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Original Research Article

Comparison of dexmedetomidine with ketamine for their effects on amplitude of motor evoked potential intraoperatively

Sudhir Sachdev[1], Ravindra Sisodia[2], Vibha Soni[1,*], Durga Jethava[1]

[1]*Dept. of Anaesthesia, Mahatma Gandhi Medical College Hospital and Research Institute, Jaipur, Rajasthan, India*
[2]*Dept. of Neuro-anesthesia, Mahatma Gandhi Medical College Hospital and Research Institute, Jaipur, Rajasthan, India*

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ABSTRACT

Introduction & Aims: Intraoperative motor evoked potential monitoring is commonly used during spinal surgeries as it reduces incidence of neurological damage and have better post-operative neurological outcome.

Anaesthetic agents cause a dose dependent inhibition of evoked potential responses while ketamine and dexmedetomidine are said to have minimal effect. We planned this study to compare effect of dexmedetomidine and ketamine on MEP.

Materials and Methods: All patients induced using glycopyrrolate, fentanyl, propofol and no anxiolytics and intubated with succinylcholine 2mg /kg, maintenance done with propofol infusion@ 60 mg/hr in both groups. Group-D- received dexmedetomidine 0.5mg/kg and Group-K- received ketamine 0.6mg/kg in 100ml NS over a period of 10mts.Electrodes were placed above the level of surgical intervention for MEP and TOF recording.

Baseline MEP recorded and after completion of infusion of the study drugs was taken as 0 min, then the MEP was recorded at every 5 min till 30 min.

Results: In our study we observed that amplitude of MEP was statistically significant (p value 0.009 at 15 minutes) and was higher in ketamine group than dexmedetomidine group.

Conclusion: We concluded that both agents are equally good as they cause minimal depression and are equally efficient in measuring the amplitude of MEP.

1. Introduction

Intraoperative neurophysiologic monitoring is becoming standard monitoring in neurosurgeries. Motor evoked potential (MEP) monitoring is useful tool for precision of spinal surgeries minimising post-operative neurological complication and ensures better outcome. Evoked Potentials- Stimulus of nervous system produces the electrical potentials which measured as evoked potentials.[1]

These are of 2 type-

1. Sensory Evoked Potentials (SEP)- is the response to sensory stimulus.
2. Motor Evoked Potentials (MEP)- Stimulus to motor pathway is given and muscle activity is recorded. Muscle MEP allow selective assessment of the functional integrity of descending motor tracts, from the motor cortex to muscles.

For eliciting MEP, current is applied to the cerebral cortex or spinal cord directly or trans-cranially. Fine wire electrodes were placed within the muscles innervated by the motor nerve or surface electrodes over the muscles which help in recording peripheral response of MEP by measuring Compound Muscle Action Potential (CMAP).

The responses can be recorded in the spinal cord, peripheral nerve or in muscle as CMAPs.[2] Reduction in motor response in the nerve and muscle occurs by the anesthetic agent and they may also affect anterior

* *Corresponding author*.
E-mail address: vibhasoni2222@gmail.com (V. Soni).

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horn cells or neuromuscular junction.[3] Narcotics have less effect than volatile anesthetics on MEP, responses may be obtunded completely by neuromuscular blocking drugs. Dexmedetomidine with TIVA has minimal effect on neuromonitoring.[4] MEP amplitude was greater with Ketamine and propofol compared to only Propofol.[5] There are no studies available comparing effect of Ketamine and Dexmedetomidine on MEP. Anesthetic agents have a dose dependent adverse effect on the ability to record evoked potential responses.[6]

