A comparative study of balanced anaesthesia with dexmedetomidine added desflurane or sevoflurane in laparoscopic surgery

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Abstract

Introduction: Laparoscopic surgery is minimally invasive technique. Dexmedetomidine, selectively acts on the alpha 2 receptors in the locus ceruleus, produces sedation and anxiolysis. The intravenous administration of dexmedetomidine before induction of anesthesia attenuates sympathoadrenal responses and provides better hemodynamic stability intraoperatively due to its hypnotic, sedative, anxiolytic, sympatholytic and analgesic properties.. Desflurane and sevoflurane are both fluorinated inhalational anaesthetics characterized by a low blood/gas partition coefficient that favours rapid emergence as compared to other inhalational agents..

Aims and objectives: To compare intra operative hemodynamic stability with dexmedetomidine added to withdesflurane or sevoflurane. To compare extubation time required after discontinuation of desflurane or sevoflurane and dexmedetomidine.

Material and Methods: After obtaining permission from the Institutional ethical committee, a prospective randomized comparative study was carried out After obtaining written informed consent, eighty patients of ASA physical Status I -II aged between 14 to 60 years of either sex who were scheduled for various laparoscopic surgeries under general anesthesia were selected.

After pre-anaesthetic checkup before surgery and all the routine and specific investigations were done and documented. Patients were randomly allocated in two Groups using closed envelope

- Group (D+D) with desflurane and dexmedetomidine infusion
- Group (S+D) with sevoflurane and dexmedetomidine infusion

After standard monitors applied After I.V. line was secured with 18/20 G intracath.Both inhalational anesthetics were subsequently titrated and adjusted to maintain a Minimum Alveolar Concentration (MAC) up to 1.5% for sevoflurane or 3% for desflurane. 0.4µg/kg/h dexmedetomidine infusion was applied both groups and when necessary it was titrated and the dose was increased up to 0.8 µg/kg/h. Titration of dexmedetomidine was targeted to maintain MAP between 70 and 85 mmHg. Inhalation agents and dexmedetomidine infusion was continued until the end of surgery. Inj. Diclofenac sodium slow IV 1.5mg/kg was to be administered to all patients fifteen minutes before the end of the surgery. Fast Tract Criteria at the following 5th and 10th min was assessed in the OR and in 5^{th}, 10th, 25^{th} min in PACU. Patients were discharged from PACU after the FTC score is >13.

Conclusion: We conclude that desflurane / dexmedetomidine combination is superior to sevoflurane / dexmedetomidine in extubation time and in time FTC ≥ 13 in laparoscopic surgery.Intravenous use of dexmedetomidine is effective in controlling haemodynamic response t the time of creation of pneumoperitoneum and extubation, thus maintaining haemodynamic stability perioperatively in patients undergoing laparoscopic surgery.

Keywords: Dexmedetomidine.

Introduction

Laparoscopic surgery is minimally invasive technique potentially offers reduced operative time and morbidity, decreased hospital stay and earlier returns to normal activities, less pain and less postoperative ileus compared with the open surgical procedures and gaining importance in general surgery.[22]

In present era laparoscopic surgery is one of the most commonly practiced surgeries for gall bladder, appendix, hernia, ovary, uterus etc. Due to its well-known advantages, laparoscopic surgery is also termed as patient friendly surgery. General anaesthesia with endotracheal intubation /supraglottic devices are gold standard for laproscopic surgery. Laparoscopic surgery poses anaesthetic challenge due to laryngoscopy and endotracheal intubation, creation of pneumoperitoneum by intra-abdominal insufflation of carbon dioxide (CO2) and positional changes leads to significant hemodynamic alteration due to rise in plasma concentration of catecholamine.

Dexmedetomidine, which was approved by FDA (food and drugs administration) in 1999 is an imidazoline derivative, selectively acts on the alpha 2 receptors in the locus ceruleus, produces sedation and anxiolysis, inhibits release and uptake of norepinephrine.[10,11]

We decided to do this study to provide balanced anaesthesia with dexmedetomidine infusion along with desflurane or sevoflurane for laparoascopic surgeries and compare hemodynamics, as well as recovery scores.

