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INVESTIGATING THE EFFECTS OF THE INDUCTION AGENTS PROPOFOL AND THIOPENTAL ON AWARENESS DURING INTUBATION AND OPERATION IN GENERAL ANESTHESIA DURING CESAREAN SECTION

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Abstract

In addition to contributing to post-operative psychological disorders, awareness causes fear in patients undergoing surgery. In cesarean section operations, developing awareness due to low anesthetic procedures cause high risk in these patients. Thus, reducing awareness by maintaining and achieving the depth of anesthesia has become very important.

Forty patients undergoing caesarean section operation were divided into two groups. In the first (propofol) group, the induction of anesthesia was done by 2.5 mg/kg propofol and 0.6 mg/kg rocuronium. In the second (thiopental) group, anesthesia was induced by 5 mg/kg thiopental and 0.6 mg/kg rocuronium. In both groups after the baby was extracted, the anesthesia was maintained with desflurane. Patients' systolic and diastolic blood pressure, heart rate, Evans Score, and Bispectral Index (BIS) values were recorded every 5 minutes.

When two groups were compared in terms of awareness no significant difference was observed. However, despite BIS values being within the normal limits (<60), awareness values were high.

Many studies have shown that, for anesthesiologists, awareness is still a serious problem during the initial stages of application of general anesthesia. In this study, the comparison between propofol and thiopental did not show any significant differences, but although the BIS values were within normal limits the awareness values were high.

Keywords: Cesarean Delivery, Awareness, General Anesthesia, Thiopental, Propofol

1. Introduction

Awareness is a common problem associated with anesthesia during general anesthesia administration (Errando et al., 2008, Avidan et al., 2008). It can be defined as recalling intraoperative events during the postoperative period and often occurs as a result of the imbalance between amount of required anesthesia to stay unconscious and amount of administered anesthesia. Typically, patients remember somatic sensations, pain, noise, speech, or emotions anytime during planned complete amnesia (Leslie and Davidson 2010).

In addition to causing fear in patients undergoing surgery, awareness may lead to post-operative psychological disorders. Finding a reliable method for detecting or preventing awareness is important for clinical improvement

because there is no clear method of choice (Avidan et al., 2009). Generally, the incidence of awareness is 0.1-0.2% however, this rate increases in patients given the general anesthesia every year. The studies highlighted here were conducted with different anesthesia and operation types. Some reports involved only total intravenous studies, while others include N2O and muscle relaxants. In addition, some patients underwent elective general and gynecological surgeries, while others only had minor surgery. In a number of other studies, patients experiencing obstetric and cardiac surgery were evaluated.

It is a widely accepted opinion that in patients with cardiac surgery the risk of awareness is higher. In obstetric surgical patients, there is a tendency to be superficial in general anesthesia in order to avoid the depressing and lethargic effects of anesthetics on the newborn and on the uterine muscles of the mother (Ghoneim 2007a,Choi et al., 2012), which increases the incidence of awareness (0.4%) (Ghoneim 2007a). General anesthesia during a caesarean section is traditionally considered to have a high risk for awareness despite potent volatile anesthetic agents (Paech et al., 2008). Particularly, the most important moment is prior to the extraction of the baby (Choi et al., 2012). The risk factors in awareness are those that are associated with superficial anesthesia, those associated with the type of surgery, conditions associated with increased risk of anesthesia, women, young patients, and obesity. Conditions associated with superficial anesthesia are hypovolemia, low cardiac index, and difficult intubation predicted at early stage. The conditions associated with the type of surgery are obstetric patients, cardiac surgery, and trauma surgery (Ghoneim 2007a, Kaul and Bharti 2002). Meanwhile, the conditions that increase the requirement for anesthesia are history of awareness, chronic alcohol consumption, opioids, sedative hypnotics, acute use of amphetamines, and genetic resistance to the effects of anesthetic drugs (Ghoneim 2007a).

The major task of anesthesiologist is to provide enough anesthesia to prevent awareness, pain, and recall. This task is achieved by balanced application of analgesics, hypnotics, and amnestic drugs (Havadi et al., 2013).

