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Study of haemodynamic changes during robotic urological surgeries: Comparison of dexmedetomidine and propofol

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Abstract

Background: General anesthesia induces endocrine, immunologic, and metabolic responses. Certain anesthetic drugs affect the hemodynamic variables of the patient by various mechanism. The purpose of this study was to compare the effects of propofol and dexmedetomidine on hemodynamic parameters in robotic renal transplant surgery.

Methods: This was a prospective comparative study performed in a tertiary care center. After local ethics committee approval and written informed consent, a total of fifty-two patients of ASA physical status 3 of either sex were randomly selected for this study. They were scheduled for elective robotic urological procedures of around three hours under general anaesthesia and divided into two groups (each group containing 26 patients). According to the haemodynamic requirement inj. dexmedetomidine maintainence(0.2 – 0.7mcg/kg/min) infusion and propofol(25 -75 mcg/kg/min) infusion started and maintained respectively. The measurements were taken on the same arm throughout the study at the following times: baseline,after loading dose,after intubation, after 20 min after the pneumoperitoneum, after 60 minutes of the pneumoperitoneum, after infusion stopped, after extubation.

Results: Heart rate and mean atrial pressure changes were significantly lower in dexmedetomidine group in all stages compared to propofol group ($P < 0.001$). Also, the rises in blood glucose and serum epinephrine levels in the dexmedetomidine group were significantly higher than in the propofol group ($P < 0.001$).

Conclusions: Anesthesia maintenance by dexmedetomidine showed a significant difference in hemodynamic parameters in comparison with propofol. While dexmedetomidine had better effects on controlling hemodynamic parameters, propofol showed better effects on decreasing stress hormones, and it can be suggested for LC surgery.

Keywords: Hemodynamic Parameters; Dexmedetomidine; Laparoscopic Cholecystectomy; Propofol; Stress Hormones

1. Introduction

Laparoscopic surgery is one of the most important diagnostic and therapeutic tools in the present surgical era. Usage of robotic assisted laparoscopic surgery is a newly developed minimal invasive surgery [1]. The benefits of laparoscopic and robotic surgeries are minimal access, less pain, early mobilization, shorter hospital stay and better cosmetic results which have further increased its applications [3].

To facilitate this procedure, the patient should be in the steep Trendelenberg position for a longer duration. Pneumoperitoneum along with adequate positioning alters homeostatic mechanisms leading to alteration in acid base

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balance, Cardiovascular system, Pulmonary physiology and stress response [4]. The extent of cardiovascular changes associated with pneumoperitoneum includes an increase in systemic vascular resistance which in turn compromises tissue perfusion

To monitor and counteract above mentioned effects, appropriate monitoring in the form of heart rate, mean arterial pressure central venous pressure and etco2 are noted at regular intervals. Various pharmacological interventions have been tried which includes preloading with intravenous fluids, Nitroglycerine [4], high doses of opioids[5],infusion of propofol and centrally acting apha2 agonists like clonidine and dexmedetomidine[6], Xylocaine [7], oral Gabapentin[8] are most commonly used.

In view of hepatic metabolism there is no cumulative effect of dexmedetomidine and propofol in chronic kidney disease patients and none of the past literatures have done the comparative study of Dexmedetomidine and Propofol on the attenuation of haemodynamic stress response and their effects as an adjuvant in anaesthesia in end stage renal disease patients posted for robotic renal transplant.

2. Material and methods

This was a prospective comparative study performed in a tertiary care center. After local ethics committee approval and written informed consent, a total of fifty-two patients of ASA physical status 3 of either sex were randomly selected for this study. They were scheduled for elective robotic urological procedures of around three hours under general anaesthesia and divided into two groups (each group containing 26 patients)

Patients posted for emergency surgical procedures, patients with cardiovascular or respiratory problems, pregnant mothers, currently breast-feeding mothers, sleep apnea ailment patients and those with psychiatric disorders were excluded from the study.

Preanesthetic checkup was conducted and a detailed history and complete physical examination recorded, routine investigations such as complete hemogram, random blood sugar, serum creatinine, chest xray (PA view),electrocardiogram and 2D echo (selected patients)were done.

