The Comparison of Sevoflurane-Remifentanyl and Propofol-Remifentanyl in Robotic Prostatectomies

Robotik Prostatektomilerde Sevofluran-Remifentanil ile Propofol-Remifentanil'in Karşılaştırılması

Robotik Radikal Prostatektomilerde Anestezi / Anaesthesia for Robotic Radical Prostatectomies

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Özet

Amaç: Robotik cerrahi, radikal prostatektomilerde gittikçe yaygın ve etkin bir şekilde kullanılmaktadır. Robotik cerrahi olgularında standart bir anestezi yöntemi olmayıp hem inhalasyon hem de intravenöz anestezikler kullanılmaktadır. Çalışmamızda radikal prostatektomilerde dengeli genel anestezi (DGA) ve total intravenöz anestezi (TiVA)'nin klinik etkilerini karşılaştırmayı amaçladık. Gereç ve Yöntem: Etik kurul ve hasta onamlarını takiben robotik radikal prostatektomi geçirecek ASA I-III, 50-75 yaşları arası 42 hasta çalışmaya alındı. İndüksiyon propofol 2-2.5 mg/kg, veküronyum 0.1 mg/kg ve remifentanil 1 µg/kg ile yapıldıktan sonra olgular iki eşit gruba ayrıldı. Grup S(n=21)'e sevofluran (%1-2 MAC)-remifentanil (0.04-0.2µg/kg/dk) ve Grup P(n=21)'e propofol (4-8 mg/kg/st)-remifentanil (0.04-0.2µg/kg/dk) ve her iki gruba da 0_2/Hava(%40-%60) ile idame yapıldı. Hastaların Kalp Atım Hızı (KAH), Ortalama Arter Basıncı(OAB), Periferik Oksijen Saturasyonu(SpO_2), End Tidal CO_2($ETCO_2$), Arteryel Kan Gazı (AKG) (pH, pO_2, pCO_2), Aldrete Derlenme Skoru (ADS) ve bulantı-kusma skorları, hasta memnuniyeti değerlendirildi. Bulgular: KAH ve OAB'ında her iki grupta da anlamlı düşüklük vardı($p<0.05$). $ETCO_2$ değerleri başlangıç değerleri ile karşılaştırıldığında her iki grupta da anlamlı yüksekti ($p>0.05$). pH; Grup P'de Grup S'den daha düşüktü ($p<0.01$). PCO_2 düzeyleri ise 2. st'de Grup P'de Grup S'den, 4. st'de ise Grup S'de Grup P'den anlamlı düzeyde yüksekti($p<0.05$). Grupiçi karşılaştırmalarda ise her iki grupta da pH anlamlı ($p<0.01$) olarak azalmış, PCO_2 ise anlamlı olarak artmıştı ($p<0.05$). ARS Grup P'de (ilk 1.st, 2.st ve 3.st) daha yüksek ($p<0.01$) bulunurken, bulantı-kusma skoru ise Grup S'de ilk iki saatte yüksekti. Hasta memnuniyeti açısından gruplar arasında fark yoktu ve iki grupta da yüksekti. Tartışma: Robotik prostatektomi için TİVA; erken ve kaliteli derlenme sağlamakta yan etkileri (bulantı-kusma) daha az olmaktadır. Ancak trendelenburg pozisyonu ve CO_2 insüflasyonu TİVA grubunda daha fazla olmak üzere asidoz riskini artırmaktadır. Bu konuda daha geniş vaka serilerine ihtiyaç vardır.

Anahtar Kelimeler

Dengeli Genel Anestezi; Propofol; Remifentanil; Robotik Prostatektomi; Sevofluran; TİVA

