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Effect of Dexmedetomidine on Haemodynamic Response to Pneumoperitoneum in Patients Undergoing Laparoscopic Cholecystectomy

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Abstract

Background: As laparoscopic cholecystectomy is a routinely performed surgery, it is desirable to have a stable intraoperative haemodynamic status. This study is designed to evaluate the efficacy of single intravenous bolus dose of dexmedetomidine, given 10 minutes before induction of anesthesia to provide hemodynamic stability in patients undergoing laparoscopic cholecystectomy. *Materials & Methods:* A Double blind randomized controlled study was conducted in the department of Anaesthesiology, Manipal Hospital Bangalore, Patients undergoing elective laparoscopic cholecystectomy, under general anaesthesia for a period of one year from June 2013 to May 2014. Total 60 patients belonging to ASA physical status I and II, in the age group of 18 to 65 years scheduled for elective laparoscopic cholecystectomy surgery were selected for this study. The two groups, Dexmedetomidine and control, were comparable with respect to age, sex, weight and ASA physical status. *Results:* We observed lesser magnitude of variation in HR, SBP, DBP, MAP atinsufflation of pneumoperitoneum until 30 minutes post pneumoperitoneum in dexmedetomidine group compared to control group ($p<0.05$). During pneumoperitoneum the maximum SBP and MAP attained in dexmedetomidine group was lesser compared to control group ($p<0.001$). Dexmedetomidine group also had less number of episodes of increase in SBP and MAP of more than 20% of baseline. We also found that the requirement for more than 1% of isoflurane in control group was higher (73%) compared to dexmedetomidine group. The recovery time was found to be similar in both groups. *Conclusion:* In conclusion, dexmedetomidine at a dose of 1 µgkg-1 bolus given at induction of anesthesia over 10 minutes resulted in statistically significant hemodynamic stability during pneumoperitoneum in patients undergoing elective laparoscopic cholecystectomy surgeries.

Keywords: Dexmedetomidine; Haemodynamic response; Laparoscopic Cholecystectomy; Pneumoperitoneum.

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Introduction

Laparoscopic surgeries require creation of pneumoperitoneum (PNP) which is produced by insufflation of Carbon Dioxide (CO_2) in the abdominal cavity by using an automated flow controlled Carbon Dioxide insufflator which supplies gas till the required intra-abdominal pressure is reached. Inflation pressure can vary from 0–30 mmHg whereas the total gas flow volume can be set from 0–9.9 L/min.

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The multiple benefits reported after laparoscopy explains its increasing use [1]. consequently, laparoscopy have now become the standard technique for cholecystectomy. However, the pneumoperitoneum (PNO) required for laparoscopy results in pathophysiologic changes. More importantly, changes in cardiovascular function occur during laparoscopy. These are characterized by an increase in arterial pressure and systemic and pulmonary vascular resistances (SVR and PVR) soon after the beginning of intra abdominal insufflation, with significant changes in heart rate (HR). A 10% to 30% decrease in cardiac output has also been reported in most studies [2-3] both mechanical and neuro-humoral factors contribute to these changes [2-4]. Several mediators have been proposed: catecholamines, prostaglandins, renin and vasopressin [5].

Joris et al. [5] studied the haemodynamic changes induced by laparoscopy. They observed that laparoscopy resulted in progressive and significant increase in plasma concentrations of cortisol, epinephrine, norepinephrine and renin. Vasopressin plasma concentrations markedly increased immediately after the beginning of pneumoperitoneum. The profile of vasopressin release paralleled the time course of changes in systemic vascular resistance. Prostaglandin and endothelin did not change significantly.

Also in addition, laparoscopic cholecystectomy is performed in reverse trendelenberg potion. This position leads to diminished venous return, further reducing the cardiac output [6].

