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C Rakesh
Assistant Professor, Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh, India

CH Ramanamurthy
Assistant Professor, Department of General Medicine, Maheshwara Medical College & Hospital, Chitkul, Sangareddy, Telangana, India

Correspondence
CH Ramanamurthy
Assistant Professor, Department of General Medicine, Maheshwara Medical College & Hospital, Chitkul, Sangareddy, Telangana, India

Intraocular pressure alterations after succinylcholine and endotracheal intubation: The role of premedication with dexmedetomidine

C Rakesh and CH Ramanamurthy

Abstract
Background: The use of succinylcholine in instances of penetrating ocular injuries can result in the adverse outcome of visual impairment due to the elevation of intraocular pressure and the heightened susceptibility to globe rupture. The objective of this study was to ascertain whether administering intravenous dexmedetomidine prior to exposure to succinylcholine and intubation could alleviate the impact on intraocular pressure.
Methods: The research conducted was both prospective and randomized. Following a comprehensive examination of the methodology, the research was conducted on a sample of 60 eligible participants, with the explicit approval of an ethics committee and the explicit informed consent of the patients. The study was conducted at Department of General Medicine, Maheshwara Medical College & Hospital, Chitkul, Sangareddy, Telangana, India between January 2016 to December 2016.
Results: The study group saw a reduction in intraocular pressure following the administration of premedication. Following succinylcholine administration and intubation, intraocular pressure (IOP) increased in all three groups. However, in both the study and control groups, IOP did not surpass the levels observed before treatment. Both doses effectively inhibited the sympathetic response to laryngoscopy and intubation, however the highest level of hemodynamic stability was achieved at a dosage of 0.4 g/kg.
Conclusion: Both dosages of dexmedetomidine are equally effective in avoiding a rise in intraocular pressure (IOP) and reducing the sympathetic response. However, it has been observed that administering a dosage of 0.4 g/kg is linked to enhanced hemodynamic stability. Therefore, administering dexmedetomidine at a dosage of 0.4 g/kg may be beneficial in preventing an elevation in intraocular pressure.

Keywords: Premedication, succinylcholine, dexmedetomidine, and endotracheal intubation

Introduction
Ensuring consistent blood pressure and pulse rates during the procedures of intubation and laryngoscopy is an essential component of any anesthetic methodology. The examination and reporting of complications arising from laryngoscopy and intubation, including alterations in hematocrit and intraocular pressure, have been extensively studied. Numerous strategies have been suggested to alleviate the impact of laryngoscopy and intubation on the sympathetic nervous system, intraocular pressure system, and catecholamine release [1, 2].
The potential impact of elevated intraocular pressure resulting from an anesthetic procedure or medication on a healthy individual remains uncertain. However, the situation undergoes a significant transformation when applied to a patient with preexisting intraocular hypertension. In scenarios involving penetrating eye damage, there is a notable preference for drugs or strategies aimed at optimizing intraocular pressure [3, 4].
Numerous strategies have been employed in an effort to alleviate the increase in intraocular pressure caused by succinylcholine. An approach known as "self-taming" involves initially administering a lower dosage of the medication, followed by the complete dosage. Additional treatments that may be administered prior to the procedure including lignocaine, nifedipine, nitroglycerine, and several other pharmaceutical agents. There exist advantages and disadvantages associated with the utilization of any certain modality, and no singular strategy is devoid of compromises. When confronted with ocular emergencies, anesthesiologists frequently encounter challenging situations, such as penetrating globe

injuries. Given that the majority of these individuals exhibit excessive satiety, the issue of aspiration emerges as a significant concern. The risk of vision loss is heightened by any increase in intraocular pressure subsequent to an open globe injury, as it can result in the drainage of aqueous fluid or the extrusion of vitreous humor through the lesion [5, 6].

To prevent a potentially blinding increase in intraocular pressure, these patients require rapid sequence induction because to the risk of aspiration. When there is a need for quick sequence induction, succinylcholine, which is a depolarizing muscle relaxant, is commonly employed. However, succinylcholine often leads to increased intraocular pressure, which is a frequent negative consequence. During stressful procedures such as laryngoscopy and endotracheal intubation, the intraocular pressure rises [7, 8].