After fitness, once patient is positioned on the operating table, patient's baseline values of heart rate, noninvasive blood pressure, pulse oximetry, electrocardiography were recorded.

An 18 guage intravenous cannula was inserted and the patient was pre-loadedwith appropriately. Before induction of anaesthesia, the group D patients were given dexmedetomidine 1mcg|kg loading dose infusion over 10 minutes while in group P patients received 25 - 75mcg/kg of the Propofol infusion. Patients were secured with double lumen Internal jugular vein catheter and intraradial cannulation. Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure were recorded at the start of bolus drug injection, at the end of bolus dose,and thereafter during intubaton.

Balanced general anaesthesia was administered for all the patients.The patients received premedication, intravenous doses of 0.2 mg glycopyrolate, 2 MCG/kg fentanyl, 4 mg ondansetron before induction of anaesthesia.Induction was achieved with 5mg|kg intravenous thiopentone, intubation was facilitated with intravenous succinyl choline and muscle relaxation maintained with 0.5mg/kg of atracurium intermittent bolus . The lungs were ventilated by maintaining tidal volume of 7 ml/kg, a frequency of 12 breaths/min and an Etco2 of 30 to 40 mmHg in 3L/min of fresh gas flow with air in a closed circuit.Isoflurane inhalation was titrated less than 0.6. According to the haemodynamic requirement inj. dexmedetomidine maintainence (0.2 – 0.7mcg/kg/min) infusion and propofol (25 -75 mcg/kg/min) infusion started and maintained respectively. Isoflurane concentration was kept <0.6% according to haemodynamic requirement. Routine monitoring consisted of HR, NIBP, SPO2, ECG and ETCO2 were recorded. The aim was to maintain HR less than 20% of the baseline and MAP <110 mmHg.The measurements were taken on the same arm throughout the study at the following times: baseline,after loading dose,after intubation, after 20 min after the pneumoperitoneum, after 60 minutes of the pneumoperitoneum, after infusion stopped, after extubation.

Intraoperative bradycardia was treated with inj.atropine 0.6mg.Intraoperative hypotension was treated with intravenous crystalloids,inj. Mephentermine,and by reducing isoflurane concentration.

Isoflurane inhalation was stopped 10 minutes before end of the surgery and inj dexmedetomidine and Propofol stopped after deflation of pneumoperitoneum.

On completion of surgery, the neuromuscular blockage was reversed with 0.05mg/kg intravenous neostigmine and 0.2 mg glycopyrrolate for each milligram of neostigmine. The extubation time was recorded together with the time to respond to simple verbal commands and the time for orientation. Patients in both the groups were monitored for RSS (Ramsay sedation score) until at least 4 hours post-surgery.

All the collected data were entered into the SPSS V20. Continuous data were expressed as mean + or - SD form. Continuous data follows normal and non-Normal distribution both. For the sample size calculation, pilot study was conducted. In this study, for group propofol mean and standard deviation 103+/- 8.82 and for the group dexmedetomidine, mean and standard deviation was calculated to be 82.23 +/-8.95. At 80% power and alpha level of significance 0.05. Independent t test and MANN WHITNEY test have been used for carrying out significant P value.

P value <0.05 considered to be statistically significant difference.

3. Results

Fifty two patients were randomly selected and compared using bolus injection followed by infusion of injection dexmedetomidine (Group D n=26) and inj. propofol (Group P n=26) in Robotic urological surgeries for their efficacy in regard to pressor responses to intubation, extubation and intra operative hemodynamic stability.

3.1. Demographic data

Table 1 Demographic variables between the two groups

	Group P (N=26)	**Group D (N=26)**	**p-value**
Age(years)	34.27±11.68	33.50±12.26	0.82 (NS)
Sex(M/F)	21/5	19/7	
Weight(kg)	56.08±6.55	56.38±8.28	0.88 (NS)
ASA risk stratification	2.85±0.54	2.77±0.65	0.64 (NS)
Duration of Surgery(min)	152.35±5.07	147.62±12.83	0.09 (NS)

As shown in table :1 there was no significant difference in age, sex, weight, ASA ,and duration of Surgery (P value >0.05) in both of the groups. Male patients are more in group propofol compared to the group dexmedetomidine.

