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Use of Surgical Plethysmographic Index to Assess the Effect of Dexmedetomidine on Hemodynamic Response to Intubation and Surgical Stress

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Abstract

Aims: To study the use of surgical plethysmographic index in assessing the effects of dexmedetomidine in attenuating the hemodynamic stress response. *Materials and Methods:* A two group comparative study was done on 60 patients of ASA I and II patients undergoing elective laproscopic cholecystectomy under general anesthesia in a tertiary referral hospital setting. Group F received 100 ml of normal saline while Group D received 0.5 μg/kg of dexmedetomidine in 100 ml normal saline. *Results:* We found that rise in Heart Rate, Systolic and Diastolic BP and Mean Arterial Pressure was significantly attenuated in the dexmedetomidine group. The Surgical plethysmographic index (SPI) was also reduced. The SPI changed earlier than heart rate and blood pressure in response to stimulation. Opioid and propofol need was also significantly reduced. Endocrine stress response was also attenuated as noted by the lower readings of blood sugar during the surgery in the dexmedtomidine group. *Conclusion:* Surgical Plethysmographic Index is an effective indicator of analgesic depth. Dexmedetomidine attenuates the hemodynamic and neuroendocrine stress response to intubation and surgery and has opioid and anesthetic sparing effects.

Keywords: Surgical plethysmography index; Dexmedetomidine; Heart rate; Mean arterial pressure; Endocrine stress response.

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Introduction

Painful stimulation causes sympathetic responses of the autonomic nervous system. During a surgery, such responses are normally suppressed by analgesic medication. If administration of analgesia is inadequate relative to the level of the stimulation, the patient may show responses such as increased heart rate and peripheral vasoconstriction.[1]

Dexmedetomidine was introduced in clinical practice in the USA in 1999 and was initially approved by the FDA only as a short-term (< 24 hours) sedative for ventilated adult patients in the ICU but is now used widely in anesthesia practice as an analgesic.[2]

In our study, we seek to assess the analgesic effectiveness in adding dexmedetomidine to the standard anesthetic medication by measuring the attenuation of changes in the heart rate and blood pressure and the Surgical Plethysmograhic Index

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(SPI) during endotracheal intubation and first surgical incision. The SPI is a novel index which derives the changes in heart rate and blood pressure from the plethysmographic signal that is measured by a pulse oximeter.[3]

The opioid and anesthetic sparing effects of dexmedetomidine were also assessed and effectiveness in attenuating endocrine stress response was measured indirectly by change in blood glucose levels.

Objective

1. To compare the hemodynamic response in relation to heart rate and mean arterial pressure in patients following intubation and first surgical incision;
2. To estimate the difference in surgical plethysmographic index between the two groups following tracheal intubation and first surgical incision;
3. Correlation of surgical plethysmographic index with heart rate and mean arterial pressure;
4. To compare propofol consumption in the two groups;
5. To compare opioid consumption in the two groups;
6. To compare neuroendocrine stress response by estimating blood glucose levels in the two groups one hour after incision.

Materials and Methods

After the approval from the hospital ethics committee, on 23rd November 2017, this two group comparative study was conducted in a tertiary referral hospital setting on 60 patients posted for elective laproscopic cholecystectomy, over a period of 15 months from January 2018 to June 2019. Written informed consent was obtained from all patients who participated in the study. The operative surgeon also was duly informed.

Inclusion Criteria

- ASA I and II class of patients. Age between 18 and 60 years.

Exclusion Criteria

- Conversion to open procedure. Patients with chronic obstructive pulmonary disease;
- Patients with anticipated difficult airway. Day care patients. Obese patients BMI > 30 kg/m^2. Patients with hypothyroidism. Pregnant and lactating mothers.

Sample size

Based on the study by Bajwa et al.[4] and using the formula. Ref. Kumar & Bhalerao[5]

$$n = \frac{2(Z_\alpha + Z_{1-\beta})^{2\sigma^2}}{\Delta^2}$$

In order to get a 5% level of significance and 80% power, the number of patients required in each group was 30, with a total of 60 patients.