Abstract

Aim: Robotic surgery is an effective and common surgery technique in radical prostatectomies. There isn't any standart anesthesia technique for robotic surgery so both inhalation and intravenous anesthetics are used . In this study we aimed that compared the clinical effects of balanced general anesthesia and total intravenous anesthesia. Material and Method: After Ethical Commitee and patient approval, 42 consecutive patients undergoing robotic radical prostatectomy were included in this randomised-controlled study. Patients were divided in two equal group. We used sevoflurane (%1-2 MAC) - remifentanyl (0.04-0.2 $\mu gkg^{-1}min^{-1}$) in Group S (n=21) and propofol (4-8$mgkg^{-1}h^{-1}$) - remifentanyl (0.04-0.2$\mu gkg^{-1}min^{-1}$) in Group P(n=21) and O_2-Air (%40-%60) in two groups. Haemorespiratuar dynamics (HR, MAP, SPO_2, $ETCO_2$), Aldrete Recovery Score (ARS), nausea-vomiting score and patient satisfaction were evaluated. Result: Heart Rate(HR) and Mean Arterial Pressure (MAP) decreased in the two groups ($p<0.05$). End tidal CO_2($ETCO_2$) values significantly increased for two groups comparison with the initial values ($p>0.05$). pH was lower in Group P than Group S ($p<0.01$). PCO_2 values significantly increased in group P than group S in 2nd h and in group S than group P in 4th h ($p<0.05$). pH significantly decreased ($p<0.01$) and PCO_2 increased for both two intra-groups comparison ($p<0.05$). ARS was higher in group P for 1st, 2nd, 3rd h and nausea-vomiting was lower for group P in first two hours. Patient satisfaction was higher and wasn't different in two groups. Discussion: TIVA for robotic prostatectomy supply early and better recovery and side-effects (nausea-vomiting) are less than balanced general anesthesia. But trendelenburg position and CO_2 insuflation increases the risk of asidosis . In this issue there is need more studies.

Keywords

Balanced General Anesthesia; Propofol; Remifentanyl; Robotic Prostatectomy; Sevoflurane; TIVA

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Introduction

Robotic surgery is one of the recent and important development in prostat cancers treatment. Less blood loss, less postoperative pain, decreases time of hospital stay, faster recovery time is important advantages for the patients [2]. This advantages supports faster extension of this procedure in the world.

Despite several advantages, two important factors limiting anesthesia that patients steep trendelenburg position and CO_2 insuflation for pneumoperitoneum [2]. The patients are taken steep trendelenburg position (45°) and are made intraabdominal CO_2 insuflation for robotic radical prostatectomy [3]. The combination of trendelenburg position and CO_2 insuflation causes cardiovascular, respiratuar, neurophysiologic changes [4].

Trendelenburg position push the abdominal content to the diaphragma, decreases Functional Residual Capacity (FRC) and causes atelectasis. Moreover this position increases Central Venous Pressure (CVP), Intracranial Pressure (ICP), Intraoculer Pressure (IOP), Pulmonary Vascular Pressure (PVP) and myocardial work. CO_2 insuflation to the peritoneum also increases blood pressure. Frequently heart rate increases or sometimes intense bradicardia occurs. Some studies show that insuflation are increases Systemic Vascular Resistance (SVR) [5, 6]. Hypercarbia occurs but $ETCO_2$ rarely increases to 40-60 mmHg [2]. Venous gas embolism is the most malign complication for CO_2 insuflation same as other laparascopic procedures. Other risk factors are elderly patients and other systemic diseases.

The aim of this study is compare to clinical effects of inhalation and intravenous anesthesia methods for robotic prostatectomy patients.

Material and Method

After Ethical Committee (Ethical committee No: 43, Umraniye Training and Research Hospital, Istanbul, Turkey, Chair person Prof. A. Gocmen, on 3 March 2011) approvel and patient informed consent, 42, ASA I-III status, 50-75 years, male patients scheduled for robotic radical prostatectomy were studied.

Exclusion criteria included history of neurological or psychological disease, allergy to propofol, hypersensitivity or intolerance to opioids, sevoflurane and severe pulmonary or cardiovascular system disease.