Till date, many different techniques and pharmacological agents have been used to reduce the detrimental hemodynamic effects of pneumoperitoneum. Techniques like reduction in intra abdominal pressure during pneumoperitoneum and gasless laparoscopy using abdominal elevators have been employed [7]. Pharmacological agents like beta blockers, opioids, increasing concentrations of inhalational anesthetic agents, nitroglycerine and alpha 2 adrenergic agents have also been tested [1,8,9]. Again combined general anaesthesia with epidural anaesthesia [10] is yet another strategy employed by anaesthesiologists to control perioperative haemodynamic instability, with limited success. Interestingly, alpha- 2 adrenergic agonists have been shown to improve haemodynamic stability during gynecolologic laparoscopy [11].

Alpha 2 agonists produce diverse responses, including analgesia, anxiolysis, sedation, and sympatholysis, each of which has been reported to contribute to the treatment of surgical and chronic pain patients and in panic disorders as well. Recently, the Food and Drug Administration registered two novel alpha 2-adrenergic agonists clonidine and dexmedetomidine [12].

Dexmedetomidine is a imidazole derivative, a highly selective and potent alpha 2 adrenoreceptor agonist. It is a dextroenantiomer and the pharmologically active component of the medetomidine [13,14]. Dexmedetomidine with a elimination half life of two to three hours is a highly potent and specific alpha 2 agonist (1620: 1, alpha 2: alpha 1), compared to clonidine [(220:1) (alpha 2: alpha 1)] [14] and has a shorter duration of action Dexmedtomidine is considered a full agonist at alpha 2 receptors as compared to Clonidine which is considered as a partial agonist. Dexmedetomidine has sedative, analgesic and anesthetic sparing effects, and the ability to blunt the sympathetic response to surgery, resulting in intraoperative hemodynamic stability. Similar to clonidine, dexmedetomidine also attenuates the haemodynamic response to tracheal intubation, decreases plasma catecholamine concentration during anaesthesia and decreases perioperative requirements of inhaled anaesthetics [15].

Aims and Objectives

1. To study the effect of dexmedetomidine 1 $\mu g kg^{-1}$, given as a bolus prior to anesthetic induction in providing hemodynamic stability during pneumoperitoneum in patients undergoing elective laparoscopic cholecystectomy surgery.
2. To study the anesthetic sparing effect of dexmedetomidine in terms of isoflurane requirement during anesthesia.
3. To study the effect of dexmedetomidine on recovery time.

Materials and Methods

A Double blind randomized controlled study was conducted in the department of Anaesthesiology, Manipal Hospital Bangalore, Patients undergoing elective laparoscopic cholecystectomy, under general anaesthesia for a period of one year from June 2013 to May 2014. Total sample size of 60 patients, randomly allocated to two groups, each group comprising of 30 patients, using computer generated randomization table (Microsoft excel 2010).

Sample Size Estimation

Sample size was calculated on the basis of earlier study reference, Hemodynamic changes during laparoscopic cholecystectomy, by Jean L Joris et al [4] where there was a 28±7 mm Hg increase in the MAP (mean arterial pressure). We hypothesized that 20% attenuation in the magnitude of change in the MAP would be clinically significant.

Group size was determined by using the sample size estimation "for two group mean method" [mean 1±SD 1 = 28 ±7, mean 2±SD 2 = 23±7, common SD = 7] with a 95% power and 5% significance. With these assumptions we are required to study 25 patients in each group. Adding 20% to compensate for loss to follow up we would require to studying 30 patients in each group.

Sampling Technique

The study population consisted of 60 patients aged between 18 - 65 years belonging to class ASA I and class ASA II scheduled for elective laparoscopic cholecystectomy. The patients were divided in to two groups of 30 patients each.

Group A (dexmedetomidine group) [n=30]; received dexmedetomidine 1 μgkg $^{-1}$ body weight infusion for 10 minutes before induction.

Group B (control group) [n=30]; received normal saline infusion for 10 minutes before induction.

Inclusion Criteria

- Patients undergoing elective laparoscopic cholecystectomy patients within age group of 18 to 65 years
- Patients with ASA grade I or II.