Method of allocation used: Sequential. The first 30 consecutive patients were allotted to Group F and the next 30 were allotted to Group D.

Protocol

Preanesthetic evaluation, Written and informed consent was done on the evening before surgery as per our hospital protocol. Patients were allocated into either of Two Groups, Group D and group F of 30 patients each. Group D received 0.5 μg/kg of dexmedetomidine. Group F received normal saline. Premedication was done as per the hospital protocol for both groups similarly. On receiving the patient, Electrocardiogram (ECG), Noninvasive Blood Pressure (NIBP), pulse oximeter and temperature probe were connected from AISYS-CS^2 (R) machine. Surgical Plesthysmographic Index (SPI) recording was turned on. Baseline readings were noted.

Heart rate, systolic, diastolic and mean arterial blood pressure, and surgical plethysmographic index were recorded during the administration of the drug, after premedication, after induction, every minute for the first 5 minutes after intubation, thereafter, every 5 minutes, on surgical incision and every minute for the first 5 minutes after incision and thereafter, for every 5 minutes. Random blood sugar was recorded at surgical incision and 1 hour postincision.

On receiving the patients in PACU, HR, SBP, DBP, MAP and Modified Ramsay Sedation Score were noted on arrival, 30 min and 60 min after arrival.

Results

The mean age of patients in Group F was 41.83 years and that of patients in Group D was 37.2 years. Not

significant (p = 0.100). The number of males and females in Group F were 14 and 16 respectively and in Group D were 14 and 16 respectively. Not significant. (p = 1.000)

The mean BMI of patients in Group F was 25.37 kg/m^2 and that of Group D was 25.39 kg/m^2. Not significant, (p = 0.975).

The mean heart rate of patients in the both groups was comparable at baseline (p = 0.703). We observed that the percentage drop in heart rate from baseline to after premedication in Group F was 6.85% and that of Group D was 10.75%, which was not significant (p = 0.146). At intubation, the mean heart rate in Group D was 73.83 bpm which was significantly lower than that of Group F's mean 83.43 bpm (p = 0.002). From "1 minute postintubation" to "5 minutes postintubation", and from "0 minutes at incision to 5 minutes postincision" and at 30 minutes, 60 minutes and 90 minutes postcompletion of drug administration the heart rate of patients in Group D was significantly lower than that of Group F (p < 0.001). These differences normalized at 120 minutes, shown in (Table 1).

Table 1: Comparison of Heart rate (bpm) between the two groups

Heart rate (bpm)	Group F	Group D	p - value
Baseline	82.93 ± 16.63	81.60 ± 9.28	0.703
After premedication	76.90 ± 13.61	72.67 ± 7.88	0.146
Intubation			
0 min	83.43 ± 14.07	73.83 ± 8.79	0.002**
1 min	101.57 ± 13.61	73.40 ± 8.72	< 0.001**
2 min	98.43 ± 13.33	72.73 ± 9.62	< 0.001**
3 min	94.60 ± 13.96	72.10 ± 8.81	< 0.001**
4 min	92.87 ± 13.80	71.37 ± 9.79	< 0.001**
5 min	88.97 ± 13.83	70.37 ± 8.78	< 0.001**
Incision			
0 min	87.60 ± 11.90	68.70 ± 9.40	< 0.001**
1 min	99.13 ± 12.43	68.70 ± 8.73	< 0.001**
2 min	97.63 ± 12.83	68.17 ± 9.14	< 0.001**
3 min	93.97 ± 12.19	67.10 ± 8.34	< 0.001**
4 min	91.07 ± 9.87	67.90 ± 9.03	< 0.001**
5 min	88.80 ± 9.75	67.20 ± 9.09	< 0.001**
Postdrug#			
30 min	86.80 ± 9.69	66.20 ± 6.83	< 0.001**
60 min	91.77 ± 9.02	66.53 ± 5.41	< 0.001**
90 min	80.73 ± 13.44	63.97 ± 12.98	< 0.001**
120 min	73.17 ± 10.37	67.83 ± 4.62	0.013*

#: Post drug - time after completion of administration of premedication.