Monitoring was consisted of noninvasive blood pressure, electrocardiogram (ECG), pulse oximeter (SpO_2), Capnograph ($ETCO_2$), airway pressure. MAP, HR, $ETCO_2$, SpO_2 were measured. All patients were given same anesthetics by the same anesthetist and operations were made by same surgeons. After induction with propofol 2-2.5 $mgkg^{-1}$, vecuronium 0.1 $mgkg^{-1}$, remifentanyl 1μgkg^{-1}, the patients separeted (with random number in sealed envelope by the second anesthetist) two equal (n=21) group .The first group (Group S) was given sevoflurane (%1-2 MAC)- remifentanyl (0.04-0.2$\mu gkg^{-1}min^{-1}$) and the second group (Group P) was given propofol (4-8 $mgkg^{-1}h^{-1}$) – remifentanyl (0.04-0.2$\mu gkg^{-1}min^{-1}$) and both two groups were given O2-Air (%40-%60) for maintanence of anesthesia. The infusions of remifentanyl (Ultiva ™ inj 1 mg vial, GlaxoSmithKline, Belgium) and propofol (Propofol %1 Fresenius Kabi AB, Upsala, Sweden) were made with 50ml injector pump (B.Braun's Perfusor Space Syringe Pump, Germany).

Radial arter catheterization (20G arterial catheter–Bio-flon, Hayrana, India) and basilic vein catheterization (Cavafix Certo 375 B.Braun, Melsungen, Germany) were made.The catheters were connected via rigid pressure tubing, filled with saline, to a continuous-flush pressure transducer system (Gemed, double pressure tansducer set, Istanbul, Turkey).Both systems were calibrated against atmospheric pressure and both pressure transducers were connected to a monitor (Drager, Infinity Kappa, Telford, PA, USA). Blood gases analysis (with Radiometer ABL 800 Flex, Radiometer Medical Aps, Bronshoj, Denmark) were made initially, after entubation, before and after CO_2 insuflation, 40th min, 1st h, 2nd, 3rd, 4th h.

Ventilation was done with Volume Control Ventilation (VCV) or Pressure Control Ventilation (PCV) to maintain an $ETCO_2$ mesure of 25-40mmHg.The patients were given Positive End Expirium Pressure (PEEP) +5cmH_2O if $ETCO_2$ values was higher than 40mmHg. All vital signs were monitored using a monitor (Drager ınfinity Kappa, Telford, PA, USA)

Patients legs were dressed with the compression stocking, the position peds were placed to the compression area and thighs abducted sufficently to accomodate the robotic system. The abdominal cavity was insufflated with CO_2 to a pressure of 12 mmHg and the patients were placed in the mild trendelenburg position after which the trocar cannulae were located. At the end the patients were slowly taken to the 45° trendelenburg position.The surgeon performed the procedure with the da Vinci Robot Surgical System (Intuitive Surgical, Sunnyvale, CA, USA).

Intraoperative fluid resusitation were made 1500-2000ml. At the end of operation recurarisation was made with neostigmin and atropine sulfat.

After, anesthesia recovery profile was made with Aldrete Recovery Score [3], and postoperative nausea-vomiting rate was made with patient number . Also patient satisfaction was evaluated (worse, medium, good, very good) .

The program of NCSS (Number Cruncher Statistical System) 2007&PASS 2008 Statistical Software (Utah, USA) was used to statistical analysis. Assuming an α level 0.05 and a power of 0.80, a minimum of 19 patients in each group were required to detect a mean difference in pH between two groups. When evaluating the study data descriptive statistical methods (mean, standart deviation) was used. Moreover for qualitative analysis of data the Student t test was used for comparison of the parameters with normal distribution and Mann Whitney U test was used to comparison of the parameters with none normal distribution between two groups. Paired sample t test was used to analysis of intragroup comparisons. Ki kare test and Fisher's exact Ki-Kare test was used in comparison of qualitative data. Significance were assessed at $p<0.05$ level.

Results

Age and operation time weren't different in two groups ($p>0.05$) (Table 1).

HR and MAP were similar in all measured times between groups ($p>0.05$). Intra-group comparison for the HR values were de-

Table 1. Distribution of groups according to age and operation time (mean±SV)

	Grup S	Grup P	p
Age (year)	60,38±6,34	63,09±6,52	0,179
Operation time (h)	4,52±0,56	4,05±1,02	0,071

creased in Group S for 30th, 45th min, 1st, 2nd, 3rd, 4th h than the initial value. HR values for Group P decreased also in 15th, 30th, 45th min and 1th h comparison with the initial value.

MAP values significantly decreased 15th, 30th, 45th min, 3rd h, 4th h in Group S and 5th, 15th, 30th, 45th min, 2nd, 4th h in Group P (p>0.05) (Figure 1, 2). All values were in normal ranges.