Alpha 2 agonists are utilized in ophthalmic treatments due to their capacity to decrease intraocular pressure and attenuate the sympathetic reaction. Clonidine and dexmedetomidine are alpha 2 agonists that have similar biochemical properties. Dexmedetomidine exhibits a high degree of selectivity and specificity towards the alpha-2 adrenergic receptor, whereas clonidine demonstrates effectiveness against both alpha 1 and alpha 2 receptors. The sedative, anxiolytic, sympatholytic, and analgesic characteristics of dexmedetomidine have been extensively studied and are well-documented. Additionally, it is capable of inducing only minor respiratory depression. The half-life of dexmedetomidine in the body is approximately two to three hours [9, 10].

In 1952, succinylcholine started being utilized clinically. Due to its early onset of action and conducive intubating circumstances, it has now been the medicine of choice for rapid sequence induction. Nevertheless, elevated IOP is a common adverse effect of this illness. In contrast to its extensive history of use in other nations, dexmedetomidine's arrival to India is quite young. Anesthesia is necessary for every eye surgery to maintain optimal intraocular pressure, clear the operational field, and stabilize the patient's heart rate. Therefore, two administrations of dexmedetomidine were administered prior to the administration of succinylcholine and intubation in order to evaluate their effects on intraocular pressure. The objective of this study was to assess and compare the efficacy of two premedication protocols, namely intravenous dexmedetomidine at doses of 0.40 micrograms/kg and 0.6 micrograms/kg administered as a single bolus over a duration of 10 minutes, in conjunction with succinylcholine administration and endotracheal intubation, in mitigating the occurrence of intraocular pressure elevation [11, 12].

Materials and Methods

A prospective and randomized strategy was utilized in the investigation. After conducting a comprehensive analysis of the technique, the study was carried out on a cohort of 60 eligible patients, with the endorsement of an ethical committee and the explicit informed permission of the patients. The study's research was carried out at a Department of General Medicine, Maheshwara Medical College & Hospital, Chitkul, Sangareddy, Telangana, India between January 2016 to December 2016.

Inclusion Criteria

- Elective non-ophthalmic procedures under G.A.
- Ages 18 to 60
- Male or female
- ASA 1 or 2
- First attempt at intubation

Exclusion Criteria

- BMI >30; >60 years old and 18 years
- Patients with Mallampatti classes III or IV • Patients with a history of coronary artery disease, systemic hypertension, or diabetic mellitus
- Individuals who have elevated intraocular pressure or any type of acute or chronic eye illness.
- People who should not take succinylcholine
- Dexmedetomidine contraindications may include: Hemodynamic instability;

Results

Following the administration of premedication, the study group had a decrease in intraocular pressure. All three cohorts exhibited an elevation in intraocular pressure (IOP) subsequent to succinylcholine administration and intubation. However, it is noteworthy that the IOP of both the study and control groups did not return to their initial values. The administration of 0.4 g/kg resulted in improved hemodynamic stability, while both dosages demonstrated efficacy in mitigating the sympathetic response to laryngoscopy and intubation.

Table 1: Age Ratios

Group	Age (in years)	
	Mean	SD
Control Group	38.7	8.9
D4 Group	39.6	9.5
D6 Group	40.5	9.7

The mean age of the control group was 38.7 years, with a standard deviation of 8.9 years. In contrast, the mean age of the D4 group was 39.6 years, and the mean age of the D6 group was 40.5 years. None of the three groups exhibited a statistically significant variation in their age distribution.

Table 2: Gender Ratios

Group	Sex			
	Male		Female	
	No	%	No	%
Control Group	10	50	10	50
D4 Group	10	50	10	50
D6 Group	10	50	10	50

The sample for the control group consisted of 50% men, while the sample for D4 and D6 also consisted of 50% men. Half of the control group, half of the D4 group, and half of the D6 group consisted of females. Based on the aforementioned data, there is no observable disparity in the proportion of males to females among the three established groups. The gender distribution among the three groups was nearly identical.