The Mean Arterial Blood Pressure (MAP) in both the groups at baseline was comparable. After premedication, MAP in Group D was significantly lower than Group F (p = 0.001). The MAP in Group F at intubation i.e. 0 minutes was significantly lower than Group D. MAP from 1 minute postintubation to 3 minutes and 4 minutes postintubation was significantly higher in Group F when compared to Group D (p < 0.001). At 5 minutes postintubation, there was no significant difference in the MAP between the two groups (p = 0.953).

From 1 minute postincision to 4 minutes postincision, MAP in Group F was significantly higher as compared to Group D (p < 0.001). MAP at 30 minutes and 60 minutes postdrug administration in Group D was significantly lower than Group F. MAP in Group F was lower than Group D at 90 minutes, however, the difference was only moderately significant (p = 0.022). At 120 minutes, there was no statistically significant difference in the MAP between the two groups (p = 0.504), (Table 2).

Table 2: Comparison of SBP (mm Hg) between the two groups

SBP (mm Hg)	Group F	Group D	*p* - value
Baseline	129.20 ± 13.29	126.27 ± 9.66	0.240
After premedication	123.10 ± 12.58	112.93 ± 8.82	0.001**
Intubation			
0 min	104.53 ± 9.46	109.00 ± 8.59	0.061 +
1 min	143.83 ± 11.14	111.63 ± 7.48	< 0.001**
2 min	136.60 ± 9.82	109.77 ± 8.79	< 0.001**
3 min	125.63 ± 9.56	108.23 ± 8.33	< 0.001**
4 min	114.43 ± 9.11	107.30 ± 9.09	0.004**
5 min	103.97 ± 9.12	105.63 ± 8.45	0.466
Incision			
0 min	100.23 ± 8.38	102.27 ± 7.79	0.334
1 min	133.43 ± 11.22	101.83 ± 9.01	< 0.001**
2 min	130.57 ± 12.31	101.10 ± 8.86	< 0.001**
3 min	121.37 ± 11.39	101.60 ± 8.61	< 0.001**
4 min	105.23 ± 8.70	100.77 ± 8.31	0.047*
5 min	99.83 ± 6.52	100.13 ± 8.82	0.881

The baseline systolic blood pressure in both groups were comparable (p = 0.240). After completion of premedication, SBP in Group D was significantly lower than Group F (p < 0.001). At intubation (0 minutes), the SBP in Group F fell by 18.88% from the baseline. At 1 and 4 minutes postintubation, systolic blood pressure in Group D was significantly lower than Group F (p = 0.004). Difference in systolic blood pressure at 5 minutes postintubation and at 0 minutes at incision was statistically insignificant.

The SBP was significantly higher in Group F from 1 minute postincision to 3 minutes postincision (p < 0.001). At 4 minutes postincision, the difference in systolic blood pressure in both groups was only moderately significant (p = 0.047). By the 5^{th} minute postincision, systolic blood pressure was comparable in both the groups (p = 0.881), (Table 3).

Table 3: Comparison of MAP (mm Hg) between the two groups

MAP (mm Hg)	Group F	Group D	*p* - value
Baseline	94.10 ± 7.44	91.83 ± 7.36	0.109
After premedication	89.70 ± 6.71	83.60 ± 6.48	0.001**
Intubation			
0 min	74.30 ± 5.97	81.53 ± 5.83	< 0.001**
1 min	103.00 ± 8.28	83.13 ± 6.52	< 0.001**
2 min	95.73 ± 8.29	81.93 ± 7.04	< 0.001**
3 min	90.03 ± 7.35	80.30 ± 6.08	< 0.001**
4 min	84.60 ± 7.30	79.10 ± 6.59	0.003**
5 min	77.93 ± 6.52	78.03 ± 6.69	0.953
Incision			
0 min	75.23 ± 6.21	76.07 ± 5.50	0.584
1 min	97.17 ± 7.85	74.77 ± 6.70	< 0.001**
2 min	91.83 ± 8.09	74.37 ± 7.80	< 0.001**
3 min	86.60 ± 8.50	72.83 ± 7.18	< 0.001**
4 min	79.40 ± 7.30	72.67 ± 6.09	< 0.001**
5 min	75.50 ± 6.32	72.30 ± 6.84	0.065 +
Postdrug			
30 min	75.70 ± 6.49	70.90 ± 7.19	0.009**
60 min	84.20 ± 7.27	72.63 ± 6.64	< 0.001**
90 min	70.27 ± 5.34	73.80 ± 6.21	0.022*
120 min	80.83 ± 5.97	81.93 ± 6.68	0.504