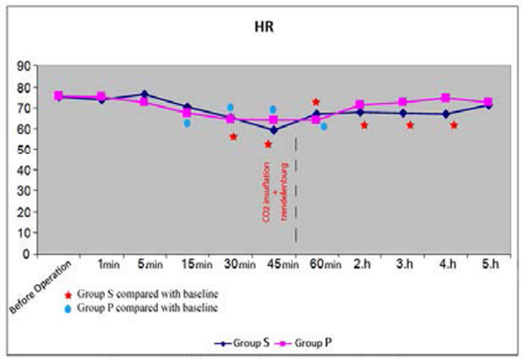

Figure 1. HR values (p‹0.05)

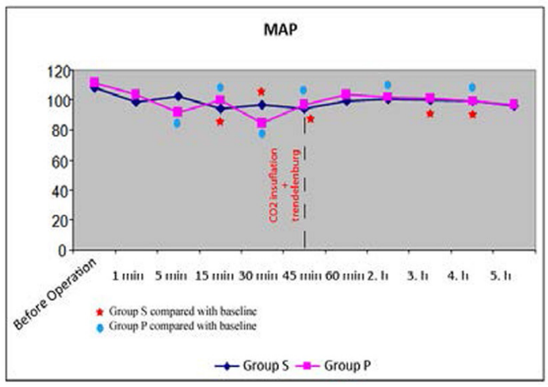

Figure 2. MAP values (p‹0.05)

SpO_2 and $ETCO_2$ values were similar in all measured times between the two groups (Figure 3).

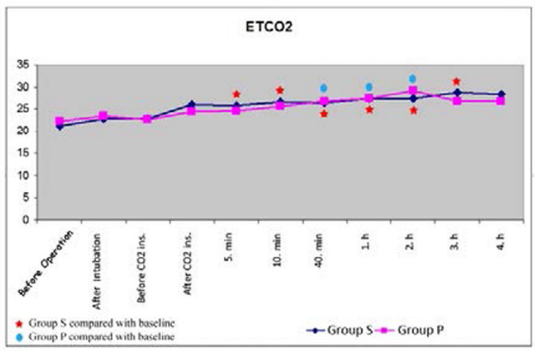

Figure3. ETCO2 values (p‹0.05)

$ETCO_2$ values increased progressively comparison to initial values for both groups.This values were significant in Group S (max 40mmHg) after CO_2 insuflation, 5th, 10th, 40th min, 1st, 2nd, 3rd h and in Group P (max 50mmHg) 40th min, 1st, 2nd h. SpO_2 values decreased slightly through trendelenburg position but were in normal ranges(Figure 4).This values didn't decrease below %94 in any patient in the study.

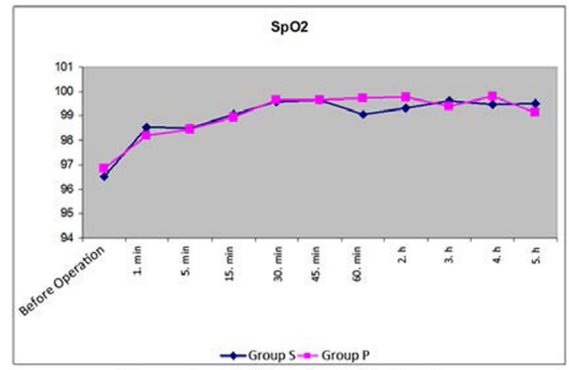

Figure 4. SPO2 values (p>0.05)

Blood Gases;

Between groups;

pH - Group P less than Group S (after entubation, 40th min, 1st, 2nd h)(p<0.01)

pO_2 - Group P less than Group S (40th min, 1st, 3rd h) (p‹0.01)

pCO_2 - Group P more than Group S (2nd h) (p‹0.05)

Group S more than Group P (4th h) (p‹0.05)

Intra-groups;

pH was significantly decreased in Group S after CO_2 insuflation (p<0.05) and, 5th, 10th, 40th min, 1st, 2nd, 3rd, 4th h (p<0.01), in Group P 40th min, 1st, 2nd, 3rd h (p<0.01) in comparison with initial value .

pCO_2 significantly increased in Group S after intubation, before CO_2 insuflation(p<0.01), 3rd, 4th h (p<0.05) and in Group P before CO_2 insuflation, 40th min (p<0.05), 1st, 2nd h (p<0.01) compared with the initial value,

pO_2 didn't changed in Group S, and significantly increased after intubation(p<0.01) but was in physiologic ranges in Group P (Figure 5, 6, 7).

