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ORIGINAL ARTICLE

Comparative evaluation of effect of vecuronium and succinylcholine on intraocular pressure

Alka Shah, MD[1], Rachana Gandhi, MD[1], Ila Patel, MD[2]

[1]Assistant Professor; [2]Associate Professor
Department of Anesthesiology, Gujarat Medical Education & Research Society (GMERS) Medical College, 225, Sola Rd, Shenbhai Nagar, Sola, Ahmedabad, Gujarat 380081, (India)

Correspondence: Dr Alka Shah, A-22, Aashna 2, Opp. Prestige Tower, Near Chief Justice Bunglow, Bodakdev, Ahmedabad 380054 (India); E-mail: drpiyushpujara@gmail.com, dralkap@yahoo.co.in

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ABSTRACT

Background and Aim: The success of ophthalmic surgery, particularly when the globe is opened, depends to large extent on good control of intraocular pressure not only at induction of anesthesia, but also during maintenance phase. Intubation is usually achieved with the use of non-depolarizing muscle relaxants for fear of increasing intraocular pressure with depolarizing relaxants. Present study was undertaken with an aim to evaluate the effect of succinylcholine or vecuronium on intraocular pressure in association with propofol induction.

Methodology: Fifty patients of both sexes of ASA physical status I and II, between 15-50 years of age were selected for the study for one year. Patients with clinically significant pre-existing eye disease, raised base line IOP, cardiorespiratory illness, CNS diseases, difficult airway, obesity, those receiving any drug likely to have an effect on IOP and in whom use of succinylcholine was contraindicated were excluded. Patients were randomly assigned to two equal groups. Anesthesia was induced by propofol 2 mg/kg over 30 sec in all patients. In Group V patients we used vecuronium and in Group S used succinylcholine for intubation. Statistical analysis was done with one way ANOVA using SPSS software version 15.

Results: In Group V, 28.49% decrease in IOP after induction and one min after intubation IOP was increase to 14.53% but it remain still lower than the baseline value. In Group S, there was 28.14% increase in IOP after induction and one min after intubation IOP was increase to 35.56%. Significant increase in pulse rate and blood pressure noted in Group S after induction agent and intubation as compared to Group V.

Conclusion: Propofol + vecuronium provide good to excellent intubating condition and it is a suitable agent for tracheal intubation for patient undergoing elective and emergency ophthalmic surgery where rise in IOP is undesirable.

Key words: Anesthesia, ANOVA, Intraocular pressure, ophthalmic surgery

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INTRODUCTION

Increasing intraocular pressure (IOP) in ophthalmic surgery has always been problematic for the surgeon and it is necessary to prevent the elevation of IOP and control it before, during and after the surgery.[1] The success of ophthalmic surgery, particularly where the globe is opened, depends to large extent on good control of intraocular pressure (IOP) not only during maintenance but also at induction of anesthesia. This is usually achieved with controlled ventilation of lungs, facilitated by the use of non-depolarizing muscle relaxants. Non-depolarizing muscle relaxants are also advocated as a part of a modified rapid sequence induction in patient with full stomach, where the use of succinylcholine is contraindicated,

as in patient with perforated eye injury. Vecuronium is a non-depolarizing agent which is short acting and free of any cardiovascular comparatively or other side effects, even when used in relatively large doses and it would appear to be suitable for the use in ophthalmic surgery.[2]

Laryngoscopy and tracheal intubation are also reported to produce a significant rise in IOP. The mechanism is not clear but probably relates to sympathetic cardiovascular response to tracheal intubation. Squeezing the eye ball due to tonic contracture of extra ocular muscles and the dilatation of choroidal blood vessel are the important reason for the rise in IOP. Since its introduction in 1906, succinylcholine has been shown to cause a transient (4-6 min) but significant rise (6-10 mmHg) in IOP. Studies of commonly used non-depolarizing agents (vecuronium, atracurium) have shown that they are not associated with increase in IOP as seen with succinylcholine.[3] Induction of anesthesia with propofol has been reported to be smooth, without major side effects and associated with rapid and smooth recovery. Its use is also associated with significant reduction in IOP and some benefit in attenuating the increase in IOP associated with tracheal intubation.

Ophthalmic surgery requires calm-co-operative patients, free from pain with immobile eye and minimal changes in IOP. Hence present study was undertaken with an aim to evaluate the effect of Succinylcholine or vecuronium on intraocular pressure in association with induction of anesthesia with propofol.