Various definitions of anesthesia depth were described from time to time. In 1847, John Snow identified five stages of ether anesthesia. Later, Guedel rearranged them into four stages based on somatic muscle tone, respiratory parameters, and ocular findings. In 1954, Artusio divided Guedel's first stage into three. Then in 1957, Woodbridge defined the four major components of anesthesia: (1) sensory block, (2) motor block, (3) autonomic reflex block, and (4) unconsciousness. According to Prys-Roberts, a common feature of general anesthesia is suppression of the conscious perception on noxious stimulus. Consciousness can be divided into two categories, short-term and long-term. Short-term consciousness covers learning, decision-making, and access to information. Meanwhile, long-term consciousness covers the procedure for how to do something and declarative memory. Declarative memory, on the other hand, can be further divided into the somatic and episodic memory. Griffith and Jones both agreed that awareness consists of four parts: (1) conscious awareness with explicit recall, (2) conscious awareness without explicit recall, (3) subconscious awareness with implicit recall, and (4) no recall or awareness (Kaul and Bharti 2002).

Some different methods including spontaneous surface electromyogram, lower esophageal contractility, heart rate variability, electroencephalogram, and its derivatives have been used to assess the depth of anesthesia during different types of surgery. Hemodynamic parameters and subjective symptoms such as moving, sweating, and tearing are used as a routine approach to assess the depth of anesthesia. However, they are not specific and stringent enough (Kaul and Bharti 2002, Havadi et al., 2013). Several studies since 1977 have been used the Bispectral Index (BIS), which is stringent enough to evaluate the depth of anesthesia. A previously published report has demonstrated the effectiveness and specificity of BIS in detecting superficial anesthesia when combined with the electroencephalogram application

(Havadi et al., 2013). The monitor working principle of BIS is analyzing burst suppression, spectral power of bandwidth, and bispectral coherence properties based on the electroencephalogram properties. A special algorithm for BIS refers to the depth of anesthesia by numeric values from 100 (fully awake) to 0 (isoelectric) and combines these features. Determining the sedation level and the concentration of anesthetic by BIS monitoring has been reported to be a top priority in many studies (Mashour et al., 2009). BIS monitoring scale can be evaluated using the following criteria: 0 = no cortical activity or coma, 40-60 = unconsciousness and general anesthesia, 60-70 = deep sedation, 70-95 = mild or moderate sedation, 95-100 = awake (Samchai 2012).

One of the most widely used scoring systems when monitoring the depth of anesthesia is Evans scoring system (Kaul and Bharti 2002). Here the scoring system is based on the patient's response to surgical stimulus (PRST). Autonomic activities such as systolic blood pressure, heart rate, sweating, and tearing are evaluated using Evans scoring system (Kaul and Bharti 2002, Somchai 2012).

In our study, we aimed to investigate differences between the use of propofol and thiopental in terms of awareness in patients undergoing cesarean section operation. We used subjective assessments such as hemodynamic parameters, tearing, sweating, and specific assessment such as BIS monitoring.

2. Materials and Methods

Erzincan University Ethics Committee approved our study on 17.12.2012, No: 3/1.

Our study included 40 patients between the ages of 20-40 with ASA I-II (American Society of Anesthesiology Risk Classification) risk group undergoing cesarean section under general anesthesia in the operating rooms of Department of Anesthesiology and Reanimation at Mengücek Gazi Teaching and Research Hospital. The following patients were excluded from the study: patients who did not consent, who were not cooperative, patient with mental and psychiatric disorders, allergies to used drugs, renal and hepatic impairment, alcohol and drug abuse, with known cerebral disease and hypertension. Patients were starved for 8 hours before the operation. The crystalloid infusion at a rate of 2 mL/kg/h was started from the vascular opening in the forearm. Patients were randomly divided into two equal groups of 20.
For group 1 (propofol group) 2.5mg/kg propofol and 0.6mg/kg rocuronium bromide was administered at induction.
For group 2 (thiopental group) 5mg/kg thiopental sodium and 0.6mg/kg rocuronium bromide was administered at induction.

In both groups, patients were ventilated for at least 2 minutes by giving 100% O2 with a face mask during induction of anesthesia. Patients were continued to be given 100% O2 after intubation. After extracting the baby, patients were given 50% O_2, 50% N_2O and 4-6% desflurane.

