

Comparison of Dexmedetomidine and Propofol on Haemodynamics, Ionic Balance and Postop Sedation in Brachial Plexus Repair Surgery: An Entropy Guided Prospective Trial

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Abstract

Context: Propofol is the commonly used intravenous drug to maintain adequate depth of anaesthesia in brachial plexus repair surgery under general anaesthesia without muscle relaxant. It has rapid onset of action, antiemetic effect and rapid emergence but causes respiratory and cardiac depression. Dexmedetomidine, an adrenergic agonist, with sedative, analgesic and anaesthetic sparing effects is an alternative intravenous drug to maintain depth of anaesthesia. **Aims:** We designed a prospective study to see the effect of intravenous infusion of dexmedetomidine and propofol on haemodynamics, ionic balance and postop sedation in brachial plexus repair surgery under the guidance of entropy. **Methods:** Fifty patients undergoing brachial plexus repair surgery were randomly divided into two groups of twenty five each. Group D group patients received 1 µg/kg dexmedetomidine iv loading dose for 10 min followed by infusion of 0.2 to 0.6 µg/kg/hr. Group P patients received propofol 1 mg/kg iv loading dose followed by infusion of 2 to 3 mg/kg/hr to maintain intraoperative entropy range from 40 to 60. Haemodynamics was noted at baseline, 1 minute, 5 minutes, 10 minutes, 15 minutes, 30 minutes after intubation and later every 30 minutes till the end of the surgery. ABG was analysed at baseline, 2 hours after intubation and half hour before extubation. Postop sedation score was noted immediate after extubation, 30 minutes and 60 minutes post extubation. **Results:** D group had significant lesser heart rate from the baseline than P group. Systolic blood pressure, Diastolic blood pressure and Mean arterial pressure at 1 minute and 5 minutes after intubation, intraoperative state and response entropy were significantly lower than the baseline in P group than D group. P group also had more postop sedation score at extubation and 30 minutes post extubation than D group. ABG was maintained in the normal range, but P group had less pH, less Serum bicarbonate, and less base excess before extubation and less serum potassium 2 hours after intubation than D group. Other parameters of demographics, pO₂, serum lactate, sodium, potassium and chloride were similar in both the groups. **Conclusion:** Intravenous Dexmedetomidine is an alternative adjuvant to propofol to maintain depth of anaesthesia for brachial plexus repair surgery with stable haemodynamics, blood gas towards normal range and low postop sedation scores.

Keywords: Brachial Plexus; Dexmedetomidine; Propofol; Entropy.

Introduction

As surgeons prefer to operate brachial plexus repair surgery under general anaesthesia without muscle relaxant, adequate depth of anaesthesia is required to prevent intraoperative awareness, to maintain haemodynamic stability and to reduce postoperative recall. Propofol, an alkyl phenol compound, is the commonly used intravenous drug to maintain depth of anaesthesia. It has the

advantage of rapid onset of action, antiemetic effect, euphoria and rapid emergence [1]. But it has no analgesic effect and causes dose dependent respiratory depression and hypotension [2]. Propofol infusion may cause lactic acidosis [3].

Dexmedetomidine, an imidazole compound and highly selective α_2 adrenergic agonist is another drug available clinically to maintain the depth of anaesthesia alternative to propofol. It has sedative, analgesic and anaesthetic sparing effect without causing respiratory

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Received on 04.04.2018, Accepted on 10.04.2018

depression [4]. Due to sympatholytic effect, it decreases norepinephrine release and reduces heart rate and mean arterial pressure [4]. It allows early awakening after surgery.

Depth of anaesthesia is measured by EEG dependant indices like BIS and entropy. Entropy yields two parameters: state entropy (SE) and response entropy (RE). Response entropy indicates nociception and state entropy states the depth of anaesthesia. Response entropy values are from 0 to 100 and state entropy ranges from 0 to 91. Response entropy is always equal to state entropy or (0 to 10) more than state entropy. Number Zero indicates patient is in very deep planes of anaesthesia and 100 entropy value indicates patient is fully conscious. To ensure adequate depth of anaesthesia, entropy in the range 40 to 60 is maintained [5,6].