In the present study, after obtaining permission from the ethical committee, 80 patients belonging to ASA Grade I-II, posted for laproscopic surgeries under general anaesthesia were divided into two groups Desflurane with dexmedetomidine (D +D) and sevoflurane with dexmedetomidine (S+D).

Our Primary aim was to compare compare post anaesthesia recovery scores including extubation timings and total amount of dexmedetomidine consumption. Secondary aim was to compare peri-operative hemodynamic changes with dexmedetomidine added to with desflurane or sevoflurane and analgesic requirement.

Materials and Methods

After obtaining permission from the Institutional ethical committee, a prospective randomized comparative study was carried out at tertiary care centre, Ahmedabad.

After obtaining written informed consent, eighty patients of ASA physical Status I -II aged between 14 to 60 years of either sex who were scheduled for various laparoscopic surgeries under general anesthesia were selected with exclusion criteria Patients not willing for study enrollment, Patients taking beta- blockers or α2- agonists, Patients with history of respiratory, cardiovascular, renal diseases, history of hypersensitivity to halogenated anaesthetic agents

All the patient went under a pre-anaesthetic checkup before surgery and all the routine and specific investigations were done and documented. NBM status of 6 hours was checked.

Patients were randomly allocated in two Groups using closed envelope

Group (D+D) with desflurane and dexmedetomidine infusion

Group (S+D) with sevoflurane and dexmedetomidine infusion After standard monitors applied including continuous 5-lead electrocardiogram, vital data -Heart Rate (HR), non-invasive blood pressure(NIBP)- mean systolic, mean diastolic and mean arterial pressure (MAP) and saturation of oxygen (SpO2) were monitored and documented. After I.V. line was secured with 18/20 G intracath. Patient's were pre medicated with Inj. Glycopyrrolate (4 µg /kg), Inj. Ondensetron (80 µ/kg), Inj. Ranitidine (1 mg/kg), Inj. Midazolam (0.1mg/kg), Inj. Fentanyl (1ug/kg) given IV (intravenous) All the patients were pre- oxygenated with 100% oxygen for 3 minutes. Induction was done with Inj. Sodium Thiopentone 5-7mg/kg i.v. In both the groups endotracheal intubation was done with appropriate number of cuffed endotracheal tube which was facilitated with inj succinylcholine 1.5 mg/kg IV. Maintenance – Anaesthesia was maintained in group (D+D) with desflurane 2-4% and in group (S+D) sevoflurane 1-3 %.Both inhalational anesthetics were subsequently titrated and adjusted to maintain a Minimum Alveolar Concentration (MAC) up to 1.5% for sevoflurane or 3% for desflurane. Dexmedetomidine was diluted with 0.9 % NaCl to a concentration of 2 µg/ ml in 50 ml. Dexmedetomidine was prepared and administered by using a syringe pump and applied at the rate of 0.4µg/kg/h dexmedetomidine infusion was applied both groups and when necessary it was titrated and the dose was increased up to 0.8 µg/kg/h. Titration of dexmedetomidine was targeted to maintain MAP between 70 and 85 mmHg.

NDMR and monitor

In the circle system, positive pressure ventilation was employed. The lungs were ventilated by maintaining a tidal volume of 6-8 ml/kg, respiratory rate of 12 to 14 per minute and end –tidal CO_2 concentration of 30-35mmhg.Inhalation agents and dexmedetomidine infusion was continued until the end of surgery.

Inj. Diclofenac sodium slow IV 1.5mg/kg was to be administered to all patients fifteen minutes before the end of the surgery.

At the end of the surgery, neuromuscular blockade was reversed with 50µgm/kg neostigmine and 8µgm/kg Glycopyrrolate. When the TOF ratio of 0.90 will be achieved, all the patients were extubated.After the discontinuation of anaesthetic agents, extubation times, FTC scores at the following 5^{th} and 10^{th} minute were assessed in the OR. Time from anaesthetic discontinuation until eye opening, time from anaesthetic discontinuation to the first following of verbal commands(recovery of consciousness) were assessed. Fast Tract Criteria at the following 5th and 10th min was assessed in the OR and in 5^{th}, 10th, 25^{th} min in PACU.In the post-anesthesia care unit, a blinded observer monitoring was done of all the patients at 5 mins, 10mins, 15minsand every 30 mins fornausea, vomiting and any other side effects, analgesic requirements and vital signs. Postoperative nausea and vomiting were treated with 4 mg of i.v. Ondansetron. Rescue analgesia with 75 mg diclofenac sodium was administered i.m.if pain score(VAS) of > 3.Patients were discharged from PACU after the FTC score is >13.