Table 3: Dispersion of Stature, Mass, and Body Mass Index

Group	Height		Weight		BMI	
	Mean	SD	Mean	SD	Mean	SD
Control Group	155.8	3.1	56.2	6.1	24.5	2.5
D4 Group	157.0	3.7	54.9	5.9	22.6	2.7
D6 Group	159.6	3.9	57.4	4.9	23.8	2.5

Table 4: Characteristics of the ASA

Group	ASA			
	1		2	
	No	%	No	%
Control Group	10	50	10	50
D4 Group	10	50	10	50
D6 Group	10	50	10	50

No significant variations in the distribution of ASA were seen across the three groups, as all three groups displayed comparable patterns.

Table 5: Time Required for Operation

Group	Duration of surgery (minutes)	
	Mean	SD
Control Group	91.5	26.4
D4 Group	92.45	25.1
D6 Group	91.54	25.4

The average surgical times shown similarity among the three groups. The control group had an average surgery duration of 91.5 minutes, whereas the D4 and D6 groups had average surgery durations of 92.45 and 91.45 minutes, respectively. The initial levels of intraocular pressure were comparable among the three groups. The groups D4 and D6, which received premedication, exhibited statistically significant decreases in intraocular pressure (IOP) as compared to the control group. Upon doing a comparison between D4 and D6, it was observed that the latter exhibited a greater reduction in intraocular pressure (IOP) compared to the former, albeit without statistical significance. Following thiopentone induction, a decrease in mean intraocular pressure (IOP) was observed in all three groups. However, it is worth noting that the disparity between the control group and groups D4 and D6 was found to be statistically significant. The average intraocular pressure (IOP) increased after succinylcholine and intubation in all three groups, except for D4 and D6, where it did not. A statistically significant alteration in intraocular pressure (IOP) was seen following the administration of succinic choline, as well as after 1 and 5 minutes of intubation.

The mean resting heart rates were comparable among the three groups. Following the administration of dexmedetomidine, the average heart rates of both groups fell, with the D6 group seeing a more significant decline. After administering succinylcholine and performing intubation, the study groups exhibited a significantly decreased average heart rate compared to the control group. Following the intubation procedure, it was observed that there was no statistically significant disparity in the average heart rate between the D4 and D6 cohorts.

Discussion

Patients who have sustained penetrating eye injuries may present to the emergency department with a pre-existing patient load. The major function of anesthesia in this context is to mitigate the elevation of intraocular pressure while simultaneously expediting the establishment of a secure airway. The administration of succinylcholine, a pharmacological agent that facilitates the initiation of the rapid sequence, has the potential to result in elevated intraocular pressure. The administration of general anesthesia involves the utilization of both laryngoscopy and endotracheal intubation, both of which are considered unpleasant stimuli capable of eliciting the body's stress response and physiological reactions. The manifestations of these diseases encompass elevated heart rate, blood pressure, intraocular pressure, and various other physiological states. While the increase in intraocular pressure is transient and subject to individual variation, it can pose a significant and even life-threatening concern in individuals with open globe injuries [10-12].

In the case of a patient presenting with a difficult airway, succinic choline is the preferable choice over rocuronium, despite the fact that both medications have a rapid onset of action and induce muscle paralysis rapidly.

In cases where patients are scheduled for emergency ophthalmic treatments and exhibit increased intraocular pressure, it is recommended to decrease their intraocular pressure and hemodynamic response to laryngoscopy and intubation, if deemed necessary. Several techniques exist to mitigate the effects of succinylcholine on intraocular pressure, although none of them are flawless. Therefore, the development of a pharmaceutical intervention capable of mitigating the decline in intraocular pressure caused by succinylcholine, laryngoscopy, or intubation, while minimizing adverse effects on intubation conditions and cardiorespiratory parameters, would be highly advantageous [12-14].

Due to the recent introduction of dexmedetomidine in India in 2009, less study has been undertaken to ascertain its efficacy in decreasing intraocular pressure (IOP). Therefore, this study aimed to examine the impact of dexmedetomidine on the reduction of intraocular pressure and the mitigation of the hemodynamic response. The study involved the participation of three distinct groups: two groups were administered varying premedication amounts of dexmedetomidine, while a control group received normal saline. The study involved a total of sixty participants, with twenty individuals assigned to each of the three groups [14, 15].