As there are very few studies done on dexmedetomidine and propofol in brachial plexus repair surgeries, we designed a prospective study so as to see the effect of dexmedetomidine and propofol on haemodynamics, ionic balance and postop sedation under entropy guidance.

Methods

Our prospective study of fifty patients was randomized into two groups of twenty five each (by sealed envelope method) after obtaining approval from the institute ethics committee and written informed consent from the patients .

Group D: Patients received iv dexmedetomidine infusion.

Group P: Patients received iv propofol infusion.

Inclusion Criteria

ASA grade I-II patients of both genders aged 18 to 65 years posted for elective brachial plexus repair surgery.

Exclusion Criteria

ASA grade III-IV
Neurologic disease
Psychiatric illness
Haemodynamic instability
Patients on sedative drugs, analgesics
Hyperkalemia
Pseudocholinesterase Deficiency.

Our patients were premedicated with tablet Alprazolam 0.5 mg and tablet ranitidine 150mg evening before and on the morning of day of surgery.

After arrival in the operating room, the demographic data (age, gender, weight and ASA grade) was noted. The patients were connected to the monitors: electrocardiogram (ECG), noninvasive blood pressure (NIBP), pulse oximetry (SpO₂), endtidal carbon dioxide (ETCO₂) and entropy. After securing good intravenous (iv) line, the patients were premedicated with injection glycopyrrolate 0.1 mg, injection midazolam 1 mg and injection fentanyl 2½µg/kg. The baseline Heart rate (HR), systolic blood pressure (SBP), Diastolic blood pressure (DBP), Mean arterial blood pressure (MAP), ETCO₂, SpO₂, Response entropy (RE) and State entropy (SE) and arterial blood gas analysis (ABG) (taken from radial artery of the nonoperating hand) were noted. The patients were preoxygenated for three minutes and induced with thiopentone 5 mg/kg iv. After administering short acting muscle relaxant injection Suxamethonium chloride 1 mg/kg, the patients were intubated with appropriate size endotracheal tube. In group D, the patients received 1µg/kg dexmedetomidine iv loading dose for 10 minutes and in group P, the patients received propofol 1 mg/kg iv loading dose. Maintenance of anaesthesia was with O₂: nitrous oxide, sevoflurane inhalational agent, intermittent iv fentanyl and the patients received iv dexmedetomidine infusion (0.2 to 0.6 ¼ g/kg/hr) in group D patients and propofol infusion (2 to 3 mg/kg/hr) in group P patients. One hour before completion of surgery, we stopped dexmedetomidine/propofol infusion and administered injection atracurium 10 mg iv. At the end of surgery, patients were reversed with Injection Neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg.

Parameters observed were HR, SBP, DBP, MAP, RE and SE at baseline, one (1) minute, five (5) minutes, ten (10) minutes, fifteen (15) minutes, thirty (30) minutes after intubation and there after every 30 minutes till the end of the surgery. Ionic balance analysis was done at baseline, two (2) hours after intubation and half hour before extubation Postop sedation score (Ramsay sedation score) was noted immediately after extubation, 30 minutes and sixty (60) minutes post extubation.

Ramsay Sedation Score

1. Patient is anxious or restless.
2. Patient is co-operative and oriented.
3. Patient responds to the command.
4. Patient exhibits brisk response to stimulus.
5. Patient has sluggish response to stimulus.
6. Patient has no response to stimulus.

Statistical analysis

We analyzed statistically with Statistical Package for Social Sciences version (SPSS) 18. 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 with unpaired t test for intergroup and paired t test for within group comparisons was used to compare the parametric data. Categorical data were analysed using Chi square test. Fisher exact test was used wherever, the expected frequency of a cell was <5. p<0.05 was considered as statistically significant.

