A comparative, randomized clinical study of haemodynamic response to laryngoscopy and tracheal intubation using vecuronium with and without neuromuscular monitoring by peripheral nerve stimulator

Rakesh Alur T[1], Anupama MK[2,*], Prakash HK[3]

[1,2]Assistant Professor, [3]Consultant Anaesthesiologist, Dept. of Anaesthesia, [1]Basaveshwara Medical College, Chitradurga, Karnataka, [2]PK Das Medical College, Ottapalam, Kerala, [3]Apllo BGS Hospitals, Mysore, Karnataka, India

***Corresponding Author: Anupama MK**
Email: anu2bdoc@gmail.com

Received: 19th June, 2018 **Accepted:** 25th October, 2018

Abstract

Introduction: Laryngoscopy and endotracheal intubation during induction of general anaesthesia are extremely strong nociceptive stimuli, which often lead to unintended stimulating of the sympathetic nervous system manifested by increased arterial pressure and tachycardia.[1] The present study aimed to assess usefulness of neuromuscular monitoring with peripheral nerve stimulator in reducing the haemodynamic response to laryngoscopy and tracheal intubation using vecuronium.

Material and Methods: This study included 100 cases classified randomly into two group (Each n= 50).

Group I (C) (n=50): control group: Laryngoscopy and tracheal intubation done at the end of 3 minutes after administration of 0.1mg/kg body weight of intravenous iv vecuronium.

Group II (N) n=50: Neuromuscular monitoring done after giving 0.1mg/kg body weight of intravenous vecuronium using TOF with supramaximal stimuli of current intensity 50 mA at right ulnar nerve, and the response of the thumb is monitored every 10 seconds, once all the responses for TOF are lost, the time noted and laryngoscopy and endotracheal intubation were performed.

Statistical Analysis: Independent- Samples t test, Cross tabs and Repeated Measure ANOVA were used. SPSS for windows (version 17.0) was employed for data analysis. $p<0.05$ was considered as significant and $p<0.01$ was considered as highly significant.

Results: Group-N (study group) showed statistically significant decreased haemodynamic response to laryngoscopy and intubation after iv Vecuronium, when compared to Group-C (control group).

Conclusion: Neuromuscular monitoring by using PNS at AP is useful to have good intubation condition and to reduce the haemodynamic response to laryngoscopy and intubation.

Keywords: Peripheral nerve stimulator, Train of four, Adductor pollicis muscle, Vecuronium, Intubation, Haemodynamic response.

Introduction

Laryngoscopy and endotracheal intubation during induction of general anaesthesia are extremely strong nociceptive stimuli, which often lead to unintended stimulating of the sympathetic nervous system manifested by increased arterial pressure and tachycardia.[1]

These cardiovascular changes accompanying intubation are transient and do not result in severe sequelae. However, in patients with concomitant coronary disease, arterial hypertension or intracranial pathology, increased values of these circulatory parameters may lead to myocardial ischaemia or secondary brain damage. To minimize effectively these adverse changes, it is suggested to administer opioids, β receptor blockers or α2 adrenergic receptors agonists, local or general lignocaine or to deepen the general anaesthesia with intravenous or inhaled agents.[2]

Adequate intubation conditions are mere common in relaxed patients.[3] Therefore, proper assessment of neuromuscular block with a relaxant is of utmost importance.

Thus monitoring of neuromuscular conduction appears to be necessary for proper timing of intubation. In clinical practice, visual assessment of the reaction of the thumb adductor to train- of –four (TOF) stimulation of the ulnar nerve at the wrist is commonly used. Adductor pollicis (AP) muscle has been promoted as the most useful clinical tool and is the gold standard because of its accessibility for visual, tactile and mechanographic assessment. The movement of thumb in response to train of four stimulus applied to the ulnar nerve is observed and data recorded.

Primary Objective

To assess usefulness of neuromuscular monitoring with peripheral nervestimulator (PNS) in reducing haemodynamic response to laryngoscopy and tracheal intubation using vecuronium.