In the present study, the synthesis of dexmedetomidine involved the addition of 100 g of dexmedetomidine to 50 ml of normal saline solution, resulting in a concentration of 2 g/ml. The resulting dose was then supplied over a duration of 10 minutes. Upon administration of dexmedetomidine as a bolus, the patient experiences a transient increase in blood pressure and a reflexive decrease in heart rate. This effect is caused by the activation of peripheral alpha 2 receptors in vascular smooth muscle, and it can be alleviated by delivering the medicine at a gradual pace. Therefore, the medicine was administered to the participants in this experiment for a duration of 10 minutes. The study conducted by Mowafi *et al*. utilized a dosage technique that was similar to the one described in this study [15, 16].

The documented pharmacokinetics of intravenous dexmedetomidine indicate a rapid distribution half-life of approximately 6 minutes. Several writers have utilized dexmedetomidine, which is commonly administered 10 minutes prior to induction. In this study, dexmedetomide was given 10 minutes before induction to mitigate the negative hemodynamic effects and elevated intraocular pressure caused by succinyl choline, laryngoscopy, and intubation, taking into account the drug's pharmacokinetic properties. No statistically significant differences were seen in terms of age, sex, weight, height, BMI, time following surgery, or American Society for Anaesthesiologists (ASA) physical state through the comparison of the two groups [14-

16].

The control group had a mean intraocular pressure (IOP) of 16.5±0.8 mmHg, the D4 group had a mean IOP of 16.7±0.4 mmHg, and the D6 group had a mean IOP of 16.4±0.8 mmHg. At the beginning, the three groups had comparable intraocular pressure. In the control group, the administration of normal saline premedication did not alter the average intraocular pressure, which remained at 16.5±0.8 mmHg. The average intraocular pressure in the D4 group was 14.4±0.6 mmHg, whereas in the D6 group it was 14.0±0.1 mmHg prior to dexmedetomidine premedication. However, it is worth noting that both groups exhibited decreased intraocular pressure values. A substantial reduction in intraocular pressure was seen (p<0.0001). The control group had a decrease in average intraocular pressure of 1.4 mmHg following the administration of thiopentone, resulting in a new minimum value of 15.1±0.6 mmHg. The average intraocular pressure decreased to 13.8±0.1 mmHg in the D4 group, and to 12.6±0.7 mmHg in the D6 group. Statistical measurements revealed substantial variations in intraocular pressure between the two groups. The administration of succinylcholine led to a rise in the average intraocular pressure (IOP) by 19.3±1.2 mmHg. It was observed that both groups experienced an increase in intraocular pressure after receiving succinylcholine (15.7±0.6 mmHg in the D4 and D6 groups, and 15.5±0.7 mmHg in the D4 and D6 groups, respectively). However, neither group's IOP exceeded its initial value [15-17].

In comparison to the study groups, the control group exhibited a statistically significant increase in intraocular pressure (IOP). However, no statistically significant difference was observed when comparing the D4 and D6 groups. In the experimental group, the average intraocular pressure exhibited a rise of 4.1 mmHg subsequent to intubation, ultimately reaching a value of 20.6 mmHg. The mean intraocular pressure (IOP) in the D4 and D6 cohorts exhibited an increase, reaching 16.4±0.4 mmHg and 15.97±0.5 mmHg, respectively. However, it remained below the initial value. Despite observing a higher intraocular pressure decline in the D6 group compared to the D4 group, no statistically significant distinction was found between the two groups. The intraocular pressure exhibited a sustained increase after to intubation, which can be attributed to the influence of succinyl choline, laryngoscopy, and intubation for a minimum duration of 5 minutes. There was a statistically significant difference in mean intraocular pressure (IOP) between the control and study groups, even 5 minutes after intubation [16-18].

The study conducted by Mowafi *et al*. examined the disparities in intraocular pressure between the control and study groups, yielding comparable findings. Pal C K *et al*. reported comparable findings pertaining to intraocular pressure subsequent to dexmedetomidine administration. The study conducted by Jakkola *et al* demonstrated that premedication with a bolus dosage of dexmedetomidine resulted in a 34% reduction in intraocular pressure (IOP). In the present investigation, the D4 group exhibited a 12.1% decrease in IOP, while the D6 group experienced a 14.6% reduction. A previous study conducted by Ayoglu *et al*. yielded comparable findings, indicating that the administration of a bolus of dexmedetomidine resulted in a reduction of intraocular pressure by 3.8 mm Hg in comparison to the first measurement [17-19].