Results

Dexmedetomidine group (group D) and propofol group (group P) of patients were comparable in terms of demographic variables (Table 1).

Regarding haemodynamics, in P group patients, the HR increased at 1 minute and 5 minutes after intubation, but later was similar to the baseline value. In D group patients, the intraoperative HR was significantly lower from the baseline through out the surgery than propofol group showing significant statistical significance. (p<0.001) (Table 2).

The intraoperative SBP was lower than the baseline in both the groups, with more fall in P group at 1 minute (p=0.029), 5 minutes (p<0.001) and 10 minutes (p<0.051) after intubation than dexmedetodine group showing statistical significance (Table 3).

Table 1: Demographics

Demographics	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
Age in years (mean)	30.36±11.03	27.48±6.93	28.92±9.23	P=0.274
Weight in kg (mean)	61.72±7.88	61.76±8.21	61.74±7.97	P=0.986
Gender(males/females)	21/4	21/4	50	P=1.000
ASA grade I/II	21/4	21/4	50	P=1.000

(ASA grade: American society of Anaesthesiagrade)

Table 2: Heart rate (HR)

HR (beats/minute)	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
Baseline	82.08±12.78	82.28±13.79	82.18±13.16	0.958
1 Min	78.88±11.04	85.68±12.78	82.28±12.31	0.050
5 min	69.24±9.35	86.28±11.05	77.76±13.29	<0.001
10 min	73.28±8.94	83.96±13.50	78.62±12.55	0.002
15 min	72.32±10.25	82.16±12.40	77.24±12.31	0.004
30 min	71.80±9.84	80.52±9.66	76.16±10.61	0.003
60 min	73.60±9.64	85.12±7.42	79.36±10.31	<0.001
90 min	74.20±10.77	86.48±8.82	80.34±11.55	<0.001
120 min	75.40±10.67	85.36±8.91	80.38±10.95	0.001
150 min	74.68±9.80	84.80±8.83	79.74±10.55	<0.001
180 min	76.32±12.82	83.36±10.24	79.84±12.02	0.037
210 Min	74.68±9.49	83.88±8.26	79.28±9.96	0.001
240 min	75.64±11.53	83.72±8.28	79.68±10.74	0.007

Table 3: Systolic blood pressure (SBP)

SBP (mm Hg)	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
Baseline	120.12±10.86	116.84±11.37	118.48±11.13	0.302
1 Min	118.96±10.65	111.60±12.36	115.28±12.01	0.029
5 min	121.00±10.41	104.12±10.28	112.56±13.32	<0.001
10 min	112.80±9.55	106.92±11.19	109.86±10.72	0.051
15 min	115.32±10.69	110.56±11.34	112.94±11.17	0.133
30 min	115.92±11.88	111.16±12.72	113.54±12.42	0.178
60 min	115.80±13.32	114.52±12.50	115.16±12.80	0.728
90 min	113.56±10.06	116.32±14.27	114.94±12.30	0.433
120 min	115.4±12.07	114.80±13.54	115.10±12.70	0.869
150 min	116.28±13.84	116.80±12.48	116.54±13.04	0.890
180 min	114.68±11.92	114.96±10.18	114.82±10.97	0.929
210 Min	113.40±12.05	112.88±11.23	113.14±11.53	0.875
240 min	111.08±7.41	113.24±9.99	112.16±8.77	0.390

Table 4: Diastolic blood pressure (DBP)