Exclusion Criteria

- Obese patients with BMI > 26
- Patients with hypertension, cardiac disease and patients on antihypertensive drugs.
- Patients with ASA grade III and above
- Patients with preoperative heart rate <45 bpm.
- Patients with hepatic and renal disease.

Methodology

The ethical clearance for the study was obtained from institutional ethics committee, Manipal Hospital, Bangalore.

Patients undergoing elective laparoscopic cholecystectomy, under general anesthesia were screened for the eligibility. Patients fulfilling selection criteria were selected for the study and briefed about the nature of study and explained about the anesthetic procedure. A written informed consent was obtained from the patient.

Statistical Methods: Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5% level of significance. Student t test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters. Student t test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale within each group. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

Statistical software: The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Observations and Results

60 patients were, recruited and randomly divided into two groups with 30 patients in each group receiving either Dexmedetomedine (group A) or Normal Saline (group B) 10 mins prior to induction. The data collected was analyzed and results are as mentioned below.

Table 1: Demographics Data Mean±SD

	Group A (Dexme)	Group B (NS)	P value
Age (years)	37±11	41±10	0.17
Gender Male:Female (%)	10:20 (33.3:66.7)	7:23 (23.3:76.7)	0.39
Weight (Kgs)	70±9	71±10	0.59
ASA Grade I: II (%)	23:7 (76.7:23.3)	23:7 (76.7:23.3)	1
Mean duration of surgery (minutes)	57±12	53±9	0.27

Values expressed as Mean±SD or Number (percentage). Dexme= Dexmedetomedine, NS= Normal saline. p value ≤ 0.05 considered significant.

Age: The average age of patients in group A was 37±11 years and 41±10 years in group B. The patients in both groups were well matched with respect to age (p=0.174). {Table 1}

Sex: In both the groups the number of female patients exceeded male patients. Group A had 20 (67.7%) female patients and 10 (33.3%) male patients compared to group B which had 23 (76.7%) female patients and 7 (23.3%) male patients. This gender distribution was comparable between two groups. (p=0.390) {Table 1}

Weight: The average weight of patients in group A was 70±9 kg and 71±10 kg in group B which was comparable. (p=0.590). {Table 1}.

ASA Grade: The number of ASA grade I patients in group A as well as group B were 23 (76.7%) and ASA grade II patients were 7 (23.3%)in both groups. (p= 1.00). {Table 1}

Mean duration of surgery: Mean duration of surgery in group A was 57±12 minutes and in group B was 53±9 minutes which was comparable with in two groups. p=0.27. {Table 1}

Haemodynamics

Base line: Base line in our study was defined as the hemodynamic variable measured prior to infusion of drug. This pre - infusion hemodynamic variable taken as baseline value against which all the subsequent hemodynamic variables are compared. Hemodynamic variable include HR, SBP, DBP, MAP.

A. Heart Rate

Table 2: Heart Rate (Hr) in Two Groups of Patients Studied

Sl.	Heart rate (Bpm)	Group A (Dexem)	Group B (NS)	P value
1	Baseline	80±11	83±14	0.271
2	After infusion of drug	77±15	81±12	0.175
3	1 minute after induction	72±13 #	82±12 #	0.004
4	1 minute after intubation	84±17	97±15	0.004
5	At pneumoperitoneum	75±14	83±15	0.049
6	Head up	81±12	88±12	0.042
7	5mins after pneumoperitoneum	80±14	85±16	0.335
8	10 mins after pneumoperitoneum	76±11	84±14	0.025
9	20 mins after pneumoperitoneum	76±12	83±14	0.042
10	30 mins after pneumoperitoneum	76±12	82±13	0.45
11	60 mins after pneumoperitoneum	81±16	87±13	0.67
12	End of pneumoperitoneum	75±12 #	80±14	0.113
13	End of extubation	88±14	96±17 #	0.036

Heart rate values are expressed as mean±SD p < 0.05 is statistically significant. For within groupanalysis after application of Bonferroni's correction, p<0.004 is considered statistically significant (#). Bpm= beats per minute, Dexem= Dexmedetomidine. NS= Normal saline (Table 2).