There is 20% ↑ in HR after intubation in group p.

In the above graph heart rate changes has been interpreted at different time intervals in the group Propofol and There is 9% ↓ in HR in group Dexmedetomidine.

Above figure shows, baseline mean heart rate was not statistically significant between the two groups (p value>0.05) as mean heart rate of group D was 90 ±5.42 while in group P 88.04±12.04

Decrease in mean heart rate found in group D after loading dose, after intubation,after 20 minutes of pneumoperitoneum,after 60 in of pneumoperitoneum,after infusion stopped, after extubation which was statistically significant (P<0.05) compared to group P.

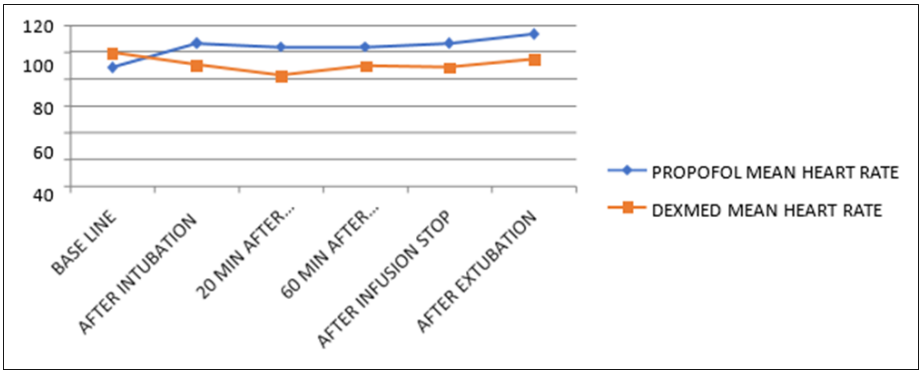

Figure 1 Comparison of perioperatve changes in heart rate between group propofol and group dexmedetomidine

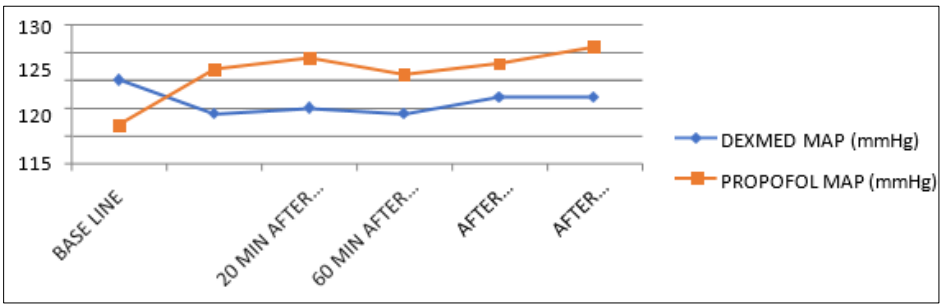

Figure 2 Comparison of perioperative changes in map between group propofol and group dexmedetomidine

Above graph shows baseline mean arterial pressure of group D was 120.21±9.22 while in group P it was 112.19±8.72,which was not statistically significant between two groups(p value >0.05)

Decrease in mean arterial pressure was found after loading dose,after intubation, after 20mins of pneumoperitoneum,after 60 mins of pneumoperitoneum after infusion stopped, after extubation which was statistically significant ($p<0.05$)in group D compared to group P.

We have done comparison of RSS in post operative period for 4 hours which shows more sedation in group propofol which was statistically significant compared to group dexmedetomidine($p<0.05$).

NTG requirement was high and statisticaly significant in group P as compared to group D(p value <0.05.). This observation derived reflects the better control of mean arterial pressure in group D was statistically significant than that of group P(NTG was initiated when MAP was>110).