Secondary Objective

To study the changes in the heart rate (HR), Systolic blood pressure (SBP), Diastolic blood pressure (DBP), and Mean arterial pressure (MAP) associated with laryngoscopy and intubation.

Materials and Methods

A double blinded comparative randomized clinical study was conducted on 100 adult patients of either sex aged between 18 to 50yrs, with ASA1 and ASA2 and modified mallampatti class I and II posted for elective lumbosacral discectomy under general anaesthesia in Apollo BGS Hospitals, Mysore with study duration from Jan 2015 to Nov 2015. Patients of ASA >3 were excluded from the study.

The study was undertaken after obtaining an informed consent from all patients.

Ethical committee clearance was obtained.

Sample Size Calculation:

The number of participants required in each study group, n, was calculated using the formula as below:

$$n = \frac{2 \times [Z\,(1-\alpha/2) + Z\,(1-\beta)]^2}{\Delta^2}$$

The study population was randomly divided into two groups with 50 patients in each group using random computer generated numbers.

Group I (C) (n=50): control group: Laryngoscopy and tracheal intubation done at the end of 3 minutes after administration of 0.1mg/kg body weight of intravenous ivvecuronium.

Group II (N) n=50: Neuromuscular monitoring done after giving 0.1mg/kg bodyweight of intravenous vecuronium using TOF with supramaximal stimuli of current intensity 50 mA[4] at right ulnar nerve, and the response of the thumb is monitoredevery 10 seconds, once all the responses for TOF are lost, the time noted and laryngoscopy and endotracheal intubation were performed.

The double blind design of the study was assured by the fact that, all the patients were connected with the neuromuscular monitor and neuromuscular monitor was covered from the visualization of the observer, who is also the one who does the laryngoscopy and tracheal intubation. The person who was not involved with the observation of the study and who knows about the group to which the patient belongs indicated at which time the observer has to do laryngoscopy and intubation, based on either time based (3minutes) or complete absence of twitch response at the thumb. Hence the observer and the patient were blinded in study.

Preanaesthetic evaluation was done on the evening before surgery

The patients were connected to Multiparameter monitor for recording Heart rate (HR), noninvasive measurements of systolic blood pressure (SBP), diastolic blood pressure (DBP), Meanarterial pressure (MAP), continuous electrocardiogram (ECG) monitoring, oxygensaturation.

The baseline (T0) systolic, diastolic blood pressure, mean arterial pressure and heart rate were recorded.

The cardiac rate and rhythm were also monitored from a continuous visual display of electrocardiogram from lead II and lead IV.

Peripheral nerve stimulator (PNS) (Nerve stimulator, NS-100, Constant current, Inmedequipments Pvt. Ltd), negative electrode (black) placed distally volar side of the right wrist, 1 cms proximal to the point at which proximal flexion crease of the wrist crosses the radial side of the tendon to the flexor carpi ulnaris muscle. The proximal electrode (Red) was placed so that distance between the centers of the two electrodes was 3 to 6 cms.

All the patients were premedicated with intravenous Midazolam 1mg and intravenous Fentanyl 2 µgm/kg.

Then the patients were pre oxygenated for 3 minutes via a face mask with closed circuit. Anaesthesia was induced with intravenous Thiopentone 5 mg/kg, after confirmation of adequacy of bag and mask ventilation. Patients in both the groups were paralysed with intravenous Vecuronium 0.1mg/kg given over a period of 5 seconds. Ventilation was assisted with 0.4% Halothane + 100% oxygen for 3 minutes in Group C, and till the disappearance of all the responses for train of four in group N.

In Group-N, neuromuscular monitoring was done using TOF stimulation(a series of four supra maximal twitches in 2 seconds, 2 Hz frequency each 0.2 ms long) at right ulnar nerve and response of the thumb (monitoring adductor pollicis muscle) was monitored. Every 10 seconds after the injection of calculated dose of vecuronium, current intensity of 50 milli amperes was used. Once all the responses for TOF are lost, time was noted.