Fast Tract Criteria (FTC)

Table 1:

Level of consciousness	
Awake and oriented	2
Arousable with minimal stimulation	1
Responsive only to tactile stimulation	0
Physical activity	
Able to move all extremities on command	2
Some weakness in movement of extremities	1
Unable to voluntarily move extremities	0
Hemodynamic stability	
Blood pressure< 15% of baseline MAP	2
Blood pressure 15%-30% of baseline MAP value	1
Blood pressure > 30% of below baseline MAP value0	0
Respiratory stability	
Able to breathe deeply	2
Tachypnea with good cough	1
Dyspnoeic with weak cough	0
Oxygen saturation	
Maintains value >90% on room air	2
Requires supplemental oxygen to maintain oxygen saturation .90%	1
Saturation<90% with supplemental oxygen	0
Postoperative pain assessment	
None or mildiscomfort	2
Moderate to severe pain controlled with iv analgesics	1
Persistent severe pain	0
Postoperative emetic symptoms	
None/mild nausea with no active vomiting	2
Transient vomiting controlled with iv antiemetic	1
Persistent moderate to severe nausea and vomiting	0
Total score	14

Table 2:

	Group (D+D)	**95% CI**	**Group (S+D)**	**95% CI**	**P value**
Age in years (Mean ± SD & range)	40.9±16.8	35.76-46.37	47.07±15.64	40.76-53.037	0.150
Weight in Kg (Mean ± SD & range)	62.2±9.08	60.39-65.09	62.39±9.09	61.56-67.83	0.200
Duration of Surgery (In minutes)	112.33±39..3	100.58-125.6	112.755±36.4	99.29-123.86	0.150

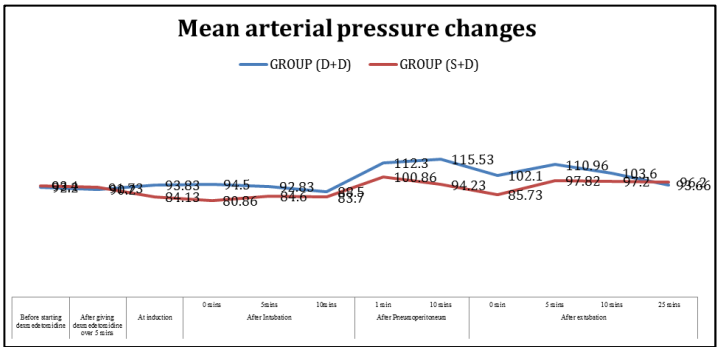

Fig. 1:

Mean arterial blood pressure difference was statistically significant between the two groups after 5 minutes of dexmedetomidine infusion, at induction minutes after intubation 0 minutes and 10 minutes, after pneumoperitoneum 1 minute and 10 minutes and just after extubation 0 minute,5 minutes,10 minutes (p value<0.05)

	Group(D+D) N=40	CI	Group (S+D) N=40	CI	t value	P Value
Dexmedetomidine total dose	36.7±8.4	34.01-39.38	28.04±5.06	25-.76-31.05	5.58	0.000**

Fast track criteria changes in both the groups

Time	Group (D+D)	95%CI	Group (S+D)	95%CI	t value	P value
1 thMin	9.94±1.54	9.80-10.06	9.6±1.28	8.89-10.56	1.07	0.286
5th Min	12.34±1.21	11.6-13.38	12.05±1.12	11.88-13.06	0.74	0.456
10th min	12.84±1.5	12.65-13.84	12.07±1.2	11.89-13.08	2.85	0.005*
15 thmin	13.20±0.92	13.10-14.06	12.7±1.2	12.06-13.80	0.98	0.39
20 thmin	13.46±0.70	12.80-14.06	13.18±1.04	12.08-13.98	1.41	0.161
25 thmin	13.62±0.62	12.65-14.94	13.23±0.72	12.06-16.84	3.39	0.001*

	Group (D+D)	CI	Group (S+D)	CI	t value	P value
Extubation time(in min)	8.17±1.22	7.77-8.56	12.33±2.38	11.56-13.09	9.83	0.000**

Discussion

According to our primary observation of recovery profiles we found (D+D) group superior to (S+D) group because time to reach FTC>13 was earlier in D+D group (15mins) and in S+D group it was seen at 20 mins.