After the patients were taken into the operating room, they were monitored for hemodynamic parameters. Their Non-Invasive Arterial Blood Pressure (NIBP) systolic and diastolic, heart rate, SpO2, and BIS measurements were taken before the intubation, during the induction and intubation, and every 5 minutes after the intubation on 1st, 5th, 10th, 15th and 20th minutes. Evans Score (Table 1) were recorded. In our study, we used BIS™ Complete 2-Channel Monitor (Covidien, USA) for BIS monitoring. The Evans score was assessed immediately after the intubation.

At the beginning of operation, patients were given an infusion of Ringer Lactate with 5% dextrose solution. The infusion was limited to 500 ml in the first 20 minutes. Patients did not require additional muscle relaxants. Moreover, patients did not need additional analgesic during the time when measurements were taken. One hour after the patients were woken up and 24 hours after the operation, patients were asked if they had remembered something about surgery.

Table 1. Evans Score

	Systolic Blood Pressure	
	< Control + 15	0
	< Control + 30	1
	> Control + 30	2
	Heart Rate	
	< Control + 15	0
	< Control + 30	1
	> Control + 30	2
	Sweating	
	Nil	0
	Skin moist	1
	Visible beads of sweat	2
	Tearing	
	No excess tears in open eyes	0
	Excess tears in open eyes	1
	Tears over flowing	2

2.1. Statistical analyses

All data was transferred to a computer environment and SPSS v17 software package was used for statistical analysis. Descriptive statistics such as frequency, mean and standard deviation were used for data analysis. A non-parametric Mann-Whitney U test was used for independent comparisons, while Wilcoxon Signed Ranks test for dependent comparisons. In addition, Chi-square test was used for cross comparison.

3. Results and Discussion

The study included patients undergoing cesarean section operation under the general anesthesia in Mengücek Gazi Teaching and Research Hospital between December 2012-November 2013. A total of 40 pregnant patients within the ASA I-II risk group between the ages of 2-40 were included in the study. Patients were divided into two groups of 20 patients. The first group was planned to be administered with 5mg/kg thiopental and 0.6mg/kg rocuronium at the induction, while the second group was administered 2.5 mg/kg propofol and 0.6 mg/kg rocuronium.

3.1. The comparison of hemodynamic parameters between the groups

Table 2: The comparison of systolic arterial pressure (independent test).

SYSTOLIC BLOOD PRESSURE	PROPOFOL GROUP		THIOPENTAL GROUP		p
	MEAN	STANDART DEVIATION	MEAN	STANDART DEVIATION	
PRE-INTUBATION	118.35	15.104	117.25	15.831	0.892
DURING INDUCTION	93.60	20.643	94.90	13.412	0.625
DURING INTUBATION	106.40	12.072	112.30	11.895	0.061
1 MIN AFTER INTUBATION	112.55	17.062	119.00	9.559	0.013*
5 MIN AFTER INTUBATION	112.30	12.044	110.10	10.528	0.514
10 MIN AFTER INTUBATION	116.50	8.793	113.50	9.451	0.328
15 MIN AFTER INTUBATION	115.70	12.774	116.90	7.159	0.745
20 MIN AFTER INTUBATION	121.20	8.643	117.05	9.923	0.277

***p<0.001, **p<0.01, *p<0.05

The patients from the propofol group and thiopental group differed only in systolic blood pressure measured 1 min after the intubation. The systolic pressure 1 min after the intubation was higher in the thiopental group.

Table 3: The comparison of systolic arterial pressure with pre-induction parameters (dependent test)

SYSTOLIC BLOOD PRESSURE	PROPOFOL GROUP	THIOPENTAL GROUP
	p	p
PRE-INTUBATION DURING INDUCTION	0.000***	0.000***
PRE-INTUBATION DURING INTUBATION	0.006**	0.086
PRE-INTUBATION 1 MIN AFTER INTUBATION	0.191	0.368
PRE-INTUBATION 5 MIN AFTER INTUBATION	0.143	0.006**
PRE-INTUBATION 10 MIN AFTER INTUBATION	0.654	0.085
PRE-INTUBATION 15 MIN AFTER INTUBATION	0.501	0.810
PRE-INTUBATION 20 MIN AFTER INTUBATION	0.499	0.881

***p<0.001, **p<0.01, *p<0.05

For the propofol group there was a difference in terms of systolic arterial pressure between pre-intubation-intubation period and pre-intubation- during intubation period. For thiopental group there was a difference pre-intubation-induction period and pre-intubation-5 min after intubation.