2. Materials and Methods

This prospective, single blind, randomized comparative study was conducted after Institutional Ethical Committee Clearance and written informed consent from sixty adult patients of either sex, ASA grade I & II scheduled for elective thoracic or lumbar spine surgeries included in this study, were randomly divided into two groups- 30 in each using chit and box method. Group D- 30 patients received dexmedetomidine 0.5 microgram/kg lean body weight & Group K- 30 patients received ketamine 0.6 mg/kg lean body weight. Complete pre-anesthetic evaluation with necessary investigations were done a day before surgery. Before start of surgery all standard monitors attached and intravenous line secured. All patients received- injection glycopyrrolate 0.004 mg/kg, injection fentanyl 3microgm/kg and no anxiolytics. Induced with injection propofol 1.5-2mg/kg and endotracheal intubation was facilitated with injection succinylcholine 2mg /kg. Maintenance was done by infusion propofol @ 60mg/hr and 50% oxygen with air. A soft bite block was placed to avoid tongue bite. All electrodes for MEP monitoring were placed. Two corkscrew electrodes were placed 2 cm antero-lateral to coronal sutures for transcranial stimulation. Needle electrodes were placed in target belly muscle abductor pollicis brevis (thenar muscle), rectus abdominis, quadriceps, tibialis anterior and adductor hallucis longus based on the surgical procedure and spinal level involved for CMAP recording. Transcranial electrical stimulus (6 pulses, 4 mili-second (ms) apart; intensity, 750 V; duration of each pulse, 0.5 ms) given. CMAP are recorded with needle electrodes from target belly muscle in all four limbs. Based on the surgical procedure and spinal level involved, muscles were selected. Readings of MEP recordings in abductor pollicis brevis (thenar muscle) of upper limb were used for the study. Though MEP changes were observed bilaterally in rectus abdominis, quadriceps, tibialis anterior and adductor hallucis longus. After positioning of patient, transcranial stimulus was given to record baseline MEP. In all patients the current of stimulus (750V) was kept same. Study drug prepared by anaesthetic technician in 100 ml Normal Saline was infused over a period of 10minutes. At completion of the infusion MEP recorded at 0 min and every 5 min. for 30 min.

3. Results

The collected data were analysed with IBM.SPSS statistics software 23.0 Version and p value $< .05$ was considered significant. To describe about the data descriptive statistics frequency analysis, percentage analysis was used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference between the bivariate samples in Independent groups the unpaired sample t-test was used. To find the significance in categorical data Chi-Square test was used.

The demographic data with respect to age, sex, height, weight and ASA grading were similar in both the groups. There was no significant change in MAP in both the groups and mild variations in SBP observed in ketamine group. Amplitude was significantly higher in ketamine group.

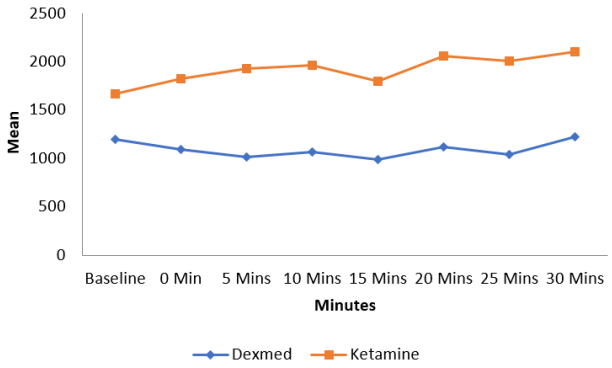

Fig. 1: Amplitude

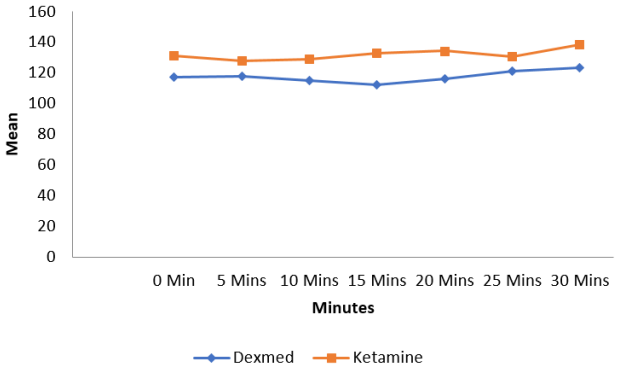

Fig. 2: Percentage with baseline

4. Discussion

Motor Evoked Potentials (MEP) is used for assessment of functions of motor cortex and descending tracts and for monitoring the prevention of neuronal injury during neurosurgical procedures.