In both the groups gentle laryngoscopy and intubation performed using Macintosh laryngoscope. Lasting for not more than 15 seconds and after confirmation of bilateral equal air entry and 3 successive graphical display of end tidal (EtCO2), the endotracheal tube was fixed. If time for laryngoscopy and intubation exceeds 15 seconds such patients were excluded from the study.

Cuffed oral endotracheal tube size 7.5 mm ID for female patients, 8.5 mm ID for male patients were used.

Time taken for laryngoscopy and endotracheal intubation noted in both the groups. Anaesthesia was maintained using 70% nitrous oxide (N2O) and 30% oxygen with 0.4% Halothane and neuromuscular blockade was maintained during surgery with 0.5 mg of vecuronium, as and when required.

At the end of surgery, residual neuromuscular blockade reversed with IV Neostigmine 0.05mg/kg body weight and glycopyrolate 0.01mg/kg body weight.

The cardiovascular parameters were monitored at the following time interval: T0 – Baseline vitals T1 – 1 min after premedication T2 – After induction T3 – Immediately after intubation T4 – 1 minute after intubation T5 – 3 minutes after intubation

Statistical Analysis: Independent- Samples t test, Cross tabs and Repeated Measure ANOVA were used. SPSS for windows (version 17.0) was employed for data analysis. $p<0.05$ was considered as significant and $p<0.01$ was considered as highly significant.

Sample Size

Sample Size of 60

Confidence Level: 95%

Confidence Interval: 5%

As calculated using the Kish Leslie Formula:

$$\text{Sample size} = \frac{Z2*(p)*(q)}{d^2}$$

Z = Z value

p = percentage picking a choice (hospital prevalence of 4%), expressed as decimal;

c = confidence interval, expressed as decimal.

Sample size = [1.96 X 1.96 X 0.04 X 0.96] ÷ [0.05 X 0.05]

Z =1.96, that is the value of Z corresponding to 95% confidence interval.

This gave a sample size of 60 divided into 2 groups. The above sample size is calculated using sample size calculator available at http://www.surveysystem.com/ sscalc.html)

Results

Mean age in Group-C and N were 41.18 ± 6.57and 41.52±7.32 respectively. There was no significant difference in the age of patients between the Group-C and Group-N. Both groups were similar with respect to age distribution (p=0.808).

Statistically there is no significant change in the gender wise distribution of patients in both the groups. (p=0.542)

The mean body weight in Group-C was 57.88 and in Group-N it was 56.42. There was no significant difference in the body weight of patients between the Group-C and Group-N (p=0.178).

The heart rate, SBP, DBP and MAP were comparable in both groups at T0, T1 and T2.

Statistical evaluation between the groups showed a highly significant increase in mean HR, SBP, DBP and MAP in Group-C after intubation at T3, T4 and T5 compared to Group-N. (p=0.000).

Table 1: Intergroup comparison of mean HR (bpm) changes in response to laryngoscopy and intubation between Group-C and Group-N

Time	Group-C	Group-N	p-value
Basal (T0)	82.32 ± 14.98	86.52 ± 13.76	0.148
premedication (T1)	80.10 ± 12.64	80.30 ± 10.37	0.931
Post Induction (T2)	78.98 ± 11.11	75.04 ± 9.78	0.063
Immediately after Intubation (T3)	93.98 ± 10.71	84.22 ± 9.61	0.000
1 min (T4)	92.42 ± 15.58	81.44 ± 9.46	0.000
3 min (T5)	91.44 ± 19.53	77.26 ± 9.00	0.000

($p<0.01$) – Highly significant (HS); ($p<0.05$) – Significant (S); ($p>0.05$) – Not significant (NS)

Table 2: Intergroup comparison of mean systolic blood pressure (SBP in mmHg) changes in response to laryngoscopy and intubation between Group-C and Group-N

Time	Group-C	Group-N	p-value
Basal (T0)	133.96 ± 15.37	130.42 ± 15.70	0.258
One minute after premedication (T1)	129.64 ± 13.70	124.96 ± 14.01	0.095
Post Induction (T2)	118.06 ± 16.72	114.30 ± 18.64	0.291
Immediately after Intubation (T3)	134.30 ± 12.09	119.48 ± 9.54	0.000
1 min (T4)	129.76 ± 16.85	119.66 ± 7.44	0.000
3 min (T5)	119.58 ± 18.08	114.48 ± 10.49	0.007

