A Comparative Evaluation of Intravenous Dexmedetomidine on Haemodynamic Stress Response during Pneumoperitoneum in Laparoscopic Abdominal Surgeries
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Abstract: Laparoscopic surgeries because of their benefits like small incision and pain due to it, early mobility, less infection rate, less postoperative analgesics usage etc. are preferred over open surgical procedures. But laparoscopic procedures also causes complications because of pneumoperitoneum created during surgeries by insufflation of gases and its duration leads to blood pressure and heart rate changes. Various drugs of different groups are used to reduce the effect of pneumoperitoneum. Dexmedetomidine is a selective α-2 agonists used for the same purpose with its various other benifits too. This randomized control study was conducted on 60 patients of ASA grade 1 and 2 after taking ethics committee approval. Group D (n=30) dexmedetomidine is infused during the surgery and in group C (n=30) normal saline is infused during the surgery. Diastolic and systolic blood pressure, mean arterial blood pressure and heart rate were measured throughout the procedure till 30 minutes after the procedure. Sedation score was also measured after the surgery. Effect of intubation and laryngoscopy induced stress response, creation of pneumoperitoneum and extubation was seen over heart rate, SBP, DBP and MAP in both the groups but was significantly less in the dexmedetomidine group(D) compared to the control(C) group showing better stability of the hemodynamic vitals in the patients given dexmedetomidine intraoperatively (P<0.05). Dexmedetomidine suppresses pneumoperitoneum induced hemodynamic instabilities in patients undergoing laparoscopic cholecystectomy under general anaesthesia.

Keywords: Blood pressure, Dexmedetomidine, General anaesthesia, Heart rate, Sedation.

INTRODUCTION
When compared to open surgery, laparoscopic approach is safer and has several benefits over the former [1, 2]. Laparoscopic abdominal surgeries have less complication and mortality rate when compared to open procedure [3]. For laparoscopic abdominal surgeries, hemodynamic instability are more during the duration of pneumoperitoneum (PNP)[4, 5] namely carbon dioxide (mainly CO2) insufflations and patient positioning[6,7].

The cardiopulmonary changes that occur during laparoscopy are characterized by decreased cardiac output, increased arterial pressures, increased systemic vascular resistance (SVR) and pulmonary vascular resistance (PVR)[8, 9]. Pneumoperitoneum decreases thoracopulmonary compliance by 30-50% [10]. Positioning during laparoscopic cholecystectomy causes diaphragm to elevate and thus decreases the FRC [11], airway pressure increases [12] and atelectasis also occurs. To attenuate these responses, various pharmacological drugs are used like adrenoreceptor blockers[13], beta blockers[14], Ca channel blocker, lidocaine[15], opioids[16], pregabalin[17], magnesium sulfate[18], vasodilators[19], remifentanil[20]. Dexmedetomidine is highly selective and potent specific α-2 agonist [21] and has shorter duration of action (2-3 hr) [22]. Dexmedetomidine attenuates the haemodynamic response to tracheal intubation, decrease plasma catecholamine and norepineprine concentrationand thus maintain blood pressure and heart rate [23] and also decreases perioperative requirements of inhaled anaesthetics during anaesthesia[24].

MATERIALS & METHODS
After obtaining approval from the ethics committee and well written informed consent from the patients, study was carried out on 90 patients of ASA grade I and II, aged 20-50 years, undergoing
Preparation of the patient

Upon arrival of the patient in the operation room, intravenous access with 18G cannula was established and 500 mL of crystalloid infusion was started. All the baseline vital parameters (HR, SBP, DBP, MAP), electrocardiography using three lead ECG were monitored. Oxygen saturation (SPO2) was monitored by using pulse oximeter. End tidal Carbon dioxide was monitored intraoperatively and kept between 25 and 30 mmHg.

Anaesthesia procedure and recording

Drugs were administered by a person who was not involved in the study to avoid bias. Patients were preoxygenated with 100% oxygen at appropriate flow for 3 minutes by facemask. After premedication with i.v.InjPentazocine0.5mg/kg, general anaesthesia was induced with i.v.InjThiopentone Sodium 5 mg/kg body weight. Endotracheal intubation was facilitated with i.v. Inj. Succinylcholine 1.5 mg/kg body weight and IPPV was done for 60 seconds with 100% oxygen.