B. Systolic Blood Pressure

Table 3: SBP (mm Hg) in two Groups of Patients Studied

Sl.	SBP (mm Hg)	Group A (Dexem)	Group B (NS)	p value
1.	Baseline	133±20	134±21	0.79
2.	After infusion of drug	130±15	131±23	0.803
3.	1 minute after induction	108±16 #	102±17 #	0.156
4.	1 minute after intubation	119±23 #	137±29	0.008
5.	At pneumoperitoneum	105±17 #	116±27 #	0.065
6.	Head up	97±14 #	110±19 #	0.003
7.	5 mins after pneumoperitoneum	110±18 #	129.±26	0.001
8.	10 mins after pneumoperitoneum	113±16 #	135±22	<0.001
9.	20 mins after pneumoperitoneum	113±14 #	128±19	0.001
10.	30 mins after pneumoperitoneum	113±13 #	127±16	0.001
11.	60 mins after neumoperitoneum	121±20	135±16	0.26
12.	End of pneumoperitoneum	114±13 #	124±19	0.024
13.	End of extubation	133±15	152±18 #	<0.001

SBP values expressed as Mean±SD p<0.05 is statistically significant. For within group analysis after application of Bonferroni's correction, p<0.004 is statistically significant (#) (Table 3).

C. Diastolic Blood Pressure

Table 4: DBP (mm Hg) in two Groups of Patients Studied

Sl.	DBP (mm Hg)	Group A (Dexem)	Group B (NS)	P value
1	Baseline	80±13	81±10	0.859
2	After infusion of drug	80±12	78±12	0.661
3	1 minute after induction	69±12 #	64±13 #	0.189
4	1 minute after intubation	74±17	84±22	0.053
5	At pneumoperitoneum	65±12 #	69±22 #	0.31
6	Head up	57±9 #	66±16 #	0.009
7	5 mins after pneumoperitoneum	69±14 #	83±21	0.003
8	10 mins after pneumoperitoneum	74±12	82±14	0.017
9	20 mins after pneumoperitoneum	72±12 #	79±14	0.046
10	30 mins after pneumoperitoneum	73±11 #	77±14	0.176
11	60 mins after neumoperitoneum	77±17	86±9	0.312
12	End of pneumoperitoneum	72±11 #	77±13	0.188
13	At extubation	82±11	90±11 #	0.002

DBP values expressed as Mean±SD $p<0.05$ is statistically significant. For within group analysis after application of Bonferroni's correction, $p<0.004$ is considered statistically significant (#) (Table 4).

D. Mean Arterial Pressure

Table 5: MAP (mmHg) in two Groups of Patients Studied

Sl.	MAP (mmHg)	Group A (Dexme)	Group B (NS)	p value
1	Baseline	100±16	102±14	0.668
2	After infusion of drug	98±13	98±15	0.993
3	1 minute after induction	82±13	79±14#	0.437
4	1 minute after intubation	91±18 #	104±24	0.017
5	At pneumoperitoneum	80±12 #	88±21	0.07
6	Head up	70±9 #	81±16 #	0.002
7	5 mins after pneumoperitoneum	85±14 #	101±21	0.001
8	10 mins after pneumoperitoneum	89±12 #	102±16	0.001
9	20 mins after pneumoperitoneum	87±12 #	98±15	0.005
10	30 mins after pneumoperitoneum	87±11 #	96±14	0.011
11	60 mins after pneumoperitoneum	93±16	107±10	0.142
12	End of pneumoperitoneum	88±11 #	96±14.17	0.028
13	At extubation	101±11	114±12.27 #	<0.001

MAP values expressed as Mean±SD $p<0.05$ is statistically significant. For within group analysis after application of Bonferroni's correction, $p<0.04$ is considered statistically significant (#) (Table 5).