METHODOLOGY

Fifty patients of either sex of ASA physical status I AND II between 15-50 years of age were selected for the study for One year. Before the beginning of the study, ethical approval and official permission was obtained from the ethical committee of the college and concerned hospital. Written informed consent was obtained from patients who participated in the study. Patients with clinically significant pre-existing eye diseases, raised base line IOP, cardiorespiratory illness, CNS diseases, difficult airway, obesity, those receiving any drug likely to have an effect on IOP and in whom use of succinylcholine is contraindicated were excluded. Patients were randomly assigned to two equal groups. In both the groups, propofol was used as induction agents. In group V, anesthesia was induced with propofol and vecuronium and in Group S: anesthesia was given with propofol and succinylcholine.

Preanesthetic checkup was done on the day before and on the morning of surgery. Clinical examination was done and routine investigations like hemoglobin, renal function tests, serum electrolytes, random blood sugar and chest x-ray PA view were advised. On the table reports noted, monitors were attached and vital parameters like pulse, systolic and diastolic blood pressures, SpO_2, ECG were noted. Baseline IOP was measured with Schiotz indentation tonometer using 5 G plunger weight after anesthetizing the cornea with topical 4% lignocaine hydrochloride solution.

Premedication, in the form of glycopyrrolate, inj midazolam and inj tramadol, was given. Vital parameters like SpO_2 and IOP were measured and recorded after 10 min of premedication.

In Group V anesthesia was induced with propofol 2 mg/kg over 30 sec followed by injection Vecuronium 0.1 mg/kg and patients were ventilated gently with 60% of N_2O in oxygen. Tracheal intubation was carried out after 2 min.

In Group S anesthesia was induced with propofol 2 mg/kg over 30 sec followed by injection succinylcholine 1.5 mg/kg IV, Tracheal intubation was carried out once the muscle fasciculation disappeared.

Patients were maintained with 60% of N_2O in oxygen, intermittent vecuronium and isoflurane in both groups. IOP was measured at following time periods:

T_0 - Before premedication

T_p - 10 min after premedication

T_{in} - After induction of anesthesia and before laryngoscopy

T_1 - 1 min after intubation and after cuff inflation

T_3 - 3 min after intubation

T5 - 5 min after intubation

T_{10} -10 min after intubation.

Heart rate and systolic blood pressure (SBP) were measured and recorded at the same time.

After completion of surgery, residual neuromuscular block was reversed with inj neostigmine 50 μg/kg and glycopyrrolate 10 μg/kg IV. Patients were extubated once they fulfilled the extubation criteria. Vital parameter were measured and recorded. Note was made of any side effects like pain on injection, bradycardia, hypotension, hiccup, involuntary movements, congestion of eye, nausea, vomiting etc. ANOVA test was used to assess variance and statistical significant differences between measurement of IOP,

arterial pressure and heart rate at different time intervals within respective groups.

Statistical analysis: The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using SPSS version 15 (SPSS Inc. Chicago, IL, USA). The variables were assessed for normality using the Kolmogorov-Smirnov test. Descriptive statistics were calculated. Means of groups were compared by one way ANOVA Test. Level of significance was set at $p = 0.05$.

RESULTS

Fifty patients belonging to ASA Grade I-II were divided into two groups. The patients in our study belonged to age group 15-50 years. There was no significant difference in the mean age and weight. There was preponderance of male patients in Group V and female patients in Group S.

Changes in intragroup IOP at various time intervals were compared with baseline IOP value which is 17.1 ± 1.25 mmHg in Group V and 16.31 ± 1.63 mmHg in Group S. After premedication, there was no change in IOP in both groups which was statistically not significant ($p > 0.05$). After induction of anesthesia, IOP was decreased 28% in Group V while IOP was increased 28% in Group S which was statistically very highly significant ($p < 0.001$).

One min after intubation: In Group V, there was 15% increase in IOP but the value was still lower than the baseline value. In Group S, there was 63% increase in IOP, higher than base line value. The difference was statistically very highly significant ($p < 0.001$).

From T_3 to T_{10}: In Group V, there was continuous fall in IOP persisted till 10 min after intubation 10.9 ± 1.01 mmHg which was lower than baseline value. Where as in Group S, the increase in IP was persisted till 5 min after intubation 18.6 ± 1.94 mmHg and it comes to baseline value at 10 min after intubation, 16.9 ± 1.7 mmHg. The difference between two groups were statistically very significant ($p < 0.001$) at three and five min and highly significant ($p < 0.01$) at ten min after intubation.