4. Discussion

Haemodynamic changes associated with Trendelenberg position and pneumoperitoneum are well described in the literature in patients undergoing laparoscopic or robotic radical prostatectomies [9]. There is an increase in MAP, central venous and pulmonary arterial pressure, whereas the effect on heart rate is variable . Kalmare et al 10 observed that during the institution of the steep Trendelenberg position, both mean arterial pressure and central venous pressure increased significantly. However, the increase was greater in mean arterial pressure than in that of central venous pressure suggesting increased cardiac output, systemic vascular resistance or both as a cause.

O' malley and Cunningham [11] demonstrated that these changes are caused by increased intra-abdominal pressure compressing the aorta and increasing the afterload, possibly further enhanced by humoral factors.

In 2002, Dirk Menninger et al [13] also concluded that effects of prolonged pneumoperitoneum and extreme trendelenberg position had an exaggerated response in haemodynamic stress in robotic surgeries when compared to that of simple laparoscopic procedures, which necessitated intervention with appropriate pharmacological agents. B. K Parikh et al [3] also observed a significant increase in the mean arterial pressure during laparoscopic renal transplant.

Laryngoscopy and endotracheal intubation are well known to cause tachycardia and hypertension due to rise in plasma catecholamine and may be associated with myocardial ischemia,arrhythmia,left ventricular failure and CV stroke .This pressure response can be more detrimental in ESRD patients as 90- 95% of them are on multiple antihypertensive drugs [15,16]

Patients with normal cardiac reserve capacity can cope with these haemodynamic changes due to intubation, pneumoperitoneum and steep trendelenburg position. But patients with ESRD who have compromised cardiac function may not be able to tolerate the hemodynamic changes [15].

Talke P et al [12] studied the effects of perioperative dexmedetomidine infusion in patients undergoing vascular surgery. He concluded that, given as a premedication dexmedetomidine blunts the haemodynamic response to intubation, increases haemodynamic stability, decreases anaesthetic requirements and decreases the level of circulating catecholamines by up to 90%. These effects are beneficial in vascular surgery as similar as in renal transplants which includes crucial vascular anastomosis.

Various drugs have been used to attenuate the haemodynamic responses to pneumoperitoneum during laparoscopic and robotic procedures. Beta-adrenergic blocking agents like esmolol and alpha2 agonists like clonidine and dexmedetomidine 4have been used to attenuate the rise in MAP and HR but there are no studies which compared the attenuating effects of dexmedetomidine and propofol on heart rate, systolic and diastolic blood pressures in robotic renal transplant. So we divided 52 patients undergoing robotic renal transplant into Group D and Group P and compared HR, SBP and DBP at the time of intubation, after creating pneumoperitoneum, after Trendelenburg position, after deflation of pneumoperitoneum and after extubation.

Physiologically peripheral diastolic blood pressure is underestimated in the peripheral arteries, aggressive treatment of diastolic blood pressure is relevant as the cardiovascular and cerebrovascular events are more common in patients with elevated persistent diastolic blood pressure [11].

In our study, MAP and mean HR were significantly lower in group D as compared to group P after laryngoscopy and intubation. In the propofol group there is a 20% increase in heart rate and 9% increase in MAP, whereas in dexmedetomidine group there is 9% reduction in heart rate and there was no change in MAP. Attenuation of stress response was observed more in dexmedetomidine group due to slow bolus of dexmedetomidine which significantly attenuated sympathoadrenal response. Chattopadhyay [19] et al also compared propofol and dexmedetomidine infusion on depth of Anaesthesia in 60 patients undergoing laparotomy under general anaesthesia and found better haemodynamic control during post intubation period in dexmedetomidine group as compared to the propofol group which supports our study. Statistically significant control in the mean heart rate and MAP after creating pneumoperitoneum and Trendelenburg position was found in group Dexmedetomidine than with the group Propofol.