Kels G et al[14] and Jindal et al[15] used Fast track criteria and alderete criteria for recovery profiles and we assessed FTC in our study which helped to study pain, nausea, vomiting and calculated by 14 points and concluded that desflurane / dexmedetomidine combination is superior to sevoflurane / dexmedetomidine in extubation time and time to reach an AC ≥ 9 and FTC ≥ 13 in spinal surgery.

This may be probably due to low solubility of desflurane and low blood gas partition coefficient compared to sevoflurane. Also the Turgut et al found the same results in their study of TIVA together with dexmedetomidine / propofol -the discharge time from PACU as 31.9 ± 4.1 min according to AC. Their extubation time is very similar to that of group (D + D), but PACU time is shorter since the AC at the 15th min was 9.9 ± 0.3 in our study.

Ozkose et al. studied desflurane with dexmedetomdine and found the AC value at the 10th min as 9.2 ± 2.1.In their study anesthesia time was shorter, and the total dexmedetomidine dose was not indicated. The difference between extubation times and AC values may result from these.

Jindal et al[15] studied short day care gynaecological procedures The emergence and early recovery time were shorter after maintenance of anaesthesia with Desflurane. Desflurane group achieved Modified Aldrete Score of 9 significantly faster than patients given Sevoflurane.[4]

Dexmedetomidine significantly reduces the release of Catecholamines, especially Norepinepherine release, thereby attenuating the increase in systemic vascular resistance. It improves intra and post operative haemodynamic stability. Dexmedetomidine was successful in improving intra and post operative haemodynamic stability during laparoscopic surgeries.[11] Intravenous Dexmedetomidine is efficacious in controlling the haemodynamic response to laryngoscopy and tracheal intubation.[8,23]

Hemodynamic response intraoperatively

Our study results shows that there was no significant difference in mean arterial pressure among both the group before induction. Statistically significant reduction in mean arterial blood pressure is found in both the groups after 5 minutes of starting the dexmedetomidine infusion.

In our study there were no changes seen at induction, intubation. In group D+D 10 mins after intubation, 1 min, 10 mins after pneumoperitoneum rise in MAP seen which was highly significant. (Table

7a) whereas in group S+D at 1min after pneumoperitoneum rise was seen which was highly significant.(7b)

Critical incidences like laryngoscopy, intubation, pneumoperitoneum and extubation do significantly increase the HR and MAP in patients undergoing laproscopic surgeries.[2,26]

The decrease in MPR and MAP was because dexmedetomidine has a sympatholytic effect that can attenuate the stress response to surgery, mitigating tachycardia and hypertension and decreases MAP when administered in low or moderate doses and slow rates of infusion.[38] This shows that in our study dexmedetomidine infusion of 0.4-0.8µg/kg/hr resulted in stable mean arterial blood pressure in both the groups which was in agreement with the studies-

Bhattacharjee DP et al[6] studied effect of Dexmedetomidine infusion at 0.2 mcg/kg/hr on haemodynamics in patients undergoing laparoscopic cholecystectomy and concluded that Mean arterial pressure Dexmedetomidine Group were significantly found less after intubation and throughout the period of pneumoperitoneum without prolongation of postoperative recovery.

