patients with restricted functional capacity and prominent heart failure symptoms.[1-3] The procedure should be conducted under deep sedation or general anaesthesia. Sedation in electrical cardioversion has some characteristics due to its short and painful procedure. Also some specific characteristics of the patient undergoing DC CV affects the sedation procedures. These patients are prone to haemodynamic instability because of their present cardiac problems and respiratory depression due to pulmonary problems. Confidence limits can easily be exceeded even in mild oversedation or undersedation. In oversedation, respiratory depression and haemodynamic instability can easily develop, whereas in case of undersedation, awareness increases and serious arrhythmias can develop as the result of sympathetic discharge. Furthermore, additional sedative drug administration would not be possible in case of undersedation as the procedure takes only a short period. Thus, the depth of anaesthesia should be adjusted optimally during the procedure, and avoidance of undersedation or oversedation is very significant.[4-6] Depth of sedation is conventionally evaluated with clinical observation of patients' responses to sound, pain and surgical stimuli. These assessments are subjective. Moreover, stimulating the patient can decrease the depth of sedation. BispectralIndex (BIS) is a parameter derived from Electroencephalography (EEG), used in order to assess the depth of anaesthesia and sedation.[7-9] BIS values can be used for the evaluation of the depth of general anaesthesia and sedation along with routine clinical knowledge. The primary aim of this study was to determine the effectiveness of BIS usage in patients with AF undergoing DC CV and to investigate its effect on the amount of anaesthetic agents and quality of anaesthesia. Besides, the study also aimed at determining the need of respiratory support in sedation conducted in DC CV in patients with persistent AF and to evaluate the haemodynamic state.

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Patients and Methods

The prospective, randomised, controlled clinical study was conducted at Akdeniz University, Antalya, Turkey from October 2010 to November 2011 after obtaining approval from the institutional ethics committee. Fifty adult patients with atrial fibrillation for whom DC CV was planned were enrolled through systematic sampling after obtaining informed written consent from each of them. The procedure was conducted under elective conditions for all patients. Structural heart diseases were investigated using routine transthoracic echocardiography (ECG) before the procedure. Effective anticoagulation was administered in order to keep the International Normalized Ratio (INR) between 2 and 3 for at least 4 weeks. The patients were randomised into two groups using sealed envelopes.

The anaesthetist performed anaesthesia by evaluating the clinical condition and taking BIS values into consideration for Group 1, and by evaluating only the clinical condition for Group 2. BIS values were recorded in the second group, too; but the anaesthesia team was kept blinded to them. The DC CV procedure was conducted in the coronary intensive care unit (ICU) by a team consisting of a cardiologist, a cardiology assistant, a cardiology nurse, an anaesthetist and an anesthesiology technician. At the beginning, the patients underwent monitoring of the systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MBP), ECG and pulse oximetry. Additionally, the probe of BIS monitor (Aspect Medical Systems) was adhered to the forehead and the values were recorded, and the patient was given nasal O2 at a rate of 2 lt/min. Drugs and devices needed for resuscitation were controlled. Values of blood pressure (BP), heart rate (HR), oxygen saturation (SpO2) and BIS were recorded before sedation.

Patients were given 100% oxygen with a mask. Further, 0.5μg/kg of fentanyl and midazolam with a slow infusion at a rate of 1 mg/min were administered via peripheral vessels. When the Ramsay sedation scale (RSS)[10] was 5-6 and the BIS was<80% (only in group 1), BP, HR, SpO2 and BIS values were measured again. The patients were monitored with DC cardioverter. The defibrillator leads were placed on the parasternal site and apex appropriately. Electrical CV was conducted by applying a 300 joule energy synchronised with the R wave on the ECG when the RSS was 5-6. In case of failure of sinus rhythm in the first application, the locations of the defibrillator leads were switched to the anterior and posterior chest wall and additional midazolam and fentanyl were administered according to the patient's condition. When the RSS was at 5-6 again, the second shock was given, and if unsuccessful, the third shock was applied. BP, HR, SpO2 and BIS values were obtained at 1minute following DC CV and complete recovery (in case of RSS being 2).

The induction time was taken as the duration between the initiation of anaesthetic agent and DC CV. The awake time was taken as the duration between DC CV and complete recovery (RSS 2). Opening eyes, replying to questions and sitting time were recorded during recovery. The durations between CV and RSS 4, CV and RSS 3 and CV and RSS 2 were recorded. Patients were asked questions about awareness and recognition of the procedure[11] and they were asked to evaluate the degree of pain with Visual Analogue Scale (VAS). All measurements were recorded on a designated form during the procedure.

All data was entered into Microsoft Excel Workbook and analysed using SPSS 13. Numerical data was analysed using the independent sample t test. Paired t test was used for in-group comparison and unpaired t test was used for comparison between groups. Categorical data was analysed using Chi-square test. P<0.05 was taken as statistically significant.