The Diastolic Blood Pressure (DBP) in both groups were comparable at baseline (p = 0.532). After premedication, DBP in Group D was lower than Group F but it was only moderately significant (p - 0.031). DBP at intubation (0 minutes) was significantly lower in Group F when compared to Group D (p < 0.001). At 1, 2, and 3 minutes postintubation, DBP in Group F was significantly higher than Group D (p = 0.001). At 4 minutes postintubation, DBP was lower in Group D but the difference was only moderately significant (p = 0.019). At 5 minutes postintubation, there was no significant difference in DBP in both the groups (p = 0.746).

At incision (0 minutes), there was no significant difference between the two groups (p = 0.827). From 1 minute to 4 minutes postincision, DBP in Group F was significantly higher as compared to Group D (p < 0.001). At 5 minutes postincision, the difference between the groups was only moderately significant (p = 0.015), (Table 4).

Table 4: Comparison of DBP (mm Hg) between the two groups

DBP (mm Hg)	Group F	Group D	p - value
Baseline	76.53 ± 8.61	75.20 ± 7.79	0.532
After premedication	73.13 ± 7.44	69.10 ± 6.68	0.031*
Intubation			
0 min	59.13 ± 5.68	67.80 ± 5.71	< 0.001**
1 min	82.70 ± 8.15	68.90 ± 7.19	< 0.001**
2 min	75.27 ± 8.89	68.07 ± 7.46	0.001**
3 min	72.20 ± 8.16	66.23 ± 6.36	0.003**
4 min	69.70 ± 8.63	64.9 ± 6.61	0.019*
5 min	64.90 ± 7.54	64.30 ± 6.72	0.746
Incision			
0 min	62.67 ± 7.24	63.03 ± 5.59	0.827
1 min	79.03 ± 8.07	61.27 ± 6.54	< 0.001**
2 min	72.50 ± 8.11	61.07 ± 8.25	< 0.001**
3 min	69.07 ± 9.06	58.53 ± 7.64	< 0.001**
4 min	66.50 ± 8.21	58.70 ± 6.40	< 0.001**
5 min	63.30 ± 7.80	58.47 ± 7.06	0.015*

The surgical plethysmographic index at baseline were comparable (p = 0.750). At 1 minute and 2 minutes postintubation, SPI was significantly higher in Group F when compared to Group D (p < 0.001). At 3 minutes the difference was only moderately significant (p = 0.012). At 4^{th} and 5^{th} minute postintubation, there was no significant difference between the two groups. At incision (0 minutes), SPI in Group F was significantly higher than Group D. Also, there was a significant rise in SPI at 0 minutes from the previous value. This reactivity of SPI was attenuated by using dexmedetomidine in Group D. From 1 minute to 3 minutes postincision, there was a significant difference in SPI between the two groups. At 4^{th} minute postincision, SPI started returning towards baseline and the difference between the two groups at this timeline was only moderately significant (p = 0.030). At 5^{th} minute postincision, there was no significant difference between the two groups (p = 0.183), (Table 5).