DBP (mm Hg)	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
Baseline	62.32±9.25	60.84±12.07	61.58±10.67	0.629
1 Min	64.08±12.58	58.56±11.50	61.32±12.25	0.112
5 min	62.12±10.43	55.08±9.77	58.60±10.61	0.017
10 min	59.04±12.14	56.80±10.03	57.92±11.08	0.481
15 min	60.76±12.41	55.16±12.40	57.96±12.60	0.117
30 min	59.60±11.88	55.00±11.54	57.30±11.82	0.171
60 min	58.04±8.08	58.68±10.70	58.36±9.39	0.812
90 min	58.72±8.70	62.64±13.66	60.68±11.51	0.232
120 min	58.52±7.84	58.56±13.58	58.54±10.98	0.990
150 min	58.80±9.22	61.60±13.62	60.20±11.60	0.399
180 min	59.56±10.14	58.36±8.25	58.96±9.17	0.648
210 Min	59.52±10.06	57.48±9.69	58.50±9.83	0.469
240 min	57.72±7.63	56.04±8.68	56.88±8.13	0.471

Table 5: Mean arterial pressure (MAP)

MAP (mm Hg)	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
Baseline	85.80±8.75	83.24±10.18	84.52±9.48	0.345
1 Min	87.08±9.70	80.04±10.43	83.56±10.58	0.017
5 min	84.96±7.79	74.72±9.38	79.84±9.98	<0.001
10 min	80.36±9.62	77.04±9.41	78.70±9.57	0.223
15 min	81.56±10.03	76.56±10.57	79.06±10.50	0.093
30 min	81.92±9.98	76.44±9.48	79.18±10.02	0.052
60 min	80.80±8.18	80.00±9.71	80.40±8.89	0.754
90 min	80.08±7.94	82.12±11.90	81.10±10.06	0.479
120 min	80.12±8.25	80.00±12.25	80.06±10.34	0.968
150 min	81.88±9.78	82.44±11.50	82.16±10.57	0.854
180 min	80.84±8.81	78.88±6.29	79.86±7.64	0.370
210 Min	80.64±8.91	77.96±8.98	79.30±8.96	0.295
240 min	78.28±7.19	78.08±9.19	78.18±8.16	0.932

Table 6: Response entropy (RE)

RE	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
Baseline	91.24±3.89	91.72±3.35	91.48±3.60	0.642
1 Min	77.40±6.14	79.40±4.25	78.40±5.33	0.187
5 min	63.80±4.85	62.64±5.35	63.22±5.09	0.426
10 min	55.40±4.04	47.36±4.15	51.38±5.74	<0.001
15 min	51.40±3.95	46.92±3.70	49.16±4.41	<0.001
30 min	50.84±4.17	47.52±4.19	49.18±4.47	0.007
60 min	51.16±3.58	46.24±2.80	48.70±4.04	<0.001
90 min	51.32±4.91	47.04±2.86	49.18±4.53	<0.001
120 min	49.64±4.88	45.72±3.17	47.68±4.53	0.001
150 min	51.24±4.68	47.76±3.64	49.50±4.51	0.005
180 min	52.08±4.86	47.16±3.14	49.62±4.75	<0.001
210 Min	57.68±5.53	48.64±4.68	53.16±6.82	<0.001
240 min	88.96±3.76	90.96±3.37	89.96±3.68	0.053

In D group patients, the DBP was higher than the baseline at 1 minute after intubation but in P group patients, there was fall in DBP from the baseline at 1 minute and 5 minutes (p=0.017) after intubation showing statistical significance. But later there was similar fall in DBP in both groups indicating they were statistically similar (Table 4).

There was a fall in MAP from the baseline through out surgery in both the groups. In P group patients, maximum fall of MAP was observed at 1minute (p=0.017) and 5minutes (p<0.001) after

intubation than D group patients showing statistical significance (Table 5).

Baseline response entropy and state entropy were comparable between the two groups. Later both entropies decreased after intubation in both the groups and was maintained in the range between 40 to 60. But P group patients had much lower intraoperative response entropy (P<0.001) and state entropy values (P<0.001) than D group patients showing statistical significance (Tables 6,7).

Regarding ionic balance, in both the groups, ABG were in the normal range but P group patients had high baseline pCO₂ values (p=0.028), less pH before extubation (p=0.001), less Serum bicarbonate before extubation (p=0.010), less SBE (p=0.016)

before extubation, less serum potassium 2 hours after intubation (0.016) than D group showing statistical significance. Both groups were statistically similar regarding parameters of pO₂ serum lactate, sodium and chloride (Tables 8,9,10).