Table 4: The comparison of diastolic arterial pressure (independent test)

DIASTOLIC BLOOD PRESSURE	PROPOFOL GROUP		THIOPENTAL GROUP		p
	MEAN	STANDART DEVIATION	MEAN	STANDART DEVIATION	
PRE-INTUBATION	67.85	9.410	71.25	9.947	0.302
DURING INDUCTION	55.30	11.974	55.65	7.982	0.211
DURING INTUBATION	57.20	9.956	62.40	7.415	0.023*
1 MIN AFTER INTUBATION	60.80	10.744	65.70	6.122	0.034*
5 MIN AFTER INTUBATION	61.20	8.269	63.10	7.391	0.550
10 MIN AFTER INTUBATION	66.80	9.412	63.10	5.812	0.255
15 MIN AFTER INTUBATION	65.00	8.105	64.70	5.027	0.913
20 MIN AFTER INTUBATION	67.00	7.356	65.25	6.703	0.514

***p<0.001, **p<0.01, *p<0.05

Patients from the propofol and thiopental groups differed in diastolic blood pressure measured during the intubation and 1 minute after the intubation. In addition, in the thiopental group diastolic blood pressures differed during the intubation and 1 minute after the intubation.

Table 5: The comparison of diastolic blood pressure with pre-induction parameters (dependent test).

DIASTOLIC BLOOD PRESSURE	PROPOFOL GROUP	THIOPENTAL GROUP
	p	p
PRE-INTUBATION DURING INDUCTION	0.000***	0.000***
PRE-INTUBATION DURING INTUBATION	0.000***	0.001**
PRE-INTUBATION 1 MIN AFTER INTUBATION	0.030*	0.002**
PRE-INTUBATION 5 MIN AFTER INTUBATION	0.003**	0.000***
PRE-INTUBATION 10 MIN AFTER INTUBATION	0.627	0.006**
PRE-INTUBATION 15 MIN AFTER INTUBATION	0.278	0.018*
PRE-INTUBATION 20 MIN AFTER INTUBATION	0.711	0.006**

***p<0.001, **p<0.01, *p<0.05

In the propofol group there was differences in diastolic blood pressure pre-induction-intubation, pre-intubation-1 minute after the intubation and pre-intubation- 10 min after the intubation. In the thiopental there is a difference for of the groups.

Table 6: Heart rate (independent test)

HEART RATE	PROPOFOL GROUP		THIOPENTAL GROUP		p
	MEAN	STANDART DEVIATION	MEAN	STANDART DEVIATION	
PRE-INTUBATION	102.70	14.090	106.05	10.480	0.316
DURING INDUCTION	121.60	13.481	114.60	11.754	0.116

DURING INTUBATION	118.40	9.832	118.50	12.116	0.828
1 MIN AFTER INTUBATION	119.70	14.568	118.00	13.510	0.588
5 MIN AFTER INTUBATION	103.10	8.891	96.10	13.722	0.158
10 MIN AFTER INTUBATION	90.00	10.829	83.60	13.597	0.193
15 MIN AFTER INTUBATION	89.70	9.102	75.50	9.703	0.000***
20 MIN AFTER INTUBATION	87.80	6.469	79.30	7.665	0.000***

***p<0.001, **p<0.01, *p<0.05

Patients from the propofol and thiopental groups differed in terms of heart rate at 15 minutes after the intubation and 20 min after the intubation. The mean heart rate values of the propofol group were higher than those of the thiopental group.

Table 7: The Comparison of Heart Rate with Pre-induction Parameters (dependent test)

HEART RATE	PROPOFOL GROUP	THIOPENTAL GROUP
	p	p
PRE-INTUBATION DURING INDUCTION	0.000***	0.000***
PRE-INTUBATION DURING INTUBATION	0.001**	0.000***
PRE-INTUBATION 1 MIN AFTER INTUBATION	0.000***	0.006**
PRE-INTUBATION 5 MIN AFTER INTUBATION	0.777	0.001**
PRE-INTUBATION 10 MIN AFTER INTUBATION	0.000***	0.000***
PRE-INTUBATION 15 MIN AFTER INTUBATION	0.004**	0.000***
PRE-INTUBATION 20 MIN AFTER INTUBATION	0.001**	0.000***

***p<0.001, **p<0.01, *p<0.05

For the propofol group, there was always a difference in heart rate values except for before the intubation and 5 minutes after intubation. For the thiopental group there was a difference in all times.