Isoflurane Requirement

Table 6: End Tidal Isoflurane Concentration in Percentages

End Tidal Isoflurane Concentration	Group A (Dexme) Number (%)	Group B(NS) Number (%)
<1%	23(76%)	8(26%)
>1%	7(24%)	22(73%)

Values expressed in number or percentages $p=0.003$

More [23 (76%)] patients in group A had end tidal isoflurane concentration <1% compared to [8 (26%)] in group B. More number of patients in group B had end tidal isoflurane concentration >1% compared to group A indicating higher Isoflurane requirements in group B (Table 6).

Recovery Time

Time at which patients were able to maintain spontaneous eye opening following reversal.

Table 7: Recovery time in Minutes

Recovery time (minutes)		
Group A (Dexme)	Group B (NS)	P value
8.26±1.57	7.73±1.47	0.16

Recovery time in group A was 8.26±1.57 minutes compared to 7.73±1.47 minutes in group B which was comparable. ($p=0.16$). (Table 7).

Discussion

Over recent years, laparoscopic cholecystectomy has become the treatment of choice for calculous cholecystitis, as this procedure is associated with less postoperative pain, rapid mobilization, shorter hospital stay as well as quicker resumption of normal activities [1].

Laparoscopic cholecystectomy using carbon dioxide insufflation is the current gold standard for the treatment of cholelithiasis.

Despite its many benefits over open cholecystectomy, laparoscopic cholecystectomy is known to cause significant hemodynamic changes especially when carbon dioxide pneumoperitoneum is used. These changes include increased peripheral vascular resistance, elevated serum catecholamine level and decreased cardiac output in laparoscopic cholecystectomy [5]. Hemodynamic changes may be due to increased intra abdominal pressure, neuro- hormonal response and absorbed carbon dioxide. Hemodynamic perturbations during pneumoperitoneum are usually well tolerated by normal patients but could be harmful especially in elderly and hemodynamically unstable patients [16]. Increases in mean arterial pressures (MAP) and systemic vascular resistance (SVR) were noted in patients with poor cardiac reserve which could be attributed to raised intra abdominal pressure and changes in positioning. In these patients, the right atrial pressure (RAP) and pulmonary artery occlusion pressure (PAOP) were greatly [17,18] or moderately [19] increased during pneumoperitoneum and cardiac index (CI) was either unchanged [18] or moderately decreased. These studies indicate that hemodynamic alterations are potentially deleterious in elderly patients and in those with limited cardiac reserve.

Intra operative opioids are associated with hemodynamic stability during laparoscopic surgeries but side effects such as postoperative nausea and vomiting [20] may delay discharge from PACU. Nervige Salman et al. [21] have compared dexmedetomidine and remifentanyl in ambulatory gynaecological laparoscopic surgeries and have demonstrated that dexmedetomidine infusion cause reduced postoperative nausea, vomiting and analgesic requirements and at the same time provides hemodynamic stability compared to remifentanyl. Alpha 2 agonists like clonidine and dexmedetomidine are known to reduce sympathetic nervous system activity and plasma catecholamine concentrations under various stressful circumstances. S Kumar et al. [22] have compared the effects of dexmedetomidine and clonidine premedication on perioperative hemodynamic stability and postoperative analgesia in laparoscopic cholecystectomy and found that both clonidine and dexmedetomidine are effective in attenuating the hemodynamic response to pneumoperitoneum with equal efficacy and without any side effects. The two drugs were also found to provide reliable post operative analgesia. However, though dexmedetomidine is a shorter acting drug compared to clonidine, it was found to have longer duration of analgesia than clonidine. Based on this finding the authors have opined that dexmedetomidine can be used as an effective premedication for attenuating hemodynamic response due to pneumoperitoneum. Similarly Rajdip Hazra et al. [23] have compared the effects of intravenously administered dexmedetomidine with clonidine on hemodynamic response during laparoscopic cholecystectomy and observed that the patients in dexmedetomidine group had better control of blood pressure during pneumoperitoeum.