Table 7: State entropy (SE)

SE	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
Baseline	85.36±4.17	85.32±3.58	85.34±3.85	0.971
1 Min	71.88±6.65	73.20±4.73	72.54±5.75	0.423
5 min	58.04±5.38	57.20±5.40	57.62±5.35	0.584
10 min	50.48±4.81	42.80±4.43	46.64±6.00	<0.001
15 min	46.04±4.05	42.64±2.89	44.34±3.88	0.001
30 min	45.08±3.84	43.16±3.16	44.12±3.61	0.059
60 min	45.36±3.55	41.80±2.36	43.58±3.48	<0.001
90 min	45.08±4.66	41.48±3.74	43.28±4.56	0.004
120 min	43.64±4.48	41.80±7.38	42.72±6.11	0.292
150 min	45.40±4.75	42.12±3.10	43.76±4.30	0.006
180 min	46.56±6.05	40.96±2.92	43.76±5.49	<0.001
210 Min	51.16±5.27	41.84±4.27	46.50±6.69	<0.001
240 min	83.20±4.24	84.28±3.41	83.74±3.85	0.326

Table 8: Baseline arterial blood gas analysis (ABG)

ABG	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
pH	7.42±0.04	7.39±0.05	7.40±0.05	0.051
PO2	226.54±68.91	269.72±101.59	248.13±88.64	0.085
PCO2	34.32±3.25	37.22±5.53	35.77±4.72	0.028
HCO3-	22.87±1.79	22.91±2.02	22.89±1.89	0.941
SBE	-1.97±1.95	-2.04±2.50	-2.00±2.22	0.910
Lactate	2.03±0.71	2.13±0.62	2.08±0.66	0.583
S. Na	137.45±2.78	137.33±2.66	137.39±2.69	0.873
S.K	4.00±0.35	4.07±0.45	4.03±0.40	0.542
S. Cl	106.68±2.87	106±2.47	106.34±2.67	0.373

Table 9: Arterial blood gas analysis (ABG) 2 hours after intubation

ABG	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
pH	7.41±0.05	7.39±0.06	7.40±0.06	0.095
PO2	214.29±70.61	234.84±71.9	224.56±71.29	0.313
PCO2	34.39±3.99	34.82±5.15	34.60±4.56	0.742
HCO3-	22.36±1.89	21.58±2.78	21.97±2.39	0.257
SBE	-2.73±2.18	-3.96±3.39	-3.34±2.89	0.133
Lactate	2.43±0.97	2.73±1.16	2.58±1.07	0.314
S.Na	137.79±3.09	138.19±2.33	137.99±2.72	0.611
S.K	3.80±0.41	3.54±0.34	3.67±0.39	0.016
S.Cl	107.20±2.89	107.00±3.83	107.10±3.36	0.836

Table 10: Arterial blood gas analysis (ABG) before extubation

ABG	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
pH	7.42±0.05	7.37±0.04	7.39±0.05	0.001
PO2	277.04±114.02	240.16±72.72	258.60±96.46	0.179
PCO2	33.66±3.46	35.82±5.69	34.74±4.79	0.112
HCO3-	22.64±2.15	21.18±1.63	21.91±2.03	0.010
SBE	-2.60±2.25	-4.22±2.36	-3.41±2.42	0.016
Lactate	2.77±1.13	3.40±2.12	3.08±1.71	0.193
S.Na	137.23±3.30	138.58±2.34	137.91±2.91	0.100
S.K	3.83±0.39	3.74±0.44	3.78±0.41	0.439
S.Cl	106.96±2.28	107.12±3.24	107.04±2.78	0.841

Table 11: Postop sedation score

Postop sedation score	Group D (Mean ± SD)	Group P (Mean ± SD)	Total (Mean ± SD)	P value
At extubation	2.64±0.64	3.16±0.55	2.90±0.65	0.003
30 min post extubation	2.20±0.41	2.60±0.50	2.40±0.49	0.003
60 min post extubation	1.84±0.37	1.92±0.28	1.88±0.33	0.394

P group patients had more postop sedation scores at extubation (P=0.003) and 30minutes after extubation (0.003) than D group indicating statistical significance (Table 11).