Laryngoscopy was done with laryngoscope having Macintosh blade and tracheal intubation done with appropriate size of cuffed endotracheal tube. Cuff was inflated and bilateral equal air entry was checked and then tube was fixed.

General anaesthesia was maintained with nitrous oxide & oxygen (67:33) and Isoflurane (0.5-1%) with Bain’s anaesthetic circuit. Loading and intermittent dosage of non-depolarizing muscle relaxant, IV AtracuriumBesylate0.5mg/kg body weight initially followed by increment doses at 0.1mg/kg was used to maintain general anaesthesia under controlled ventilation throughout the surgical procedure. After intubation, the infusion of Dexmedetomidine (1 µg/kg) in 50 mL normal saline or 50 mL normal saline was started 10 min before induction of pneumoperitoneum. This was followed by a continuous infusion of dexmedetomidine at the rate of 0.2 µg/kg/hr and NS at a rate of 0.5 ml/kg/hr according to the study group.

During study period haemodynamic parameters such as heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) were recorded at 0 minute (B), D0, D10, BPN, APN, APN30, APN60, APN90, APN120, APN, APN30, APN60, APN90, RPN, AR, AR15, AR30, intervals. PNP -Pneumoperitoneum, B- Basal value (0 minute), D0-Before study drug, D10- After study drug, BPN- Before pneumoperitoneum, APN- After pneumoperitoneum, RPN- Release of pneumoperitoneum, AR- After reversal.

All the study drugs were stopped once surgical procedure was over and pneumoperitoneum was released. After surgery, patients were reversed with Inj. Glycopyrrolate0.005mg/kg and Neostigmine 0.08mg /kg intravenously. After extubation patients were observed for recovery time defined as time to vocalize after extubation.

Side effects and complications

Patients were closely observed for bradycardia / tachycardia (± 20% of basal value), hypotension / hypertension (± 20% of basal value), bradycardia & desaturation (<85%) during intra and postoperative period. During postoperative period along with above, nausea, vomiting, respiratory depression, sedation and shivering were also recorded if occurred. Any

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complication if occurred was treated with appropriate medications.

**Statistical analysis**

The observations were recorded and subjected to statistical analysis using students “t” test by statistics calculator SPSS 17. Student ‘t’-test for inter group comparison was used. p-value >0.05 was taken to be statistically insignificant & p-value <0.05 was taken statistically significant and p-value <0.01 taken to be statistically highly significant.

**RESULTS**

Data obtained from the patients involved in the study were analyzed. The mean age, weight, sex, type of surgery, duration of pneumoperitoneum, duration of anaesthesia, type of surgery and Ramsay sedation score after extubation were comparable in two study groups as shown in table. Preoperative heart rate, systolic, diastolic and mean blood pressure and blood sugar level were comparable in all the two groups.

<table>
<thead>
<tr>
<th>DEMOGRAPHIC DATA</th>
<th>Group C</th>
<th>Group D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>34.43±8.75</td>
<td>36.53±7.85</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>53.23±7.20</td>
<td>50.90±5.28</td>
</tr>
<tr>
<td>Sex (Female)</td>
<td>73.33%</td>
<td>97.67%</td>
</tr>
<tr>
<td>Duration Of Pneumoperitoneum (Min)</td>
<td>62.96±18.14</td>
<td>62.73±17.80</td>
</tr>
<tr>
<td>Duration Of Anaesthesia (Min)</td>
<td>89.16±19.47</td>
<td>91.16±18.36</td>
</tr>
<tr>
<td>Type Of Surgery</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laparoscopic Cholecystectomy</td>
<td>93.33%</td>
<td>100%</td>
</tr>
<tr>
<td>Laparoscopic Hernia</td>
<td>6.67%</td>
<td>-</td>
</tr>
<tr>
<td>Ramsay Sedation Score After Extubation (Mean+Sd)</td>
<td>1.43±0.56</td>
<td>2.20±0.96</td>
</tr>
</tbody>
</table>

**Graph-1: Statistical analysis of mean pulse rate (bpm)**
DISCUSSION

Pneumoperitoneum used for laparoscopic procedure which is produced by insufflation of carbon dioxide (CO\textsubscript{2}) causes significant haemodynamic variation \[8,9\] like adverse cardiovascular effects due to increase of plasma levels of epinephrine, nor-epinephrine, vasopressin, neurophysin and plasma renin activity increase\[26\]. These changes in turn contribute to increase in heart rate, arterial pressure, systemic and pulmonary vascular resistance and reduced cardiac output. In addition trendelenburg position causes reduction in cardiac output due to decrease in venous return\[6\].