3.2. The Comparison of BIS Values Between the Groups

Table 8: The comparison of BIS values (independent test)

BIS VALUE	PROPOFOL GROUP		THIOPENTAL GROUP		p
	MEAN	STANDART DEVIATION	MEAN	STANDART DEVIATION	
PRE-INTUBATION	97.60	1.429	98.00	1.589	0.334
DURING INDUCTION	51.40	8.450	50.00	4.565	0.733
DURING INTUBATION	49.45	4.559	53.10	9.095	0.008**
1 MIN AFTER INTUBATION	47.95	5.596	54.95	8.953	0.001**
5 MIN AFTER INTUBATION	49.40	7.308	55.25	8.271	0.013*
10 MIN AFTER INTUBATION	46.50	10.952	53.60	7.007	0.014*
15 MIN AFTER INTUBATION	50.60	3.747	51.80	6.918	0.232
20 MIN AFTER INTUBATION	52.00	5.272	53.65	7.140	0.251

***p<0.001, **p<0.01, *p<0.05

Patients from the propofol group differed from the thiopental group in terms of BIS values during intubation, 1 min, 5 min and 10 min after the intubation. The BIS values were higher in the thiopental group.

Table 9: The Comparison of BIS values with Pre-induction Parameters (dependent test)

BIS VALUES	PROPOFOL GROUP	THIOPENTAL GROUP
	p	p
PRE-INTUBATION DURING INDUCTION	0.000***	0.000***
PRE-INTUBATION DURING INTUBATION	0.000***	0.000***
PRE-INTUBATION 1 MIN AFTER INTUBATION	0.000***	0.000***
PRE-INTUBATION 5 MIN AFTER INTUBATION	0.000***	0.000***
PRE-INTUBATION 10 MIN AFTER INTUBATION	0.000***	0.000***
PRE-INTUBATION 15 MIN AFTER INTUBATION	0.000***	0.000***
PRE-INTUBATION 20 MIN AFTER INTUBATION	0.000***	0.000***

***p<0.001, **p<0.01, *p<0.05

In the propofol group as well as in the thiopental group, there were differences in all pre-induction parameters.

3.3. The Comparison Between Groups in Terms of Recall on 1st and 24th Hour

Table 10: Postoperative 1st hour recall (chi square)

POSTOPERATIVE 1ST HOUR		No recall	Recall	Total
PROPOFOL GROUP	n	18	2	20
	%	90.0%	10.0%	100.0%
THIOPENTAL GROUP	n	15	5	20
	%	75.0%	25.0%	100.0%
Total	n	33	7	40
	%	82.5%	17.5%	100.0%

Fisher's Exact Test p=0.407>0.05

At postoperative 1st hour, there was no difference between propofol and thiopental groups in terms of recall. However, patients' recall rates were high. These patients were the ones who have previously undergone operations.

There was no difference between the propofol and thiopental groups in terms of recall at postoperative 24th hour. However, recall rates were high in patients. These patients were the ones who have previously undergone operations.

Table 11: Postoperative 24th hour recall (chi square)

POSTOPERATIVE 24TH HOUR		No recall	Recall	Total
PROPOFOL GROUP	n	17	3	20
	%	85.0%	15.0%	100.0%
THIOPENTAL GROUP	n	13	7	20
	%	65,0%	35.0%	100.0%
Total	n	30	10	40
	%	75.0%	25.0%	100.0%

Yates Chi-Square=1.200, p=0.273>0.05

Table 12: The comparison between recall at postoperative 1st and 24th hour (dependent test)

POSTOPERATIVE		PROPOFOL GROUP	THIOPENTAL GROUP
		p	p
POSTOPERATIVE 1st HOUR	POSTOPERATIVE 24th HOUR	0.564	0.414

***p<0.001, **p<0.01, *p<0.05

There was no difference between propofol and thiopental groups in terms of recall at postoperative 1st and 24th hours.

3.4. The Evaluation of the Evans Score

Table 13: Evans Score

	PROPOFOL GROUP		THIOPENTAL GROUP		p
	MEAN	STANDART DEVIATION	MEAN	STANDART DEVIATION	
EVANS SCORE	2.10	1.586	2.65	1.785	0.329

***p<0.001, **p<0.01, *p<0.05

The Evans score of patients from the propofol group was not different from that of thiopental group patients. There was no significant difference between groups in terms of SpO_2 values.