After induction of anesthesia, in Group V, there was decrease in pulse rate to 80 ± 11 beats/min while in Group S, pulse rate was increase to 86.44 ± 6.36 beats/min. the difference was statistically significant ($p < 0.05$). One min after intubation, in Group V, there was increase in pulse rate to 91 ± 10 beats/min but the values were still lower than baseline value. In Group S, there was further rise in pulse rate 99.5 ± 14.29 beats/min. The difference was statistically very highly significant ($p < 0.001$).

After induction of anesthesia more decrease in SBP 106.56 ± 9.87 mmHg was observed in Group V compared to Group S 123.9 ± 8.03 mmHg, the difference was statistically highly significant ($p < 0.001$). One minute after intubation further increase in SBP was observed in Group S compared to Group V, which was statistically highly

Table 1: Demographic data of the patients

Variables	Group V	Group S	p-value
Age (in years)	31 ± 11.25	31 ± 11	> 0.05
Weight (in kg)	48 ± 7.46	45 ± 8.9	> 0.05
Male: Female	13(52%):12(48%)	14(56%):11(44%)	
ASA Physical status I II	19(76%) 6(24%)	21(84%) 4(16%)	

Data given as mean ± SD or n(%)

Table 2: Comparative baseline hemodynamic parameters (mean ± SD)

Variables	Group V	Group S	p-value
Pulse rate (beats/min)	93.1 ± 4.6	81.4 ± 6.37	> 0.05
Systolic BP (mmHg)	124.8 ± 10.37	129.36 ± 9.09	> 0.05
Diastolic BP (mmHg)	76 ± 5	78.02 ± 5.08	> 0.05
IOP (mmHg)	17.1 ± 1.25	16.31 ± 1.63	> 0.05

All the variables were comparable in both groups.

Table 3A: IOP (mmHg) at various time intervals (mean ± SD)

Time	Group V	Group S	p-value
T_0	17.5 ± 1.25	16.31 ± 1.63	> 0.05
T_p	17.1 ± 1.25	16.31 ± 1.63	> 0.05
T_{in}	12.4 ± 1.33	20.9 ± 2.02	< 0.001
T_1	14.9 ± 1.79	26.7 ± 2.42	< 0.001
T_3	11.7 ± 1.17	21.8 ± 2.58	< 0.01
T_5	10.9 ± 1.01	18.6 ± 1.94	< 0.01
T_{10}	10.9 ± 1.01	16.9 ± 1.7	< 0.01

significant ($p < 0.001$). From $T_{3\ to}$ T_{10} there was continuously more decrease observed in SBP in Group V compared to Group S which was statistically highly significant ($p < 0.001$).

In Group V more patient developed pain on injection compared to Group S; and 2 patients developed congestion of eye compared to one in Group S. In the latter group 2(8%) of the patients developed bradycardia.

DISCUSSION

Most of the ophthalmic surgeries are conducted under local anesthesia and monitored anesthesia care which required calm and cooperative patients. In uncooperative patients especially in children general anesthesia is preferred and the goal of general anesthesia is to provide immobilization of the eyeball, minimal changes in intraocular pressure, smooth induction and smooth postoperative emergence. Most of the anesthetic agents decrease the IOP except succinylcholine and ketamine. Succinylcholine is, however, a drug of choice for facilitating tracheal intubation in suspected full stomach patients. The rise in IOP produced by succinylcholine is transient for 4 to 6 min and is usually caused by contraction of extra ocular muscles and dilatation of choroidal blood vessel.[4]

Good control of IOP during intraocular surgery is usually attended with non-depolarizing muscle relaxant. Vecuronium offers several well documented advantages,

Table 3B: Intra group comparison of IOP (mmHg)

Time interval	Group V		Group S	
	F- Statistic	p-value	F- Statistic	p-value
T_0 vs. T_p	0.00	> 0.05	0.0	> 0.05
T_0 vs. T_{in}	165.84	< 0.001	78.15	< 0.001
T_0 vs. T_1	25.42	< 0.01	317.13	< 0.001
T_0 vs. T_3	249.66	< 0.01	8.99	< 0.01
T_0 vs. T_5	372.48	< 0.01	20.42	< 0.01
T_0 vs. T_{10}	372.48	< 0.01	1.57	> 0.05