Our results does not match with the study done by Dr Vandana shah et al [17] .It could be because in their study they have compared the effects of dexmedetomidine and propofol infusion in patients with ASA 1 and 2, without hypertension or with well controlled hypertension posted for laparoscopic cholecystectomy. They concluded that dexmedetomidine showed significant attenuation of MAP after intubation and up to 60 minutes of surgery as compared to propofol.But after 60 minutes haemodynamic attenuation of MAP was similar in both the groups..In comparison our studies included patients with ESRD having secondary renovascular hypertension and were on multiple antihypertensive drugs, among which clonidine (an alpha 2 agonist having same action as that of dexmedetomidine)was the drug most commonly used. This can be the reason for better MAP control in dexmedetomidine group in our study. Another reason for difference in our observation could be difference in position of the patients. In their study all the patients posted for cholecystectomy are included which is performed in reverse Trendelenburg position where there is peripheral pooling of blood leading to decrease venous return whereas in our study all patients were given steep Trendelenburg position leading to increase preload because of central pooling of blood which can give exaggerated haemodynamic changes.

Many of our patients who could have withdrawal hypertension from clonidine as drug dosage could not be maintained due to long duration of surgery, had controlled heart rate and MAP control by dexmedetomidine infusion because both the drugs are α2 agonist. Allison B et al proved the effectiveness of clonidine on withdrawal from long term dexmedetomidine sedation in paediatric patients in ICU. stability of heart rate which conversely supported our observation.(16)

During intra operative period end tidal CO2 was maintained in both the groups . There was no significant changes in the group as demonstrated by Dr Vandana Shah et al in their study [17], as hypercapnea can interfere with the haemodynamics in robotic pelvic procedures. They also studied and established the pivotal role of dexmedetomidine when compared to Propofol in the effective control of haemodynamics in laparoscopic procedures.

The effective BIS correlated dose was established by the study of dexmedetomidine and propofol with BIS adjusted between 40 to 60 (as required for the surgical plane) and similar dose range has been inculcated in our studies and proved to be effective.(dexmedetomidine0.2 to 0.7mcg|kg and propofol25 to 75mcg|kg body weight). Uddalak Chattopadhyay et al [19] also concluded in their study that dexmedetomidine was comparable with propofol in maintaining anaesthesia and it can produce better control of haemodynamics and BIS value.

Nitroglycerine is the most used drug in the control of hypertension intraoperatively (MAP >110), as studied by BK Parikh et al [3] elaborated the essentials of conducting laparoscopic renal transplants. In our study nitroglycerine infusion requirement was high and statistically significant in group propofol ($p<0.05$), as compared to the group dexmedetomidine which supports our study proclaiming efficient haemodynamic control by dexmedetomidine compared to that of group propofol.

In accordance to the Ramsay sedation score, Post-operative sedation was significantly high in propofol group when compared to that of dexmedetomidine group.($p<0.05$).Lingling ding, Hong Zhang et al [20] published the improvised effects of dexmedetomidine on anaesthesia and recovery and post-operative cognitive function of patients posted for robot assisted laparoscopic radical cystectomies, which correlates with our study.

5. Conclusion

All the patients in our study were of ASA category 3 with ESRD posted for renal transplantation. Haemodynamic control is inevitable as these patients are on multiple antihypertensives preoperatively and are of with intermediate cardiovascular risk. As the heart rate and mean arterial pressure monitoring and optimization are an indespensible parts of management for the systemic stability of the patient, hence forth to counter balance the adverse sympathoadrenal excess caused by the pneumoperitoneum and trendelenberg position performed in robotic procedures.

In our study heart rate and mean arterial pressure were being monitored continuously and has been documented suggesting both of the parameters were well controlled in dexmedetomidine (group D) as compared to the propofol group (group P), which has been statistically backed but patients were haemodynamically stable throughout the study in both the groups. The usage of adjunctive antihypertensive therapy intraoperatively was statistically more in Propofol group than that of dexmedetomidine group.

Post-operative sedation was significantly more in propofol group as compared to that of dexmedetomidine group.

Compliance with ethical standards

Disclosure of conflict of interest

None to disclose.

Statement of ethical approval

The present research work does not contain any studies performed on animals/humans subjects by any of the authors

Statement of informed consent

Informed consent was obtained from all individual participants included in the study

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