It is a noticeable trend, that despite the availability of regional anesthesia, many countries still perform the cesarean section under general anesthesia. Many of these patients are afraid of the probability of injection on the waist or staying awake during major abdominal surgery. Regional anesthesia may not be the best method for some patients with specific medical problems or other contraindications. Many different studies have reported that the common experience of unpleasant dreams and awareness values ranging from 0.13-7% to 17% during cesarean section under general anesthesia (Hadavi et al., 2013). The predisposing factors for awareness are female gender, young age, smoking, severe obesity, and the absence of premedication. Therefore, the high incidence of awareness in cesarean section operations might be due to these predisposing factors (Ghoneim 2007a, Czarko et al., 2013). In a literature study,

Ghoneim suggested that superficial anesthesia might be the reason for very commonly seen awareness. Yet in another study, Ghoneim and his colleagues reported the same reason for commonality of awareness (Ghoneim 2007a, Ghoneim 2007b). Robins et al. stated that in average inadequate anesthesia the occurrence of awareness would not be possible without average superficial anesthesia and negligence. Furthermore, although one study has reported that in patients undergoing cesarean section under the general anesthesia routine monitoring of brain function leads to 82% reduction of the incidence of awareness it is still controversial. However, low BIS score does not guarantee unconsciousness. No studies have been conducted on whether routine monitoring of brain function in specific general anesthesia settings during caesarean section reduce the incidence of awareness (Robins and Lyons 2009). However Myless et al. (2004) reported that in application of BIS-guided muscle relaxant general anesthesia in adult patients the risk of awareness reduces and that the use of routine BIS also reduces the cost. O'Connor et al. have indicated that although BIS monitoring decreases the risk of awareness, based on its use it may be difficult to extrapolate on costs justifications (O'Connor et al., 2001).

Kim et al. (1995) demonstrated that patients undergoing caesarean section, where either thiopental-ketamine or propofol were used, indicated that unpleasant recall and high rates of maternal awareness without neonatal depression were associated with the induction agent. In this work, the monitored the depth of anesthesia by using isolated forearm technique. In our study, the rates of maternal awareness were also high (25%).

Czarko et al. (2013) in their study with patients undergoing cesarean section and gynecological procedures compared four groups of patients. Group A consisted of patients undergoing gynecological operations with cisatracurium and target-controlled infusion of propofol and remifentanil. Group B consisted of patients undergoing gynecological operations with thiopental, fentanyl and cisatracurium induction, and sevoflurane during maintenance. Group C had patients undergoing short-term gynecological operations with propofol, fentanyl induction, and sevoflurane during maintenance. Group D consisted of patients undergoing cesarean section with thiopental, suxamethonium, fentanyl and cisatracurium induction. The authors concluded that, despite the common occurrence of awareness in patients with previous experience who were undergoing caesarean section under the general anesthesia, the occurrence of intraoperative awareness was still rare. In our study, almost all of the patients who developed awareness had undergone caesarean section or another operation in the past.

Hadavi et al. (2013) have done BIS monitoring, blood pressure measurement, heart rate and body temperature measurements and used thiopental and suxamethonium at the induction, midazolam and fentanyl after the baby extraction and atracurium when in need for muscle relaxants in patients undergoing caesarean section. They reported that the average BIS values were below 70, hemodynamic parameters increased during laryngoscopy and intubation, and that none of the patients had experienced awareness or recall. In our study, both groups demonstrated systolic blood pressure and diastolic blood pressure level drops that were significant during induction and during intubation, whereas the heart rate increased significantly. However, the awareness levels were high in both groups.

Beck et al. (2006) compared the depth of anesthesia achieved by propofol and thiopental during the intubation reported that none of the patients recalled anything 24 hours later and concluded that thiopental is favorable in terms of reaching a comfortable level of anesthesia, although propofol can be used as an alternative . However, in their study they evaluated patients who underwent various surgical procedures. In our study, at 1st hour the recall in the propofol group was 10%, while in the thiopental group it was 25%. The recall at 24th hour in the propofol group was 15%, while in the thiopental group it was 35%. When the recall rates of the 1st and 24th hours were compared there was no significant difference between propofol and thiopental groups.