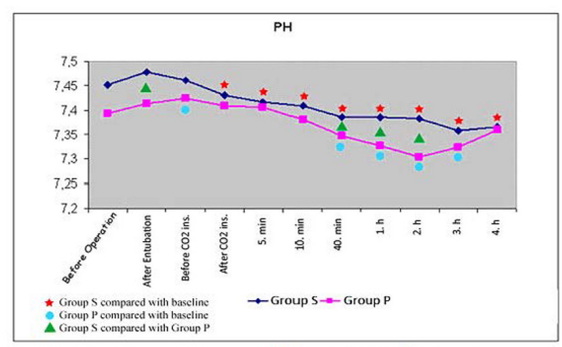

Figure 5. pH values (p‹0.01), (p‹0.05)

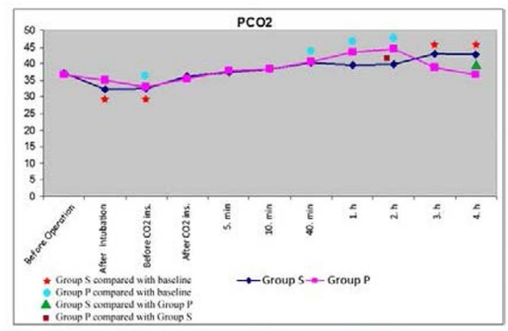

Figure 6. pCO2 values (p‹0.01) (p‹0.05)

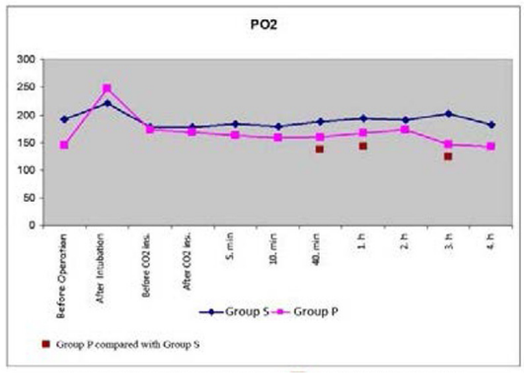

Figure 7. pO2 values (p‹0.01)(p‹0.05)

In Group S; 2 patients and in Group P 3 patients PEEP needed (p> 0.05). ARS was higher 1st, 2nd, 3rd h in Group P than Group S (Table 2). Nausea-vomiting score was higher in Group S for 1st (score was significant) and 2nd h than Group P. No patient given medication (p<0.01) (Table 3).

There wasn't any difference for patient satisfaction between groups and high enough both two groups (Table 4).

Table 2. Aldrete Recovery Score (*p<0.05) (**p<0.01)

	Group S	Group P	p
1.h	8,81±0,81	9,05±1,68	0.050*
2.h	9,14±0,79	9,90±0,54	0.001**
3.h	9,57±0,59	9,95±0,22	0.009**

Table 3. Nausea-vomiting score (*p<0.01) for patient number

	Group S	Group P	p
1. h	11 (%52,4)	0 (%0)	0.01*
2. h	5 (%23,8)	1 (%4,8)	0.184
3. h	2 (%9,5)	1 (%4,8)	1.000

Table 4. Patient satisfaction for patient number

	Group S	Group P
Very good	9 (%42,8)	12 (%57,1)
Good	12 (%57,1)	9 (%42,8)

Discussion

Robotic surgery is very similar to laparascopic procedures with the difference that deep trendelenburg position increasing the existing risks (Table 5). Trendelenburg position and pneumoperitoneum could increase SVR and MAP (depends on compression effect of increased intraabdominal pressure on aorta, increased afterload and humoral factors) [7-11]. After CO_2 insuflation, SVR, MAP, filling pressure can increase and Cardiac Index (CI) can decrease %50 [11].