To attenuate these responses, various pharmacological drugs are used like adrenergic receptor blockers\[13\], beta blockers\[14\], Ca channel blocker, lidocaine\[15\], opioids\[16\], pregabalin\[17\], magnesium sulfate\[18\], vasodilators\[19\], remifentanil\[20\].

Nowadays, α-2 agonist due to their beneficial effects like sedation, analgesia, attenuation of stress response and reduction of inhalational agent requirement has been studied to attenuate laparoscopy related adverse responses. Dexmedetomidine is one such drug of alpha-2 agonist category that significantly reduces the release of catecholamines, predominantly having an effect on systemic vascular resistance and improves intra and postoperative haemodynamic stability by stabilizing the changes in heart rate, arterial pressure and cardiac output.

The present study was conducted to evaluate and compare the effects and efficacies of dexmedetomidine on HR, SBP, DBP and MAP during pneumoperitoneum. This study was also aimed to observe any untoward effects of study drugs and effect on sedation after extubation. Selected groups were comparable for the demographic variables like age and weight parameters, type of surgery, sex, duration of pneumoperitoneum and duration of anaesthesia with P>0.05. Effect of intubation and laryngoscopy induced stress response, creation of pneumoperitoneum, reversal of pneumoperitoneum and extubation was seen over heart rate, SBP, DBP and MAP in both the groups but was significantly less in the dexmedetomidine (D) group compared to the control (C) group showing better stability of the hemodynamic vitals in the patients given dexmedetomidine intraoperatively.

Hazra R et al. \[27\] conducted a study in which they administered iv clonidine 1µg/kg, iv dexmedetomidine 1µg/kg and normal saline in three different groups, 15 minutes prior to induction. They observed significant reduction (p<0.05) in heart rate after intubation, 10, 20 and 30 minutes after pneumoperitoneum, after release PNP and after extubation in dexmedetomidine group compared to clonidine and control group. These findings are very similar to our study which stated that dexmedetomidine provides better heart rate control as compared to clonidine and control group in laparoscopic surgeries.

Lawrence CJ and Lange SD \[28\] used 2 µg/kg iv dexmedetomidine and observed that intraoperative heart rate variability, postoperative analgesia and perioperative serum catecholamine concentration were significantly less in dexmedetomidine group (p<0.05). They also found that isoflurane requirement was significantly less in dexmedetomidine group as...
compared to placebo group (24% and 72% respectively). In our study we observed requirement of inhalational agent was significantly reduced in dexmedetomidine group as compared to control group.

SwaikaS et al.[29] supported the use of dexmedetomidine in laparoscopic surgery for attenuating haemodynamic response on comparing dexmedetomidine iv (1µg/kg bolus and 0.2-0.4 µg/kg/hr infusion) and paracetamol iv.

GhodkiPK et al. [30] studied similar doses as used in our study i.e.dexmedetomidine 1 µg/kg over 15 minutes followed by maintenance infusion of 0.2 µg/kg/hr and observed significant reduction (p<0.05) in blood pressure during pneumoperitoneum. They also didn’t observe any incidence of bradycardia.

Tuffanogullari B et al.[31] compared three infusion dose of dexmedetomidine 0.2, 0.4 and 0.8 µg/kg/hr with saline in morbidly obese patients, undergoing laparoscopic bariatric surgery. It was found that intraoperative haemodynamic values were similar in the four groups, arterial blood pressure values were significantly reduced in the dexmedetomidine 0.2, 0.4 and 0.8 groups compared with the control group.

CONCLUSION
Study conducted can be concluded as the creation of pneumoperitoneum in laparoscopic abdominal surgeries produces significant increase of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) and dexmedetomidine by decreasing these responses, stabilizes all haemodynamic parameters (HR, SBP, DBP and MAP) during pneumoperitoneum in laparoscopic abdominal surgeries.

REFERENCES
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