Table 3: Showing intergroup comparison of mean diastolic blood pressure (DBP in mmHg) changes in response to laryngoscopy and intubation between Group-C and Group- N

Time	Group-C	Group-N	p-value
Basal (T0)	82.40 ± 12.92	81.26 ± 13.22	0.664
One minute after premedication (T1)	78.16 ± 7.80	76.16 ± 7.22	0.187
Post Induction (T2)	77.16 ± 12.25	74.22 ± 14.04	0.267
Immediately after Intubation (T3)	88.68 ± 9.79	79.58 ± 7.67	0.000
1 min (T4)	85.40 ± 12.16	76.38 ± 6.75	0.000
3 min (T5)	80.74 ± 13.12	67.20 ± 8.37	0.000

Table 4: Intergroup comparison of mean arterial pressure (MAP in mmHg) changes in response to laryngoscopy and intubation between Group-C and Group-N

Time	Group-C	Group-N	p-value
Basal (T0)	100.56 ± 12.25	98.20 ± 12.96	0.352
One minute after premedication (T1)	95.76 ± 8.95	93.30 ± 8.90	0.171
Post Induction (T2)	91.36 ± 13.83	88.50 ± 15.38	0.331
Immediately after Intubation (T3)	104.48 ± 9.19	94.50 ± 7.65	0.000
1 min (T4)	101.44 ± 12.83	93.22 ± 6.48	0.000
3 min (T5)	94.54 ± 11.85	85.48 ± 8.35	0.000

In our study mean time taken for intubation in both the groups was comparable (p=0.167). In the study group minimum time taken for disappearance of 4th twitch was 174.00 seconds, Maximum was 330.00 seconds. Mean was 251.72 seconds (4.18 minutes).

Discussion

Most of the general anaestheticprocedure requires laryngoscopy and tracheal intubation which provoke transient but marked sympathoadrenal response manifesting as hypertension and tachycardia.[5]

Complete relaxation of the jaw, laryngeal muscles and diaphragm is needed for excellent intubation conditions in order to reduce the vocal cord trauma and haemodynamic response to laryngoscopy and intubation.[6]

Lee HJ et al in 2009 and Haller G et al in 1998 have shown that monitoring AP to determine tracheal intubation conditions is more clinically relevant than monitoring OO muscle. Hence in our study we monitored the AP muscle for determining the time of intubation.[7,8]

TOF pattern of nerve stimulation was selected in our study, because it is the most commonly used method in clinical practice and as quoted by Ali HH who introduced TOF in early 1970.It can be utilized to assess the degree of block produced by muscle relaxants without the use of transducing evoked response.[9]

Vecuronium is the most commonly used amino steroid synthetic, competitive non depolarizing relaxant and it has got negligible effect on the cardiovascular status. Hence no direct effect on the intubation response. Hence vecuronium was selected as muscle relaxant in our study.[10]

In 1996, Koscieiniak-Nielsen ZJ et al suggested that in a fit adult patient it is as good as to wait 3 minutes after injection of vecuronium 0.1mg/kg before tracheal intubation, as to use a nerve stimulator. And also intubation at 3minutes after iv vecuronium is routinely practiced by most of the anaesthetists. Hence in our study 3 minutes was taken as standard time for intubation in Group-C.[11]

The heart rate, SBP, DBP and MAP were comparable in both groups at T0, T1 and T2.

Statistical evaluation between the groups showed a highly significant increase in mean HR, SBP, DBP and MAP in Group-C after intubation at T3, T4 and T5 compared to Group-N. (p=0.000).

Our study was comparable to study conducted by, Malgorzata Witkowska et al in 2009. [12]

In our study mean time taken for intubation in Group-C was 8.64 seconds and in Group-N was 8.30 seconds which was comparable in both the group (p=0.167).

In the Group-N, minimum time taken for disappearance of 4th twitch was 174.00 seconds, maximum was 330.00 seconds. Mean was 251.72 seconds (4.18 minutes).