Table 4: Pulse rate (beats/min) at various time intervals (mean ± SD)

Time	Group V	Group S	p-value
T_0	93.1 ± 4.6	81.4 ± 6.37	> 0.05
T_p	93.1 ± 5	81.4 ± 6.23	> 0.05
T_{in}	80 ± 11	86.44 ± 6.36	< 0.05
T_1	91 ± 10	99.5 ± 14.29	< 0.001
T_3	90 ± 9.9	89.7 ± 5.79	< 0.05
T_5	90 ± 9.6	85.4 ± 5.25	< 0.05
T_{10}	90 ± 9.8	83.2 ± 3.56	< 0.05

Table 5: SBP (mmHg) at various time intervals (mean ± SD)

Time	Group V	Group S	p-value
T_0	124.8 ± 10.37	129.63 ± 9.09	> 0.05
T_p	124.8 ± 10.37	129.5 ± 9.25	> 0.05
T_{in}	106.56 ± 9.87	123.9 ± 8.03	< 0.001
T_1	127.6 ± 10.52	139.3 ± 8.06	< 0.001
T_3	114.96 ± 7.3	133.9 ± 7.5	< 0.001
T_5	114 ± 7.84	129.2 ± 7.46	< 0.001
T_{10}	114 ± 7.63	126.64 ± 6.52	< 0.001

Table 6: Comparison of side effects

Side effect	Group V N (%)	Group–S N (%)
Pain on injection	6 (24)	4 (16)
Congestion of eye	2 (8)	1 (4)
Bradycardia	-	2 (8)

such as cardio stable and relatively shorter duration of action, even when administered in large doses. Induction of anesthesia with propofol produces significant reduction in IOP, and some benefit in attenuating the increase in IOP, with rapid and smooth recovery without major adverse effects.

B. Vanacleer[2] reported that there was 25.37% decrease in IOP, one min after giving propofol. The administration of vecuronium immediately after propofol contributed to further 11.94% decrease in IOP. Even after intubation IOP was 15.67% lower than the baseline value, it is comparable with our study. R. K. Mirakhaur[3-6] reported that, there was 36.9% decrease in IOP after propofol and vecuronium. After intubation IOP was increased but still 29.78% lower than the baseline value, which is comparable with our study.

Some researchers reported that rise in IOP after succinylcholine started within one min which was 25.1% higher than the baseline value, and that it was not associated with any rise in ocular blood flow. [7]

In our study, the pulse rate did not show any significant changes 10 min after premedication in any of the groups. In Group S there was significant increase in pulse rate noted after succinylcholine administration ($p < 0.05$) and very highly significant increase in pulse rate was noted at one min after intubation ($p < 0.001$), whereas in Group V, throughout the study pulse rate remained stable and below baseline value.

In Group S, a significant rise in SBP was noted at various time intervals except 10 min after premedication. While in Group V, SBP remained stable throughout the study and decrease in SBP was noted after induction agent. Some author reported similar results as shown in our study.[4,6,8]

Pain on injection with propofol was the main side effect found in our study which was higher in Group V (24%) as compared to Group S (6%). Congestion of eye was more in Group V than in Group S. Bradycardia was observed only in Group S and it might be due to combined effects of propofol and succinylcholine.[9,10]

The findings from our study conferm that the induction of anesthesia with propofol and vecuronium is associated with useful and significant decrease in IOP as compared to propofol and succinylcholine at all time interval. Combination of propofol and succinylcholine is choice of drug when difficult airway or full stomach is suspected.

CONCLUSION

To conclude induction with propofol plus vecuronium provide good to excellent intubating condition compared to a combination of propofol plus succinylcholine. It is a suitable regimen for tracheal intubation for patients undergoing elective and emergency ophthalmic surgery where rise in IOP is undesirable. Careful assessment of airway should be made before administration of vecuronium and risk of aspiration kept in mind in case of full stomach patients.

Conflict of interest: None

Author contribution:
AS: Concept and manuscript drafting
RG: Dat collection and manuscript drafting
IP: Statistical analysis

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"Research is to see what everybody else has seen, and to think what nobody else has thought"
Albert Szent-Gyorgyi quotes (Hungarian Biochemist, 1937 Nobel Prize for Medicine, 1893-1986)

"To steal ideas from one person is plagiarism, to steal ideas from many is research."