Table 5: Comparison of SPI between the two groups

SPI	Group F	Group D	p - value
Baseline	40.67 ± 11.67	42.17 ± 11.86	0.750
After premedication	38.33 ± 9.31	39.90 ± 10.10	0.240
Intubation			
0 min	36.20 ± 9.63	38.67 ± 9.61	0.325
1 min	55.83 ± 8.97	36.07 ± 10.22	< 0.001**
2 min	45.10 ± 11.41	34.03 ± 10.16	< 0.001**

SPI	Group F	Group D	*p* - value
3 min	39.93 ± 9.89	33.53 ± 9.31	0.012*
4 min	33.30 ± 7.80	32.50 ± 9.65	0.725
5 min	30.53 ± 8.21	32.17 ± 9.33	0.475
Incision			
0 min	39.83 ± 6.46	31.50 ± 9.16	< 0.001**
1 min	53.40 ± 8.22	32.73 ± 8.84	< 0.001**
2 min	47.27 ± 8.17	31.53 ± 9.64	< 0.001**
3 min	40.77 ± 8.31	29.80 ± 8.28	< 0.001**
4 min	34.53 ± 7.03	29.93 ± 8.91	0.030*
5 min	32.47 ± 7.95	29.77 ± 7.56	0.183

The total fentanyl and morphine used in Group D was significantly lower than Group F ($p < 0.001$). The total propofol consumption in Group D was also significantly lower when compared to Group F ($p < 0.001$), (Table 6). The baseline RBS in both groups were comparable ($p = 0.137$). At one hour postincision, the rise in RBS was higher in Group F as compared to Group D ($p = 0.001$), (Table 7).

Table 6: Comparison of total fentanyl (μg), total morphine (mg) and total propofol (mg) requirement between the two groups

	Group F	Group D	*p* - value
Total fentanyl (μg)	176.67 ± 23.21	139.67 ± 19.91	< 0.001**
Total morphine (mg)	4.47 ± 0.73	0.10 ± 0.55	< 0.001**
Propofol (mg)	84.67 ± 17.32	63.17 ± 12.63	< 0.001**

Table 7: Comparison of RBS (mg/dl) levels between the two groups

RBS (mg/dl)	Group F	Group D	*p* - value
0 hr	110.77 ± 20.05	102.67 ± 21.54	0.137
1 hr	128.73 ± 18.61	110.77 ± 20.67	0.001**

In our study, out of the 30 patients allotted to Group F, 24 of them received a score of 2 on the Modified Ramsay Sedation Scale on arrival to PACU. Six out of the 30 received a score of 3 on arrival to PACU. Whereas in Group D, 18 out of 30 received a score of 2 and 12 received a score of 3. The difference in sedation score in both the groups was only suggestive of significance at this timeline ($p = 0.094$). Thirty minutes after arrival in PACU, all patients in Group F received a score of 2 on MRSS. In Group D, 25 out of 30 patients received a score of 2. Five out of 30 received a score of 3. The difference in sedation score between both groups at this timeline was moderately significant ($p = 0.019$). At the end of one hour in PACU, all patients in both groups received a score of 2 on MRSS, (Table 8).

Table 8: Comparison of MRSS between the two groups

MRSS	Group F	Group D	*p* - value
on Receiving	2.20 ± 0.41	2.40 ± 0.50	0.094 +
30 min	2.00 ± 0.00	2.17 ± 0.38	0.019*
1 hour	2.00 ± 0.00	2.00 ± 0.00	–

Since, there was maximum response at 1 minute postintubation and 1 minute postincision, we looked at correlation of heart rate vs surgical plethysmographic index and heart rate *vs* mean arterial pressure at those timelines. In both groups, there was only trivial to small correlation between HR and SPI, and MAP and SPI, (Table 9).