Wanna et al. (2004) compared propofol and ketamine for induction in cesarean section and found that in ketamine group the systolic and diastolic blood pressures increased 10-25% during intubation, induction, skin incision and courts clamping, while in propofol group there was an increase only in the heart rate. The awareness, nightmares and psychotomimetic side effects were unprecedented for ketamine, while the postoperative nausea and vomiting, unpleasant light sleep were not seen very often. As a result, it was suggested that propofol and ketamine could be used as an alternative to thiopental as induction agents. Similarly, our study had no significant superiority of propofol and thiopental over each other. However, only in the propofol group the decrease in the systolic and diastolic blood pressures during induction was more pronounced.

Sie et al. (2004) also compared propofol and thiopental as induction agents and reported that risk of awareness increased if the intubation is delayed or prolonged (20). In that study, they evaluated various surgical patients.
Furthermore, Celleno et al. (1993) compared thiopental, propofol, and midazolam as induction agents in cesarean section and stated that thiopental was still the first choice for induction in cesarean section. They also indicated that midazolam had a long induction period and that propofol and midazolam might have a risk of potential neonatal depression and maternal awareness. In our study, we did not observe a significant difference between thiopental and propofol in terms of the risk of awareness.

Kuizenga et al. (2001) evaluated biphasic EEG changes in unconsciousness with thiopental, propofol, etomidate, midazolam and sevoflurane used for induction. They reported that thiopental, propofol, etomidate, and sevoflurane caused a biphasic EEG effects during the transition period from the conscious to unconscious state, however they haven't observe such effects with midazolam. The authors suggested the reason for this might be the continuous increase of the concentration of hypnotic drugs.

Massahel and Gregorio (2007) used BIS in their study of the depth of anesthesia and awareness and suggested that in patients undergoing surgery, pre-and intraoperative anesthetic care, convenience of BIS monitoring owned by modern anesthesia units, anesthetic gases and good anesthesia preparation is a key combination in eliminating awareness during the surgery. In comparison our study consisted of patients undergoing cesarean section, therefore they were not well prepared and most of the patients underwent emergency operation that resulted in the high awareness rates.

Furthermore, Murdoch et al. (2012) in their study regarding the selection of anesthetic agents in cesarean surgeries reported that thiopental decreased the awareness by 31% and that it was the first choice induction agent in the United Kingdom and suggested that propofol might also be used in the induction. In our study none of the drugs had superiority over each other in terms of awareness.

Mercan et al. (2012) investigated the effects of propofol and thiopental on BIS values in cesarean section patients and reported that patients administered with propofol had lower heart rate, blood pressure and BIS values before extraction of the baby compared to patients administered with thiopental.

In a prospective cohort study Ekman et al. (2004) stated that BIS monitoring significantly decreased the incidence of awareness. In our study, both groups had a high risk of awareness. Although BIS values were found to be high they were within the desired limits. Consistent with previous studies, we suggest that correlation between development of unconsciousness and awareness cannot be established or that high awareness rates might be due to previous experience with anesthetics.

Lastly, Paech et al. (2008) investigated the relationship between general anesthesia in cesarean section and recall and awareness and reported that intraoperative recall and awareness were important complications but stated that they could be prevented.

4. Conclusion

In our study, no significant differences were found in the comparison of awareness between the propofol and thiopental groups. In addition, our studies suggest that the depth of anesthesia in both groups was not sufficient to reduce awareness.

Many studies have reported that today awareness is still a serious problem for anesthesiologists during the initial application of general anesthesia. Although many studies have been conducted for detection and prevention of awareness, it could not be accurately achieved, yet there are studies that are working to reduce the incidence. In our study, the incidence of awareness was high. We suggest that the reasons for that might be that majority of our patients underwent emergency surgery and had a history of previous surgeries. Considering late effects created by awareness greater efforts for reducing the awareness would be worth studying. Nowadays, in order to prevent awareness, the depth of anesthesia is provided based on hemodynamic parameters and BIS monitoring, but it appears that these parameters are not sufficient. It should be noted that with the present methods of anesthesia awareness cannot be fully avoided and there is a need for many more studies and methods regarding this subject until an obvious consensus and solution is presented.

5. References

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