CHANGES IN INTRAOCULAR PRESSURES DURING LAPAROSCOPY: A COMPARISON OF PROPOFOL TOTAL INTRAVENOUS ANESTHESIA TO DESFLURANE-THIOPENTAL ANESTHESIA

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Abstract

The aim of the study was to examine intraocular pressure (IOP) changes during laparoscopic cholecystectomy performed under either desflurane-thiopental anesthesia or propofol total intravenous anesthesia (TIVA).

36 patients who will undergo elective laparoscopic cholecystectomy were enrolled in the study. The patients were randomly divided into one of two groups: desflurane (Group D, n=18) or propofol (Group P, n=18). All patients received fentanyl 2 micro/kg IV, and then breathed 100% oxygen for 3 minutes prior to induction of anesthesia. Anesthesia was induced by using thiopental 5 mg/kg IV in Group D and 2 mg/kg IV propofol in group P. Neuromuscular block was achieved with rocuronium 0.6 mg/kg IV. Anesthesia was maintained with desflurane 3-6% in group D and propofol infusion 5-10 mg/kg/h in group P. Desflurane and propofol concentrations were adjusted to maintain mean arterial pressure witihin 20% of the preinduction value. During anaesthesia, fractionated doses of fentanyl 0.5-1 µg /kg IV and maintenance doses of muscle relaxants were used. In both groups, the the mixture 60% nitrous oxide and 40% oxygen was administered used. Arterial pressure, heart rate, $ETCO_2$, SpO2 and IOP were recorded at the predefined time points.

Creation of pneumoperitoneum resulted in a significant increase in IOP which remained elevated throughout the operation in both groups. Also, we recorded a similar IOP changes with both techniques except at five minutes after pneumoperitoneum in 15° reverse Trendelenburg position during desflurane-thiopental anesthesia.

In conclusion, desflurane-thiopental anesthesia maintains the IOP at least at similar levels compared to propofol TIVA anesthesia.

Key words: intraocular pressure (IOP), laparoscopy, desflurane, propofol.

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Introductıon

Compared to traditional open surgery, laparoscopic surgery (LS) is associated with less postoperative pain, less scaring, less trauma, fewer complications, shorter hospital stays and reduced risk of infection[1]. Despite these advantages, LS is associated with an increase in intraperitoneal pressure and many other physiological changes that tend to increase the intraocular pressure[2,3]. Despite the fact that the use of propofol and the new low solubility inhalation anesthetics lead to faster induction and recovery[4], propofol was found to reduce the intraocular pressure in an independent way from the changes in arterial blood pressure or heart rate[5].

Our purpose was to investigate IOP changes during laparoscopic cholecystectomy (LC) under either desflurane-thiopental or total IV propofol anesthesia (TIVA).

Methods

After the study protocol had been approved by the local ethical commitee, writen informed consent was obteined from 36 ASA physical status I or II inpatients aged 18-65 yr scheduled to undergo elective laparoscopic cholecystectomy. Patients with previous eye disease, ophthalmic surgery, history of diabetes mellitus, hypertension, known allergy to the anesthetic drugs and anticipated difficult intubation were excluded. All patients were premedicated with 0.04 mg/kg of IV midazolam 3 minutes before the start of anesthesia.

The patients were randomly divided into one of two groups: desflurane (Group D, n=18) or propofol (Group P, n=18). All patients received fentanyl 2 micro/kg IV, and then breathed 100% oxygen for 3 min prior to induction of anesthesia. Anesthesia was induced by using thiopental 5 mg/kg IV in Group D and 2 mg/kg IV propofol in group P. Neuromuscular block was achieved with rocuronium 0.6 mg/kg IV. Controlled mechanical ventilation was applied to maintain endtidal CO_2 between 35-45 mmHg. Anesthesia was maintained with desflurane 3-6% in group D and propofol infusion 5-10 mg/kg/h in group P. Desflurane and propofol concentrations were adjusted to maintain mean arterial BP witihn 20% of the preinduction value. During anesthesia, fractionated doses of fentanyl 0.5-1 µg /kg and maintenance doses of muscle relaxants were used. In both groups, the mixture 60% nitrous oxide and 40% oxygen was administered using a semiclosed flow circle system. The flow rate of fresh gases was 3 L/ min. Lactated Ringer’s solution 4-6 ml/kg/h was given IV throughout surgery.