Unsuspected and unpleasant neurological deficit after spinal surgery can be prevented by the use of intraoperative

Table 1: Demographic distribution

S. No.	Data	Dexmedetomidine	Ketamine	P value
1.	Mean Age (Years)	40.6±13.5	41.2±13.6	0.857
2.	Weight (KG)	66.1±11.1	68.6±12.3	0.398
3.	Height (CM)	162.4±7.7	161.2±7.9	0.565
4.	Sex	Male- 15 Female- 15	Male- 18 Female- 12	0.11
5.	ASA I II	16(53.3%) 14(46.7%)	17(56.7%) 13(43.3%)	1.000

Table 2: Intraoperative monitoring

S. No.	Variables	Drugs	Time							
			Baseline	0min	5min	10min	15min	20min	25min	30min
1	HR	D	79.5±13.1	76.5±10.7	75.0±9.0	75.1±7.5	75.8±8.9	75.9±10.9	76.4±9.7	76.6±10.1
		K	80.9±13.1	80.3±12.0	79.8±11.2	79.2±11.6	77.9±11.7	77.9±11.1	77.7±11.1	77.7±11.7
		p value	0.680	0.193	0.076	0.110	0.445	0.499	0.641	0.698
2	SBP	D	110.9±15.2	108.1±11.8	104.0±9.0	101.5±13.5	99.5±10.5	105.2±11.6	104.0±10.5	103.8±8.8
		K	111.2±11.2	108.2±9.6	106.9±9.8	109.4±12.1	109.5±9.9	108.5±12.1	107.3±9.8	109.5±9.8
		p value	0.931	0.981	0.236	0.021	0.0005	0.285	0.208	0.020
3	DBP	D	73.7±10.3	71.2±12.1	72.7±11.5	67.6±11.5	68.1±10.1	72.9±17.1	70.3±11.4	68.8±9.3
		K	72.7±9.5	72.4±10.1	71.9±8.6	72.0±7.8	70.9±7.1	72.9±6.4	71.3±7.7	71.0±7.9
		p value	0.689	0.686	0.752	0.088	0.219	1.000	0.702	0.342
4	MAP	D	82.2±9.6	81.7±11.9	81.7±10.8	77.6±11.3	76.5±10.3	81.8±15.2	78.6±9.8	78.1±8.7
		K	82.0±9.0	81.9±9.6	81.0±8.2	81.5±8.1	81.1±6.8	82.6±6.5	80.5±7.2	80.7±7.1
		p value	0.934	0.943	0.788	0.128	0.046	0.801	0.397	0.222

In our study SBP was significant in ketamine group

MEP monitoring. Various pharmacological and physiological factors affects MEP, such as – Inhaled anaesthetics reduce the amplitude and increases latency, intravenous anaesthetics have the same effect but to a lesser degree, barbiturates suppresses myogenic MEP etc.

There was no significant change in MAP in both the group at any point of time in our study while a study done by P. Chauhan et al[7] found more than 20% fall in HR and no change in their study using ketamine with dexmedetomidine and fentanyl.

In our study we found that the SBP (mm/hg) of both the groups at different times varied in their statistical significance. In both groups, baseline, at 0min, 5mn, 20min, & 25 min SBP values were statistically insignificant. At 10 & 30 min SBP value of both the groups were statistically significant. At 15 min the SBP value of both drugs was highly significant. In ketamine group SBP was significantly higher than dexmedetomidine while DBP (mm/hg) of both the groups at different times of observation were statistically insignificant from baseline to 30 min.