Table 9: Correlation between SPI and heart rate, SPI and MAP at baseline, 1 minute postintubation and 1 minute postincision

Pair	Group F		Group D	
	r - value	*p* - value	*r* - value	*p* - value
Heart rate vs SPI				
HR *vs* SPI @ baseline	0.270	0.148	-0.043	0.822
HR *vs* SPI @ 1 min Intubation	0.025	0.894	0.081	0.671
HR *vs* SPI @ 1 min Incision	0.267	0.154	0.049	0.795
MAP vs SPI				
MAP *vs* SPI @ baseline	–0.254	0.176	0.398	0.029*
MAP *vs* SPI @ 1 min Intubation	0.042	0.825	0.220	0.242
MAP *vs* SPI @ 1 min Incision	–0.169	0.372	0.106	0.577

Discussion

Laryngoscopy, intubation and surgical incision induce a stress response characterized by cardiovascular response in the form of hypertension and tachycardia. This sympathoadrenal stress response results in increased myocardial O_2 demand leading to ischaemia and acute heart failure in susceptible individuals. Alpha-2 receptor agonists (such as Dexmedetomidine) are known to decrease heart rate and blood pressure, cause arousable sedation and provide analgesia without causing significant respiratory depression and are widely used in clinical practice in anesthesiology and critical care.[6]

We noted a significant attenuation of hemodynamic response (HR, SBP, MAP, DBP) to intubation and surgical incision with dexmedetomidine at a low-dose of 0.5 μg/kg as compared to the control group ($p < 0.001$).

SBP was significantly lower in Group D. However, at intubation (0 minutes), the mean SBP was lower in Group F when compared to Group D. This may probably be due to a higher requirement of propofol in Group F. Hence, the difference in systolic blood pressure between the two groups was only suggestive of significance at this timeline ($p = 0.061$). The systolic blood pressure in Group F from 1 minute postintubation to 3 minutes postintubation and from 1 minute postincision to 3 minutes postincision was significantly higher ($p < 0.001$). This is suggestive of pressor response being blunted better in Group D.

MAP was significantly lower in Group D. Findings from baseline to 5 minutes postincision were similar to that of SBP. MAP at 30 minutes postdrug administration in Group D was significantly lower than Group F ($p = 0.009$). At this timeline, percentage change in MAP was greatest among all timelines. However, the lowest recorded MAP at this timeline was 61 mm Hg. At 120 minutes, there was no statistically significant difference in the MAP between the two groups ($p = 0.504$). Findings of DBP were similar to that of SBP and MAP.

Bajwa SS[3] et al. in their study used dexmedetomidine in the dose of 1 μg/kg and found that dexmedetomidine significantly decreased the hemodynamic response to intubation. They also, demonstrated a decrease in fentanyl and isoflurane dose required in their study group. Although, we used a lower-dose in our study, our findings were consistent.

Keniya VM et al.[6] found that dexmedetomidine in a dose of 1 μg/kg lowered the percentage increase in systolic blood pressure, diastolic blood pressure and heart rate significantly. In our study, we also studied, the effect of dexmedetomidine on a novice index known as Surgical Plethysmographic Index (SPI).[7] SPI is a noninvasive, inexpensive technique which gives beat to beat information of the depth of analgesia of the patient.

Both the heart rate and the plethysmographic amplitude are normalized in order to decrease interpatient variability by applying a histogram transformation on the raw time serial data. Then a linear combination of the normalized values is computed as SPI = 100-(0.7*PPGAnorm + 0.3*HBInorm), in which PPGAnorm is the normalized plethysmographic pulse wave amplitude and HBInorm the normalized heart beat interval. Surgical Plethysmographic Index has been validated as a tool to guide analgesia.[8–11]

In our study, we found that SPI was significantly higher in Group F when compared to Group D ($p < 0.001$). At incision (0 minutes), SPI in Group F was significantly higher than Group D. Also, there was a significant rise in SPI at 0 minutes from the

previous value. Whereas, there was no such change in heart rate or MAP, indicating SPI reacts almost immediately to nociceptive stimuli even before there is a change in heart rate. This occurs as SPI not only takes into account heart beat interval, but also pulse wave amplitude which depends on peripheral vasoconstriction. This reactivity of SPI was attenuated by using dexmedetomidine in Group D.

In the present study, since, there was maximum response at 1 minute postintubation and 1 minute postincision, we looked at correlation of heart rate *vs* surgical plethysmographic index and heart rate *vs* mean arterial pressure at those timelines. In both groups, there was only trivial to small correlation between HR and SPI, and MAP and SPI. SPI is not only based on heart beat interval, but also pulse wave amplitude reflecting peripheral vasoconstriction, which may be the reason why SPI did not correlate with heart rate.