The abdomen is insufflated with CO_2 to achieve a pneumoperitoneum pressure of 15 mmHg while the patient in the supine position. Patients were then placed in the 15° reverse Trendelenburg (head up) position. Systemic arterial pressure including the systolic, diastolic and mean arterial pressure (MAP), heart rate, SpO2, Et CO_2 and IOP (using a Shioetz tonometer) were recorded at the following points of time:

T1: One minute after endotracheal intubation.

T2: Five minutes after pneumoperitoneum in supine position.

T3: Five minutes after pneumoperitoneum in 15° reverse Trendelenburg position.

T4: 10 minutes after pneumoperitoneum in 15° reverse Trendelenburg position.

T5: 20 minutes after pneumoperitoneum in 15° reverse Trendelenburg position.

T6: After the pneumoperitoneum resolution in supine position.

T7: Just before tracheal extubation.

IOPs were measured with a Schiotz tonometer. The tonemeter was calibrated before each reading. In each patient, IOP was measured by 5.5 scale of Schiotz tonometer, and the average of the two measurements was calculated for each eye; the mean of the IOPs for both eyes was used as the patient's IOP.

A preliminary estimate of sample size was based on the previous studies, which was defined as the IOP. Using data from the previous studies, we calculated that a sample size of 16 patients per group would have 90 % power at 5% significance level to detect a difference in IOP of 3 mm Hg among groups with two sided significance testing. We planned to include 36 patients in this study to allow for dropouts.

Statistical analysis of our study was made by using SPSS 13 software. Wilcoxon Signed Ranks test was used for intra-group comparisons, and Mann

Whitney U test for inter-group comparisons. $P<0.05$ was considered to be significant.

Results

Four patients were withdrawn from the propofol group: two because the proposed laparoscopic cholescystectomy surgery was converted to open cholecystectomy and two because the standard anesthetic protocol was not followed. Aside from these four patients, 32 patients completed the anlysis.

Demographic profile, duration of surgery and anesthesia were similar in the both groups (Table 1). There was no statistically significant difference between both groups regarding mean arterial pressure, systolic blood pressure, diastolic blood pressures and end tidal carbon dioxide (Table 2 and Table 3). Figure 1 demonstrates the IOP changes between and within the two groups at measurement points. No significant differences in IOP changes were found between the groups except at time T3: IOP was significantly higher in Group P than in Group D (Group P versus Group D, $P<0.05$) (Figure 2). After the creation of pneumoperitoneum, IOP increased and remained significantly elevated at time points T2, T3, T5 compared with T1 in each group ($p<0,05$). IOP at T6 and T7 were also significantly higher than T1 in both groups.

Table 1

Demographic data, duration of surgery and anesthesia

	Desflurane Group n=18	Propofol Group n=14	P Value
Age (year)	46.33±11.32	49.57±9.93	0.404
Duration of surgery (minute)	52.83±27.47	50.50±29.63	0.819
Duration of anesthesia (minute)	61.50±29.827	59.92±24.11	0.874
Sex (F/M)	13/5	8/6	-

Data are mean±SD

* Abbreviations used are: T1, 1 min after endotracheal intubation; T2, 5 min after pneumoperitoneum; T3, 5 minutes after tilting into 15° reverse Trendelenburg position; T4, 10 min beginning of 15° reverse Trendelenburg position; T5, 20 min after the beginning of 15° reverse Trendelenburg position;T6, after the pneumoperitoneum resolution; T7, just before tracheal extubation; MAP, mean arterial pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; $ETco_2$,, end tidal carbon

Table 2

Hemodynamic Changes Of Poropofol Group During Laparoscopic Surgery

Time	T1	T2	T3	T4	T5	T6	T7
MAP, mmHg	100±19	107±21	106±11	103±16	105±11	102±17	108±18
SBP, mmHg	138±22	146±32	141±24	136±23	142±24	139±29	146±27
DBP, mmHg	83±18	89±17	88±9	84±15	86±9	82±15	90±14
$ETco_2$, mmHg	35±0.4	35±4	36±5	35±4	36±5.8	36±4.2	40±5

Hemodynamic changes were measured in Propofol Group. Data are mean±SD.