The study group saw the most significant reduction in intraocular pressure in the D4 and D6 groups, with decreases of 20.1% and 23.1% respectively, following the administration of thiopentone. Several authors have conducted study on the maximum reduction in intraocular pressure (IOP) following dexmedetomidine injection. Seluck *et al*. observed that the maximum pain alleviation achieved through dexmedetomidine infusion was 28%. At the beginning, the average resting heart rates of both groups were comparable. Following saline premeditation, the heart rates of individuals in the control group exhibited minimal fluctuations. However, the administration of dexmedetomidine before to therapy led to a notable decrease in heart rates compared to the initial measurements in both experimental groups. The group assigned to group D6 exhibited a statistically significant elevation in heart rate reduction in comparison to the group assigned to group D4. The heart rates of individuals in the control group exhibited a substantial increase following intubation, with the most pronounced surge observed shortly following the surgery. The study done by Aho *et al*. likewise yielded comparable findings. While the study groups experienced an increase in heart rates following intubation, the administration of dexmedetomidine premedication resulted in a notable reduction in the sympathetic response. This reduction was observed to be statistically significant when comparing heart rates at various time intervals up to 10 minutes after intubation. Specifically, the control group exhibited a consistently higher heart rate increase at all intervals [18-20]. Several writers have observed the capacity of dexmedetomidine to decelerate the heart rate. According to Mowafi *et al*., the administration of dexmedetomidine resulted in a reduction of the heart rate by 14 beats. Scheinin, Ferdi, *et al*. saw a reduction of ten heartbeats. In accordance with previous studies, our research revealed a notable reduction in heart rate of 12 beats in the D4 group and 15 beats in the D6 group [19, 20].

Based on the findings of Basar *et al*., it was seen that the control group exhibited a 10 beat increase in heart rates following laryngoscopy and intubation. Conversely, the dexmedetomidine group had an 8 beat decrease in heart rates compared to the initial measurements. Although dexmedetomidine effectively mitigated the heart rate elevation observed in the research groups, the mean heart rate following intubation was elevated compared to the values before intubation in both the D4 and D6 groups. In contrast, Aho *et al*. observed a significant elevation in heart rate among the dexmedetomidine group compared to the control group [19-21].

At the commencement of the experiment, both the study and control groups exhibited comparable systolic blood pressure levels. The patient's systolic blood pressure exhibited a substantial increase immediately upon intubation and remained elevated (in comparison to pre-intubation readings) for a duration of 15 minutes. Following pretreatment with dexmedetomidine, there was a significant decrease in systolic blood pressure observed in both groups as compared to the control group. The D6 group had a much greater decrease in systolic blood pressure compared to the D4 group. Although both the study and control groups experienced a statistically significant rise in systolic blood pressure after intubation, the difference between the two groups was less in the study group. While the D6 group had a lower average systolic blood pressure value upon intubation compared to the D4 group, the disparity did not

reach statistical significance. Aho *et al*. observed a significant rise in blood pressure following intubation, with a 40 mmHg increase in the control group and an 18 mmHg increase in the dexmedetomidine group. This aligns with the findings reported in references [20-23].

Conclusion

The decrease in intraocular pressure resulting from succinyl choline administration and intubation can be effectively mitigated by administering either 0.4 g/kg I/V or 0.6 g/kg I/V of dexmedetomidine diluted in normal saline at a concentration of 2g/ml for a duration of 10 minutes before induction. Moreover, it significantly diminished the sympathetic reaction observed during the procedures of laryngoscopy and intubation. The intravenous administration of a dose of 0.4 micrograms per kilogram resulted in the achievement of the intended hemodynamic stability. If an increase in intraocular pressure could have negative effects, it is possible to provide dexmedetomidine (0.4 micrograms per kilogram of body weight) intravenously before administering succinyl choline injection and intubation.

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Conflict of interest

Nil

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