Choice of Dosage

Different doses of dexmedetomidine for attnenuating hemodynamic stress response have been studied by various authors. Jaakola et al. [24] found decreased blood pressure and heart rate during intubation following administration of 0.6 µgkg^{-1} bolus dexmedetomidine preoperatively. Lawrence et al. [25] found decreased hemodynamic response to tracheal intubation and extubation following a single high dose of dexmedetomidine (2 µgkg^{-1}), but bradycardia was observed in first and fifteen minutes after administration of dexmedetomidine. Ghodki et al used [26] dexmedetomidine 1 µgkg^{-1} intravenously over 15 minutes before induction followed by maintenance infusion of 0.2 µgkg^{-1} hr^{-1} and observed minimal changes in blood pressure during laryngoscopy and pneumoperitoneum.

Since high dose (>1µkg^{-1}) of dexmedetomidine is associated with increased incidence of bradycardia and hypotension, we chose to conduct our study using 1 µkg^{-1} bolus dose of dexmedetomidine given over 10 minutes just prior to anesthetic induction. Since the elimination half-life of single intravenous bolus dose of dexmedetomidine is about 2 to 3 hrs and average duration of laparoscopic cholecystectomy surgery is between 60 to 90 minutes, we avoided maintenance infusion of dexmedetomidine in order to prevent prolonged duration of action of drug resulting in increase in the recovery time.

Intra Abdominal Pressure (IAP)

At IAP of 15 mm Hg Joris et al. [5] found 35% increase in MAP, a 65% increase in SVR, a 90% increase in PVR, while there was a 20% decrease in cardiac output. Ischizack et al. [27] tried to determine the safe range of IAP during laparoscopic surgery. At 16 mm Hg of IAP, significant fall in cardiac output was observed. However at 12 mm Hg of intra abdominal pressure hemodynamic alterations were not observed. During laparoscopy the current recommendation is to monitor IAP and to maintain it at just tolerable levels, not above 14 mm Hg. In our study IAP was maintained at 14 mm Hg throughout the surgery.

Haemodynamics

Preoperative hemodynamic parameters like heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressures were comparable between the two groups.

Heart Rate (Table 2)

We found significant difference in HR variations in dexmedetomidine group at intubation, at insufflation of pneumoperitoneum, up to 30 minutes after pneumoperitoneum and at extubation ($p<0.05$) compared to control group. Similar responses in HR were observed in studies where in same dose of dexmedetomidine (Rajdip Hajra et al. [23] and S kumar et al. [21]) was used as a premedication prior to induction. DP Bhattacharjee et al. [28] also have found similar results in heart rate response by using 0.2 µgkg^{-1} of dexmedetomidine maintenance infusion during laparoscopic cholecystectomy. In our study, we also found a decrease in HR, at different time points after insufflations of pneumoperitoneum till the end of pneumoperitoneum when compared to baseline. The incidence of HR varying above 20% of the baseline were also lesser in the dexmedetomidine group. However, this lesser magnitude of variation noted in HR response was not statistically significant when compared to control group.

Systolic Blood Pressure (Table 3)

There was a significant difference in SBP variation in dexmedetomidine group compared to control group at intubation, at insufflation of pneumoperitoneum until 30 minutes post pneumoperitoneum ($p<0.05$). SBP was lower in dexmedetomidine group compared to its baseline value whereas there was not much change noticed in SBP response in control group, when compared to the baseline, during pneumoperitoneum, thus indicating a muted stress response to carbon dioxide pneumoperitoneum. Similar results have been found in studies by S Kumar et al. [21] and Rajdip Hajra et al. [23] when 1μgkg^{-1} of dexmedetomidine was compared with clonidine and normal saline.