Table 3

Hemodynamic Changes Of Desflurane Group During Laparoscopic Surgery

Time	T1	T2	T3	T4	T5	T6	T7
MAP, mmHg	105±15	102±19	104±16	103±16	103±16	100±14	104±14
SBP, mmHg	141±21	141±29	140±24	139±23	138±25	137±24	144±17
DBP, mmHg	89±15	87±16	85±15	84±15	82±13	78±11	88±15
$ETco_2$, mmHg	35±2.4	36±4	37±5	35±4	37±4	36±3	36±7

Hemodynamic changes were measured in Desflurane Group. Data are mean±SD.

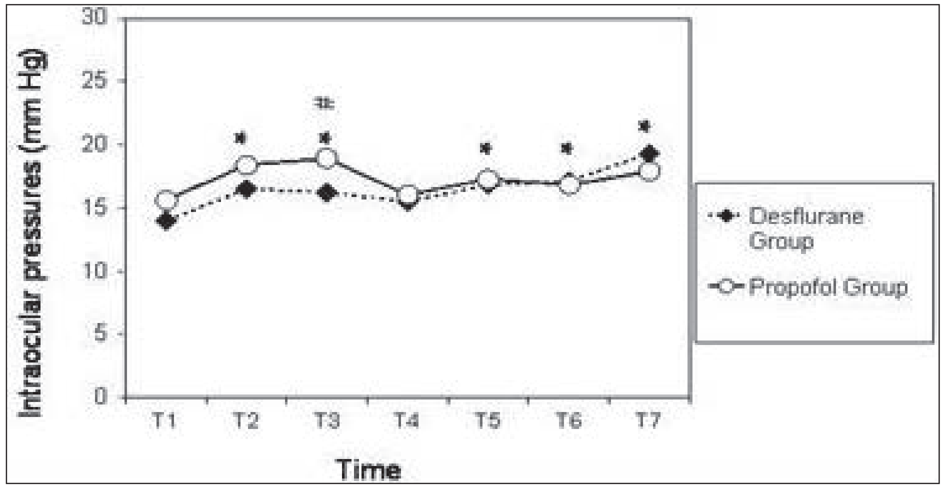

Fig. 1
Changes in intraocular pressure in the desflurane and propofol groups

dioxide.

* Abbreviations used are: T1, 1 min after endotracheal intubation; T2, 5 min after pneumoperitoneum; T3, 5 minutes after tilting into 15° reverse Trendelenburg position; T4, 10 min beginning of 15° reverse Trendelenburg position; T5, 20 min after the beginning of 15° reverse Trendelenburg position;T6, after the pneumoperitoneum resolution; T7, just before tracheal extubation; MAP, mean arterial pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; ETco_2,, end tidal carbon dioxide.

Intraocular pressures were measured in the both groups, 1 min after endotracheal intubation (T1), 5 min after pneumoperiotoneum (T2), 5 minutes after tilting into 15° reverse Trendelenburg position (T3), 10 min (T4) and 20 minutes (T5) after the beginning of 15° reverse Trendelenburg position, after the pneumoperitoneum resolution (T6), just before tracheal extubation (T7).

* P<0.05, as compared to T1 within the groups.

# P<0.05, between the groups.

Discussion

We conducted a prospective, randomized clinical study to compare the effects of desflurane and propofol on IOP in patients undergoing LC. As