In our study, in Group-C, 80% of the patients had good and 20% of the patients had fair intubation condition with mean Cooper's score of 5.98 and six patients required ELM who had fair Cooper's score. All the patients in Group-N had excellent intubation condition.

Limitations

The best methods for assessment of the extent of NMB include EMG, MMG, AMG, PMG and KMG. Because of non availability of these instruments, also they are expensive and bulky, so not used in our study.

Conclusion

In our study, Group-N (study group) showed statistically significant decreased haemodynamic response to laryngoscopy and intubation after iv Vecuronium, when compared to Group-C (control group).

Hence Neuromuscular monitoring by using PNS at AP is useful to have good intubation condition and to reduce the haemodynamic response to laryngoscopy and intubation.

Conflict of Interest: None.

References

1. Kazama T, Ikeda K, Morita K. Reduction by fentanyl of the Cp50 values of propofol and hemodynamic responses to various noxious stimuli. *Anesthesiol* 1997;87:213-227.
2. Kovac AL. Controlling the hemodynamic response to laryngoscopy and endotracheal intubation. *J Clin Anesth* 1996;8:63-79.
3. Morgan JM, Barker I, Peacock JE, Eissa A. A study of intubating conditions in children following induction of anaesthesia with propofol and suxamethonium or propofol and remifentanil. *Anaesth* 2007;62:135-139.
4. Viby-Mogensen J, Claudius C. Neuromuscular Monitoring. In: Miller RD, Cohen NH, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Young WL (eds.), Miller's Anesthesia. Vol I. 8th edition. New York: Churchill Livingstone, Elsevier; 2014. pp.1604- 21.
5. Prys-Roberts C, Green LT, Meloche R, Foex P. Studies of anaesthesia in relation to hypertension. Haemodynamic consequences of induction and endotracheal intubation. *Br J Anaesth* 1971;43:531-547.
6. Suresh SN, Singh NG. Comparison between adductor pollicis and orbicularis oculi as indicators of adequacy of muscle relaxation for tracheal intubation following rocuronium induced neuromuscular block: Randomized comparative clinical trial. *Recent Res Sci Technol* 2010;2(5):130-135.
7. Lee HJ, Kim KS, Jeong JS. Comparison of adductor pollicis, Orbicularis Oculi and corrugator supercilii as indicators of adequacy of muscle relaxation for tracheal intubation. *Br J Anaesth* 2009;102:869-874.
8. Haller G, Gardaz JP, Bissonnette B. Evaluationdes conditions d' intubation sous rocuronium. *Can J Anaesth* 1998;45:312-316.
9. Dorsch JA, Dorsch SE. Neuromuscular transmission monitoring. In: Understanding anesthesia equipment. 5th edition. Philadelphia: Lippincott Williams and Wilkins; 2008. pp.805-21.
10. Naguib M, Lien CA, Meistelman C. Pharmacology of neuromuscular blocking drugs. In: Miller RD, Cohen NH, Eriksson LI, Fleisher LA, Wiener-Kronish JP, Young WL (eds.), Miller's Anesthesia. Vol I. 8th edition. New York: Churchill Livingstone, Elsevier; 2014. pp.958-94.
11. Koscieiniak-Nielsen ZJ, Horn A, Sztuk F, Eriksen K, Skovgaard LT, Viby Mogensen J. Timing of tracheal intubation; Monitoring the orbicularis oculi, adductor pollicis or use a stop watch ? *Eur J Anesthesiol* 1996;13(2):130-135.
12. Witkowska M, Karwacki Z, Wierzchowska J, Bukowski P. Neuromuscular block monitoring for optimalisation of conditions for endotracheal intubation. *Anaesthesiol Intensive Ther* 2009;XLI(3):112-115.

How to cite this article: Alur RT, Anupama MK, Prakash HK. A comparative, randomized clinical study of haemodynamic response to laryngoscopy and tracheal intubation using vecuronium with and without neuromuscular monitoring by peripheral nerve stimulator. *Indian J Clin Anaesth* 2019;6(1):19-22.