In our study MAP decreased in period of anaesthesia induction and patient preparation and increased with trendelenburg position and CO_2 insuflation. Prior studies showed that HR is increased, decreased and not changed in laparascopic surgery cases [10, 13-16]. In this study HR decreased after trendelenburg position and pneumoperitoneum in both groups (more significant in Group S). HR significantly decreased during the operation comparison with the value of before operation for both Group P and Group S. But MAP and HR were in physiologic ranges in all times. We thought that the anaesthetics decreased the MAP at the beginning and deep trendelenburg position caused the rising MAP after insuflation.

Table 5. The side effects of pneumoperitoneum and steep trendelenburg position (CVS: Cardiovascular system, SVR:Systemic Vascular Resistance, CO: Cardiac Output, HR: Heart Rate, MAP: Mean Arterial Pressure, SVP: Systemic Vascular Pressure, VC: Vital Capasity, FRC: Functional Residual Capacity, CPP: Cerebral Perfusion Pressure, CBF: Cerebral Blood Flow, GFR: Glomerular Filtration Rate, ICP: Intracranial Pressure, IOP: Intraocular Pressure, GOR: Gastroesophageal Reflux)

	Steep trendelenburg	Pneumoperitoneum
CVS	SVR, MAP, myocard O_2 consu mption↑Renal,portal,splanic flow↓CO↑ /↓	SVR, MAP, PVR, SVP, HR↑ Venous return, CO↓ Cardiac indeks↓
Respiratuar	FRC, VC, Compliance↑, Peak airway P↑, $ETCO_2$↑, Diaf.elevation, small airway early closing, atelectasy risk,V/Q mismatc, endobronchial ent.risk	Compliance↑, V/Q mismac, hypercarbia, asidosis, intrathorasic P↑, havayolu P↑,FRC↑ endobronchial. intubation risk,
Neurologic	ICP, SVR, IOP↑,CPP↓	CBF ve ICP↑
Endocrine	Renin-anjyotensin, GFR ↓,urine↓, syst.activation, cathecolamin ↑	GFR ↓
Other	GOR, peripheric nerve damage, face-airway edema	Hypothermia,liver, portal, mesenteric system, renal syst. Blood flow↓, gastric pH ↓ İntraabdominal mechanical pressure

Taura et al [16], indicated that high Intra-Abdominal Pressure (IAP) (due to CO_2 insuflation) causes increased plasma lactat levels that results with lactic asidosis. We found that pH values in blood gases decreased in both groups.This decreases is higher in Group P. This condition was similar to prior studies suggest that propofol causes asidosis [17, 18]. Kalmar et al [3] indicated that PCO_2 and $ETCO_2$ increases with trendelenburg position and CO_2 pneumoperitoneum. In our study PCO_2 and $ETCO_2$ increased after CO_2 insuflation in both groups. This increase was significant comparison with initial values but in normal ranges and was similar to study of Kalmar.

Kim et al [19] suggest that $PaCO_2$ monitoring is important for adequecy of ventilation along with CO_2 insuflation. In our study we monitored $PaCO_2$ and found that the long time steep trendelenburg position and CO_2 insuflation tolerable for the patients and haemodynamic parameters were in physiologic ranges. Intraoperative respiratory parameters that we used should play a role for this condition.

We didn't see any side effects (emboli, arythmia...etc) depends on CO_2 insuflation in any patient.

Recovery from sevoflurane is similar [20], faster [21, 22] or slower [23, 24] than propofol in prior studies. In our study we found that the ARS values of patients in Group P beter than the values of patients in Group S, in recovery room. After that the values were similar before sending patients to the ward.

Other studies indicate that propofol has lower side effects (nausea-vomiting) than sevoflurane [20, 21, 23] . In our study we detected the lower nausea-vomiting in Group P (% 0) than Group S (%52).

In conclusion, TIVA provide early and quality recovery and lower side effects in robotic prostatectomy cases. The prolonged steep trendelenburg position and CO_2 pneumoperitoneum was well tolerated for both two groups. Haemodynamic parameters within physiologic ranges. But we think that steep trendelen-

burg position and CO_2 insuflation can increase the risk of asidosis, we should be very careful about the risk group patients.

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