Dexmedetomidine mediates analgesia through stimulation of the α_2C and α_2A receptor in the dorsal horn, reducing the release of pronociceptive transmitters, substance P and glutamate, and hyperpolarization of interneurons. Systemic use has an opioid-sparing effect. This effect is advantageous in patients who are prone to postoperative apnea or hypoventilation, such as patients undergoing bariatric surgery. In our study, we compared the requirement of opioids in the two groups. There was a significant reduction in consumption of both fentanyl and morphine ($p < 0.001$). This finding was similar to that of Bajwa SS[3] et al. who used dexmedetomidine in the dose of 1 μg/kg as premedication and found that the requirement for fentanyl and isoflurane were both reduced in the patients who received dexmedetomidine.

Dexmedetomidine is also known to decrease the anesthetic requirement during general anesthesia. In our hospital, loss of verbal contact with the patient is used as end point of induction of propofol. We found that the total dose of propofol required in study Group D was significantly lower ($p < 0.001$). As a higher-dose of propofol was used in the Group F that did not receive dexmedetomidine, hypotension was seen more in this group. Our findings were similar to that of Morgan Le Guen et al. [12] who also demonstrated a decrease in propofol and remifentanil requirement during their study.

Turgut N et al.[13] used dexmedetomidine in a bolus dose of 0.6 µg/kg before induction and 0.2 μg/kg/hr by infusion. They found that propofol dosages for induction and maintenance of anesthesia were lower with dexmedetomidine. The fentanyl group patients required supplemental analgesia earlier than the dexmedetomidine group.

Suvadeep Sen et al.[14] also, in their study demonstrated a reduction in propofol requirement in patients who received dexmedetomidine. Surgery and anesthesia cause an endocrine stress response leading to release of multiple hormones like renin, glucagon, ACTH, cortisol, ADH, GH, etc. There is also inhibition of insulin release. This eventually leads to hyperglycemia. In our study, we looked at rise in serum glucose levels in both groups to see if dexmedetomidine decreased the endocrine stress response. We found that serum glucose levels was significantly lower in the group receiving dexmedetomidine ($p < 0.001$). This finding was similar to the study conducted by Ahmed G Yacout et al.[15] They evaluated the effect of intravenous dexmedetomidine infusion on stress response markers as plasma interleukin-6, cortisol and blood glucose level. Postoperatively, the levels of interleukin-6, cortisol and blood glucose were significantly lower in the group that received dexmedetomidine.

On the contrary, Kumkum Gupta et al.[16] found no difference in blood glucose levels between the two groups they studied. One group received intravenous dexmedetomidine 1 μg/kg and and other received fentanyl 2 μg/kg. Blood glucose concentration has shown 20% increase after surgery. The differences between the groups were not statistically significant as observed by analyzing the variation of serial perioperative blood glucose estimation.

Conclusion

1. On the basis of the study, we conclude that intravenous dexmedetomidine significantly attenuates hemodynamic response to intubation and surgical incision.
2. Surgical plethysmographic index, an index to measure depth of analgesia was also attenuated with dexmedetomidine.
3. There is no correlation of heart rate and mean arterial pressure with surgical plethysmographic index.
4. Surgical plethysmographic index detects noxious stimulation prior to heart rate and blood pressure.
5. Opioid requirement is significantly lowered by use of dexmedetomidine as a premedicant.
6. Dexmedetomidine decreases anesthetic

requirement significantly.

7. Dexmedetomidine attenuates neuroendocrine stress response to anesthesia and surgery as seen by lower blood glucose levels in the study group.
8. Hypotension and bradycardia requiring intervention was not seen in the dexmedetomidine group as a low-bolus dose was administered.
9. Postextubation, patients of the dexmedetomidine group were more sedated than the fentanyl group on arrival at PACU, however, at the end of two hours, there was no difference between the two groups.

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