In our study, during pneumoperitoneum the maximum SBP attained in dexmedetomidine group was 133±13 mm Hg compared to 152±19 mm Hg in control group, which was statistically significant ($p<0.001$). Dexmedetomidine group also had less number of episodes of increase in SBP of more than 20% of baseline. The magnitude of variation of SBP around baseline in dexmedetomidine group during pneumoperitoneum was more in control group which was a statistically significant finding ($p=0.004$) SBP around baseline in dexmedetomidine group during pneumoperitoneum was more in control group which was a statistically significant finding ($p=0.004$).

Diastolic Blood Pressure (DBP) (Table 4)

There was a statistically significant ($p<0.05$) difference in DBP variation in dexmedetomidine group from beginning of pneumoperitoneum until 20 minutes post pneumoperitoneum when compared to control group, thus indicating a decreased response to carbon dioxide pneumoperitoneum. Similar kind of response was seen in studies by S Kumar et al. [22] and Rajdip et al. [23] where in dexmedetomidine was compared to control group. The magnitude of variation in DBP around baseline was lesser compared to the control group which was found to be statistically significant ($p=0.05$).

Mean Arterial Blood Pressure (MAP) (Table 5)

The decreased stress response was also reflected in mean arterial pressure which was significantly less in dexmedetomidine group compared to control group from beginning to end of pneumoperitonem ($p<0.001$), this difference between the two groups was statistically significant. S Kumar et al. [22], Rajdip et al. [23] and DP Bhattacharjee et al. [28] have found similar decreases in MAP in dexmedetomidine group during pneumoperitoneum when compared to control group.

During pneumoperitoneum, the maximum increase in MAP wasless in dexmedetomidine group (100±16 mmHg) compared to control group (111±14 mmHg)($p=0.001$). The incidence of increase in MAP of more than 20% of their baseline values was significantly low in dexmedetomidine group ($p=0.005$). The magnitude of variation of MAP from baseline was significantly lower in dexmedetmidine group compared to control group ($p=0.02$).

Pneumoperitoneum is known to cause fluctuations in hemodynamics as measured by increases in MAP, SVR, pulmonary vascular resistance and decrease in cardiac output [5] In our study, we found that 1μgkg^{-1} bolus dose of dexmedetomidine, given 10 minutes prior to induction, resulted in lesser magnitude of variation in HR, SBP, DBP and MAP during pneumoperitoneum giving the much desirable hemodynamic stability.

Recovery Time

Dexmedetomidine is associated with 'arousable sedation' or 'conscious sedation'. Turan et al. [29] in their study on patients undergoing craniotomy found that dexmedetomidine improved extubation conditions without prolonging recovery. Norimasa et al. [30] studied the recovery profile when dexmedetomidine was used as a general anaesthetic adjuvant in patients undergoing lower abdominal surgery and concluded that postoperative recovery was not affected by dexmedetomidine administration. Studies have reported prolonged recovery time with dexmedetomidine especially when large infusion doses were used during anesthesia or when used as an adjuvant along with propofol infusion as a part of TIVA (Total intravenous anesthesia) [31].

In our study, recovery time is defined as spontaneous eye opening following reversal of muscle relaxant. We found no difference in recovery time between the two groups. We used only single bolus dose 1 μgkg $^{-1}$ of dexmedetomidine given 10 minutes prior to induction of anesthesia. Maintenance infusion of dexmedetomidine was avoided and adequate anesthetic depth was maintained using entropy monitoring in all patients.

Conclusion

In conclusion, dexmedetomidine at a dose of 1 μgkg^{-1} bolus given at induction of anesthesia over 10 minutes resulted in statistically significant hemodynamic stability during pneumoperitoneum in patients undergoing elective laparoscopic cholecystectomy surgeries. It also resulted in reduced Isoflurane requirements without prolonging recovery.

We have done this study on ASA1 and 2 physical status patients. Further studies may be required to be conducted on similar lines in patients with lesser cardiopulmonary reserve, to find out if dexmedetomidine can result in better tolerance of hemodynamic variations associated with pneumoperitoneum during laparoscopic surgeries.

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