Results

Overall, 23(46%) of the 50 patients were male and 27(54%) were female. Of them, 34(68%) patients underwent DC CV for the first time, 7(14%) underwent DC CV twice, and 9(18%) underwent DC CV three times. The two groups had 25(50%) patients each. Group 1 included 12(48%) males and 13(52%) females, while Group 2 had 11(44%) males and 14(56%) females. No difference was found between the groups in terms of age (57.7±13 years vs.63.6±9.7; p>0.05) and gender (p>0.05) (Table-1). In the first group, valvular heart disease-related AF was detected in 9(36%) patients and non-valvular heart disease-related AF in 16(64%). In Group 2, the corresponding numbers were 7(28%) and 18(72%). Sinus rhythm could not be achieved in 4(16%) patients in Group 1, and in 3(12%)

Table-1: Clinical features.

Features	Group 1	Group 2
Age, (year)	57.7±13.4	63.6±9.7
Gender(female/male)	13/12	14/11
Weight, kg,	76.8 ± 16	79.5 ± 8.7
Height, cm,	165± 7	168± 8
Underlying cardiac disease (valvular)	9	7
Underlying cardiac disease (non valvular)	16	18
Second shocks	2	5
Third shocks	6	3
Successful cardioversion	21	22

Values are expressed as mean ± standard deviation.

Table-2: Haemodynamic and BIS Data.

		Before induction	After induction	After cardioversion	Complete recovery
HR beat/min	Group-1	88±23	89±22	74±12*	73±13*
	Group-2	91±17	93±16	75±12*	72±13*
SBP mmHg	Group-1	133±20	123±21*	140±21	116±14*
	Group-2	143±26	128±23*	150±22	124±17*
MBP mmHg	Group-1	105±16	93±17*	108±18	87±13*
	Group-2	114±19	104±19*	120±21	96±12*
DBP mmHg	Group-1	89±14	80±14*	91±14	74±13*
	Group-2	94±17	86±13*	97±15	78±12*
Sp02 %	Group-1	98.9±0.9	98.9±1.2	99.3±1.4	98.6±1.4
	Group-2	98.1±1.4	99.0±1.8	99.5±1.1	99.0±1.1
B?S	Group-1	97.6±0.5	78.9±4.5*	81.9±6.1*	96.8±1.4
	Group-2	97.6±0.6	74.1±8.8*	80.9±7.5*	96.8±1.6

In-group comparisons(Paired t test used for comparison)
* means statistically significant (p<0.05)
HR: Heart Rate
SBP: Systolic Blood Pressure
MBP: Mean Blood Pressure
Sp02: Oxygen saturation
BIS: BispectralIndex.

Table-3: Anaesthetic features.

	Group 1	Group 2
Induction time (min)	5.6±1.3	5.8±2.1
Awake time (min)	43±13	45±13
Eye opening time (min)	21±7	24±7
Replying time (min)	26±12	26±8
Sitting time (min)	35±12	42±12
Total midazolam (mg)	4.7±1.1	4.5±1.5
Total fentanyl (µg)	36.9±12.7	29.3±9.6

Values are expressed as mean ± standard deviation.

patients in Group 2.

BIS values were found to be similar in both groups before induction (97.6±0.5 vs.97.6±0.6; p>0.05). The BIS values decreased in both groups with induction, but no statistically significant difference was found between the groups (78.9±4.5 vs.74.1±8; p>0.05). The BIS values did not decrease with DC CV and no statistically significant difference was found between the groups (81.4±6.1 vs.80.9±7.5; p>0.05). The BIS values increased to pre-induction values in both groups at the end of recovery and no statistically significant difference was found between the groups in terms of these values (96.8±1.4vs. 96.8±1.6; p>0.05) (Table-2).

There were also no significant differences between the groups in terms of induction time, awake time, eye opening time, replying time, sitting time, total midazolam amount and total fentanyl amount (p> 0.05 in all cases) (Table-3). In Group 1, 1(4%) patient reported severe chest pain (VAS 7), 1(4%) reported mild chest pain (VAS 2), 1(4%) reported bouncing sensation on the chest without pain, and 1(4%) reported touch sensation without pain. In Group 2, 2(8%) patients reported VAS 6-7 chest pain, 1(4%) reported a burst sensation on the chest, and 1(4%) patient reported touch sensation. A total of 21(42%) patients in the two groups did not feel the procedure. Chest pain and awareness did not occur in patients who received DC shock once, but occurred in patients who received it twice or more.

Apnoea and superficial respiration developed in 19 patients (76%) in group 1 and 21 patients (84 %) in group 2. All of our patients received 100% supplemental O_2 before the procedure. None of the patients required endotracheal intubation. Bag-mask ventilation was needed for all patients just before and after DC CV.

The difference between the groups in all parameters related to HR were statistically insignificant (p>0.05). The same was the case with all aspects of SBP, DBP, MBP as well as saturation levels (p>0.05).