Dexmedetomidine requirement

Dosage of Dexmedetomidine

Dexmeditomidine has a biphasic, dose-dependent effect on blood pressure. Low dose infusion of 0.25-0.5 µgm/kg/hr results in a monophasic response of 10-15% fall in mean arterial blood pressure and PR and also exhibits linear kinetics. A biphasic response on blood pressure occurs with a bolus dose. Initially, there occurs hypertension followed by fall in blood pressure.[54] However, with higher dose infusion of dexmedetomidine, high incidence of adverse cardiac effects have been observed.[43] It has been used in infusion form with or without bolus dose. Infusion rates varying from 0.1 to 1.0 mcg/kg/h.[43,48,49]

In our study Dexmedetomdine required in D+D group (36.7±8.04)µgms was more as compared to S+D group(28.04±5.06.).µgms

Similar results seen by, Keles GT et al [13] in the study on balanced anaesthesia with desflurane and sevoflurane with added dexmedetomidine in spine surgery and found that dexmedtomidine consumption was more in D+D(40.6±30.6) as compared to S+D (28.9 ±26.1).

Extubation Time

We found that D+D group had significantly faster extubation time (8.77 ±1.22) and recovery profile during laparoscopic surgery than the S+D group (12.33±2.8) in balanced anaesthesia.

Similar results were found by the Kels G et al[14]studied Balanced Anesthesia with Dexmedetomidine added to Desflurane or Sevoflurane in Spinal Surgery found that extubation time is less in desflurane group(5.9 ± 2.4 mins) as compared to sevoflurane(8.3 ± 3.9)mins.

This may be due to the fact that the elimination of desflurane is faster and elimination does not defer with use of dexmedetomdine.

Ravi Jindal et al[4] did Comparison of maintenance and emergence characteristics after desflurane or sevoflurane in laparoscoic gynecological surgery found that desfl urane have shorter emergence times as compared to sevoflurane.

Feb Rörtgen D et al did Comparison of early cognitive function and recovery after desflurane or sevoflurane anaesthesia in the elderly Emergence was significantly faster in the desflurane group for 'time to open eyes' and 'time to extubation'.[8]

Dexter et al did Statistical modeling of average and variability of time to extubation for meta-analysis on 32,792 patients comparing desflurane to sevoflurane. Desflurane reduced the mean extubation time by 25% (95% CI 17%-32%, P < 0.0001) and standard deviation by 21% (95% CI 16%-26%).[8]

Post operative duration of analgesia

In our study, pain was assessed using visual analogue score (0-10),if VAS >4, rescue analgesic, inj. Diclofenac 1.5 mg/kg was given. We found non significant variation in post operative duration of analgesia requirement in both the groups.

Kels G et al[14] dexmedetomidine reduced analgesic requirement especially in group (D+D) without respiratory depression. Postoperative analgesic use in group (D+D) is statistically less than that in group (S+D).

Dexmedetomidine produces analgesia effect by an action on alpha receptor within the locusceruleus and the spinal cord. Dexmedetomidine has an analgesic-sparing effect, significantly reducing opioid requirements both during and after surgery[42] and this could be reason for long duration of post op analgesia requirement.

Manne GR et al[33] observed that low dose dexmedetomidine infusion in the dose of 0.4 mcg/kg/h reduces post –operative analgesic requirements is very similar to our study[33]

The analgesic effects of dexmedetomidine have been demonstrated in numerous studies Similarly, In our study, dexmedetomidine reduced analgesic

requirement. In this study, we too found that better treatment can be achieved with dexmedetomidine depending on its dose.

It is emphasized that when dexmedetomidine is used in laparoscopic surgery patients during the surgery, the need for analgesics during the postoperative period is less and later.

Periopertaive complications

In our study we found that nausea was seen in 2 subjects in group D+D and 1 in S+D. vomiting was complained by 1 in D+D group. Bradycardia was seen in S+D group by 1 patient whereas tachycardia was seen in 2 patients in D+D group and in 1 in S+D group. Hypotension was seen by 1 in S+D group and hypertension by 1 Patient in D+D group.

With higher dose infusion of dexmedetomidine, high incidence of adverse cardiac effects have been observed. A biphasic response on blood pressure occurs with a bolus dose. Initially, there occur hypertension followed by fall in blood pressure. This response is seen often more in young and healthy patients. Stimulation of α2 B receptor in vascular smooth muscles is said to be responsible for this.[30]

Massad et al[29] reported incidence of nausea and vomiting after combining dexmedetomidine to provide balanced anaesthesia in laparoscopic gynecological surgeries. Of the 42 patients in the dexmedetomdine group 13 (31%) experienced nausea and vomiting.

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Conflict of interest

None.

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