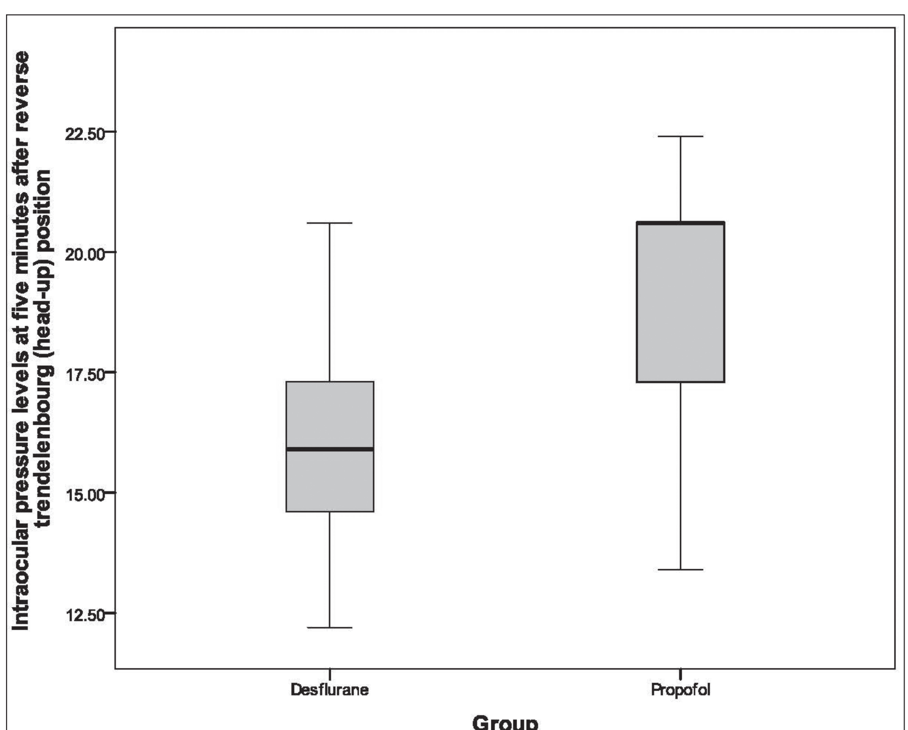

Fig. 2
Intraocular pressure levels at 5 minutes after reverse trendelenburg (head-up) position

the results showed, creation of pneumoperitoneum resulted in a significant increase in IOP and remained elevated throughout the whole operation regardless of anesthetic techniques used. Also, we recorded a similar IOP changes with both techniques except at time T3, which might be an advantage of desflurane-thiopental anesthesia. This could be due to the long duration of action of thiopental induction compared to propofol induction.

We used thiopental and desflurane in group D since thiopental induction and maintenance with an inhalational agent is one of the most widely used anesthetic regimen. Also, desflurane is a volatile anesthetic with a low blood-gas solubility coefficient. Recovery is more rapid[4] than other potent inhalation anesthetic agents and comparable with propofol[6]. Limited data suggest that it is also useful as propofol for the maintanence of IOP during anesthesia[6]. To our knowledge, there have been no pubished studies assesing the influence of desflurane on IOP in humans undergoing LC.

IOP is influenced by many factors. Coughing, straining, vomiting, laryngoscopy, intubation, extubation can lead to an increase in IOP[7,8]. In fact, the major factor in determining IOP changes acutely is the episcleral pressure, which is determined by central venous presseure (CVP)[8]. Laparoscopic surgery tend to a further increase in IOP resulting from intrathoracic pressure increase and postural changes, which lead to rise in CVP[2]. In addition to CVP, blood pressure, ETCO2, pneumoperitoneum are also the other factors that seem to have a clear impact on IOP rise[9]. However, most induction agents and all inhalation anesthetic agents reduce IOP in poroportion to the depth of anesthesia, by mainly central control mechanism[6,8]. Its well known that propofol decreases IOP by inhibiting somatodendritic AVP release from the supraoptic nucleus during laparoscopy[2]. Previous studies have shown decrease in IOP between 65% and 29% whether propofol alone or in combination with remifentanil and succincylcholine[7]. Reader J.C. et al. found that desflurane provides less expensive and faster recovery in cholecystectomy operations. However, propofol was found to cause less pain and nausea in the recovery unit[10].

A principal criticism of our study is that we did not include any measurement of IOP before the induction of anesthesia (because of ethical constraints), so that we accepted the baseline values of IOP as one minute after the intubation. It could be argued that the increases in IOP we observed were caused by the decrease of IOP due to induction of anesthesia. We believe this to be unimportant because, the purpose of this study was to ascertain to compare desflurane-thiopental anesthesia versus propofol anesthesia on IOP during LC.

In conclusion, desflurane- thiopental anesthesia appears to be a useful alternative to propfol-tiva anesthesia for maintenace of IOP during LC.

Acknowledgment

The study was approved by the Ethics Comittee of Antalya Education and Research Hospital (Reference No:85/15/06).

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