Discussion

The study found that sufficient depth of sedation was provided via monitoring of conventional clinical data, and that additional BIS monitoring did not contribute to the adjustment of the depth of anaesthesia or to reduce awareness.

In our study, deep sedation at the level of RSS 5-6 was provided via careful clinical monitoring at the level of BIS 78 in Group 1 and at the level of BIS 74 in Group 2. These findings suggest that sufficient sedation depth (RSS 5-6) can be provided via close monitoring of the patients. The depth of sedation was evaluated clinically in both groups and knowledge of the BIS values did not affect the midazolam and fentanyl doses. Evaluation of the sedation depth can only be achieved in the presence of an anaesthetist experienced in sedation scoring. In sedation attempts that will be conducted by less experienced teams, BIS monitoring can be used in the determination of the depth of anaesthesia and additional drug need.

In our study, similar recovery rates were found in both groups according to RSS. Patients' opening the eyes, replying to questions and the sitting times were found to be similar in both groups. In our study, alterations in BIS or additional drug need during the procedure were not required, as the DC CV procedure that was conducted just following the achievement of RSS 5-6 sedation level took a very short time.

Two patients in each group who received more than one shock, felt pain during the procedure, and two patients in each group perceived the procedure with touch sensation or hearing sound without pain. Overall, 21 patients in both groups did not perceive the procedure. Administration of similar doses of drugs in both groups explains the similarity of recovery rates and awareness. Effectiveness of BIS on the adjustment of the sedation level has been investigated in various environments, patient groups and procedures.[12-16] Sedation was evaluated according to RSS in a group of surgical and internal intensive care patients and it was found that the BIS scores changed in a wide range at any level of consciousness and concluded that routine use of BIS was not appropriate in monitoring the level of consciousness in ICU patients.[17] In ICU patients, various individual or environmental factors affecting the BIS values (hepatic and renal dysfunctions, neurological state, electrical signals from mechanical ventilators, chest tubes, catecholamine infusions etc.) have been reported to play roles in these changes.[18] In our study, the BIS values changed in a narrow range, predicting the RSS 5-6 sedation level. Our study population and environment being different from ICU patients and keeping RSS at a narrow range were probably responsible for the difference in BIS values. A study[19] reported that during endoscopic interventions, use of BIS in sedation provided with propofol led to an insignificant decrease in the amount of propofol and the recovery time was shorter during the procedure. They have reported that BIS values affect the additional propofol use in 66% of cases. In our study, the amounts of midazolam and fentanyl and the recovery times were not found to be different in BIS use. The patient population in this study was quite different from the patients who had undergone endoscopic interventions in terms of cardiovascular problems, respiratory problems and the age group.

In general, DC CV causes a sympathetic stimulus. This leads to an elevation in BP. SBP, DBP and MBP were also found to increase with DC CV application in our study. A study[20] reported that BP increased, both in etomidate and propofol groups with DC CV application, and concluded that this condition could be explained with the sympathetic stimulus caused by DC CV application. Increase in BP values was detected despite fentanyl administration to all the patients for pain relief, despite midazolam administration in both groups in order to keep the RSS of 5-6 and BIS<80. BP and HR elevations are observed with skin incision in patients under general anaesthesia. The DC CV leading to BP elevations despite sufficient analgesia and sedation suggests that DC shock causes a similar degree of pain and stimulus to skin incision. Furthermore, absence of hypotension suggests that midazolam can be used safely for these patients.

Apnoea and superficial respiration developed in a large portion of our patients. All of our patients received 100% supplemental O_2 before the procedure. In our study, none of the patients required endotracheal intubation. Thus, reversal of midazolam with flumanezil was not required in any patient. Bag-mask ventilation was needed for all patients just before and after DC CV. It has been reported that ventilation with bag-valve mask is required in 1 of 500-1000 patients in sedations of patients without cardiac problems.[21-24] The fact that these patients were free of cardiac problems can explain being safer during sedation. It was reported that such respiratory support was not required in sedations applied to patients with recent onset AF (in the first 48 hours) who would undergo DC CV at the emergency department.[25] New onset and permenant AF have different effects on respiratory and haemodynamic situation, as permanent haemodynamic disturbances have yet not developed in new onset AF, long-standing AF aggravates this decompansation process and haemodynamic disturbances become permanent. We think that persistent AF cases require more respiratory support. Althought some authors reported that DC CV was performed safely without anaesthetic support, but our observations show that when applying deep sedation at an RSS level of 5-6 with fentanyl and midazolam for DC CV of persistent AF, all measures should be taken against respiratory depression and there should definitely be an anaesthetist in the team for risky airway management.

Conclusion

The study found that in the presence of an anaesthetist in the team, BIS monitoring did not contribute to decisions regarding anaesthetic drug dosage and the depth and quality of anaesthesia in patients with persistent AF during cardioversion.

Declaration

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