Discussion

Brachial plexus repair surgery is done under general anesthesia without muscle relaxant for nerve stimulation. Propofol is the common intravenous drug used to maintain depth of anaesthesia due to rapid onset of action, antiemetic effect, rapid emergence and easy availability. But it causes cardiac and respiratory depression and has no analgesic effect. Literature has reported metabolic acidosis even with short term infusion of propofol. Dexmedetomidine, a new potent α_2 adrenergic agonist, is available clinically alternative to propofol to maintain the depth of anaesthesia. As it has sedative, analgesic effects and maintains haemodynamic stability, we conducted this study to see the effect of intravenous infusion of dexmedetomidine and propofol on haemodynamics, ionic balance and postop sedation under entropy guidance. In our study, both groups were comparable in terms of demographic variables (age, weight, sex and ASA grade) similar to study done by Chattopadhyay et al.

Regarding haemodynamics, intraoperative heart rate was significantly lower in the dexmedetomidine group than the baseline. This may be due to the sympatholytic action of dexmedetomidine. In propofol group patients, there was rise in HR at 1 minute and 5 minutes after intubation but later values were similar to the baseline HR. In Chattopadhyays study there was rise in heart rate after intubation with subsequent fall in both the groups but with more fall in dexmedetomidine group.

The intraoperative SBP decreased from the baseline in both the groups, but significant fall was observed in propofol group at 1 minute, 5 minutes and 10 minutes after intubation than dexmedetomidine group. It is similar to Mahmoud et al study, who had significant fall in SBP with propofol and less fall in SBP with dexmedetomidine

In dexmedetomidine group patients, the DBP increased from the baseline at 1 minute after intubation, whereas in propofol group patients, the DBP decreased significantly from the baseline at 1 minute and 5 minutes after intubation. Later there was similar decrease in DBP in both the groups.

Intraoperative MAP decreased from the baseline in both the groups. This may be due to the suppression of sympathetic response but more decrease was noticed in propofol groups at 1 minute and 5 minutes after intubation. This is similar to Kaygusuz K et al. study who observed more fall in MAP in propofol group than dexmedetomidine group patients.

Regarding ionic balance, both the groups had ABG in the normal range, but D group patients had low baseline pCO_2 values, more pH before extubation, more serum bicarbonate and less base excess before extubation. But in study done by Venn et al, blood gas analysis in terms of pH, pO_2 and pCO_2 was similar in dexmedetomidine and propofol groups. In our study, serum lactates were similar in both the groups. But Bonhomme et al. found lactic acidosis associated with propofol in their study. Other parameters of pO_2 , serum sodium and chloride in both the groups were similar.

We used Entropy to maintain the depth of anaesthesia and titrate the infusion dose of dexmedetomidine and propofol. This is similar to Vakkuri et al who used entropy monitoring to assist the titration of propofol. Entropy was maintained in the range 40 to 60 in both the groups intraoperatively. But both intraoperative response entropy and state entropy were lower in the P group than D group.

Our postop sedation scores were more in P group patients at extubation and 30 minutes than D group. It is in contrast with the study done by Venn and Grounds who observed patients more sedated with dexmedetomidine postoperatively than propofol but without any delay in extubation.

Conclusion

Propofol is the common intravenous drug used for maintenance of anaesthesia in patients undergoing brachial plexus surgery. As Dexmedetomidine has

analgesic effect, maintains haemodynamic stability and has less postop sedation, it can be safely used as an alternative to propofol .

Conflicts of Interest: Nil

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