In both groups, baseline Amplitude were similar. At 0min & 30 min amplitude was significantly higher in the ketamine group than dexmedetomidine group. At 5min, 10min, 15 min, 20 min, 25 min the amplitude was higher in the ketamine group than dexmedetomidine group which was highly significant. In a study done by Tobias et al[4] found decrease in the MEP amplitude using dexmedetomidine, similar result was shown in our study. A study done by Kalkaman[8] using ketamine found increase in the amplitude of MEP by 150-250% within 10 minutes of injection, we also found similar rise in amplitude.

The changes in Amplitude of both the groups according to the percentage with baseline were insignificant. In a study done by Sheng Lin et al[9] to elicit the effect on somatosensory and motor evoked potentials in patients undergoing spinal surgery using dexmedetomidine-etomidate – fentanyl combined anesthesia. They concluded that TIVA using combined agents as mentioned above may be safely administered in spine surgeries. In our study we used ketamine with propofol (Group K) and propofol with dexmedetomidine (GroupD) and found that these drugs can be used safely in spinal surgeries. Penney et al[10] in their case report stated that dexmedetomidine and ketamine infusions as a combination can be used as an alternative to propofol based TIVA during scoliosis repair surgery with intraoperative somatosensory evoked potential and MEP

Table 3: Amplitude and percentage with baseline

S. No.	Variables	Drugs	Baseline	Time 0min	5min	10min	15min	20min	25min	30min
		D	1199.1±1154.6	1089.1±1037.7	1014.7±976.4	1066.7±1080.6	985.3±945.2	1122.2±1150.6	1039.6±932.9	1226.0±1257.0
1	Amplitude	K	1667.6±1158.1	1822.3±1512.3	1932.1±1449.3	1962.3±1346.2	1793.2±1174.0	2058.8±1496.4	2005.5±1454.9	12103.0±133.8
		P value	0.122	0.033	0.006	0.006	0.005	0.009	0.004	0.011
		D	141.10±64.90	117.45±64.43	118.10±74.60	115.49±69.15	112.93±56.57	116.75±76.25	121.03±84.02	123.30±72.35
2	% with baseline	K	131.00±0.00	131.23±60.35	128.87±53.16	129.10±53.07	133.03±40.07	134.23±57.88	130.40±58.73	139.57±48.49
		P value	0.552	0.381	0.941	0.980	0.485	0.888	0.572	0.767

In our study we observed that effect on amplitude of MEP was significant in ketamine group.

monitoring. We did a similar study in spinal surgeries using ketamine with propofol and dexmedetomidine with propofol and found both drugs can be used safely during TIVA. Kawaguchi et al[11] in their study concluded that if a train of pulses were used for transcranial stimulation, low dose propofol can be effectively used as a supplement to ketamine-based anesthesia during intraoperative monitoring of myogenic MEPs. And also, they concluded that addition of propofol significantly reduced the ketamine induced psychedelic effects. In our study also we found similar results using ketamine with propofol.

Regarding the use of dexmedetomidine and ketamine for MEP recording during general anesthesia with TIVA, the results of most of the above-mentioned studies matches to the result our study.

5. Conclusion

We concluded that mean amplitude was higher in ketamine than dexmedetomidine group but when amplitude was compared with baseline of respective group there was no statistically significant difference between both the groups. Also, both the agents are equally good as they cause minimal depression and are equally efficient in measuring the amplitude of MEP.

6. Limitations

1. In our study we measured effect of dexmedetomidine and ketamine over only amplitude of MEP but not on the latency.
2. The serum concentrations of the drugs were not measured which could be varied according to the individual metabolism as we used fixed dose regimen in our study.

7. Source of Funding

None.

8. Conflict of Interest

None.

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Author biography

Sudhir Sachdev Professor

Ravindra Sisodia Consultant

Vibha Soni 3rd Year Resident

Durga Jethava Professor & HOD

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