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Original research article

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

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Abstract

Background: When used in cases with penetrating eye injuries, succinylcholine can lead to the disastrous complication of vision loss by increasing intraocular pressure and increasing the risk of globe rupture. The goal of this research was to determine if pre-treatment with intravenous dexmedetomidine could mitigate the effects of succinylcholine and intubation on intraocular pressure.
Methods: The study was prospective and randomized. After discussing the technique in detail, the study was done on 50 eligible patients with the agreement of an ethical committee and the patients' signed informed consent. Research for this study was carried out at Lifecare Hospital, Baniyas, Abu Dhabi between January 2016 to December 2017.
Results: The intraocular pressure of the study group decreased after receiving premedication. After succinylcholine and intubation, IOP rose in all three groups, but in the study groups, it never went beyond pre-treatment levels. The sympathetic response to laryngoscopy and intubation was successfully suppressed at both doses of dexmedetomidine, but hemodynamic stability was better at 0.4 mcg/kg than at 0.6mcg/kg.
Conclusion: When it comes to preventing an increase in intraocular pressure (IOP) and dampening the sympathetic response, both dosages of dexmedetomidine i.e. 0.4 mcg/kg and 0.6 mcg/kg are equally effective. Nevertheless, the dose of 0.4 mcg/kg is associated with greater hemodynamic stability. Hence, preventing an increase in intraocular pressure with dexmedetomidine 0.4 mcg/kg may be useful.
Keywords: Premedication, succinylcholine, dexmedetomidine, and endotracheal intubation

Introduction

Maintaining steady blood pressure and pulse rates during intubation and laryngoscopy is a crucial part of any anesthetic technique. Complications from laryngoscopy and intubation, such as changes in hemodynamics and intraocular pressure, have been widely examined and reported. Many methods have been proposed to mitigate the effects of laryngoscopy and intubation on the sympathetic nervous system, the intraocular pressure system, and the release of catecholamines [1, 2].
It is unknown what effect, if any, an increase in intraocular pressure from an anesthetic medicine might have on a healthy person. Yet, the scenario changes dramatically when used in a patient who has pre-existing intraocular hypertension. So, in situations like penetrating eye damage, the medications or approaches for optimizing intraocular pressure are particularly desirable [3, 4].
Many strategies have been attempted to mitigate succinylcholine's elevation in intraocular pressure. One technique is called "self-taming", which entails administering a smaller dose of the medicine first and then the full dose. Others include pre-treatments with lignocaine, nifedipine, nitro-glycerine and other drugs before the procedure. There are benefits and cons to using any particular modality and no single approach is without compromise. While dealing with emergencies involving the eyes, anesthesiologists often face difficult scenarios, such as penetrating globe injuries. Since most of these individuals present with full stomach, aspiration is a major concern. Any rise in intraocular pressure following an open globe injury increases the risk of vision loss due to the drainage of aqueous fluid or extrusion of vitreous humor through the lesion [5, 6].
Because of the risk of aspiration, these patients need rapid sequence induction to avoid a potentially blinding rise in intraocular pressure. When rapid sequence induction is required, succinylcholine, a depolarizing muscle relaxant, is typically utilized. Nevertheless, elevated intraocular pressure is a

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common adverse effect of succinylcholine. The intraocular pressure increases during stressful procedures like laryngoscopy and endotracheal intubation [7, 8].

Due to their ability to reduce intraocular pressure and dampen the sympathetic response, alpha 2 agonists find useful application in ophthalmic procedures. Clonidine and dexmedetomidine are examples of alpha 2 agonists that share these characteristics. Dexmedetomidine is extremely selective and specific for the alpha-2 adrenergic receptor, while clonidine acts on both alpha 1 and alpha 2 receptors. Dexmedetomidine's sedative, anxiolytic, sympatholytic, and analgesic properties are well characterized, and it causes only mild respiratory depression. Dexmedetomidine has a half-life of about two to three hours in the body [9, 10].

In 1952, succinylcholine started being used clinically. Due to its rapid onset of action and conducive intubating settings, it has been the medication of choice for rapid sequence induction. Nevertheless, increased IOP is a common side effect of this condition. In contrast to its long history of use in other nations, dexmedetomidine's introduction is very new. Every eye surgery requires anesthetics to ensure intraocular pressure is well-controlled, the operative field is unobstructed, and the patient's heart rate remains stable. Hence, two doses of dexmedetomidine were premedicated prior to succinylcholine delivery and intubation to assess their impact on intraocular pressure. The purpose of this research was to compare the effectiveness of two premedication protocols involving intravenous dexmedetomidine with succinylcholine administration and endotracheal intubation in preventing an increase in intraocular pressure [11, 12].

Materials and Methods

The study was prospective and randomized. After discussing the technique in detail, the study was done on 50 eligible patients with the agreement of an ethical committee and the patients' signed informed consent. Research for this study was carried out at Life care Hospital, Baniyas, Abu Dhabi between January 2016 to December 2017.

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.
Patients in whom succinylcholine is contraindicated.
Contraindications to dexmedetomidine: Hemodynamic instability.

Results

After receiving premedication, the study group saw a reduction in intraocular pressure. All three groups showed an increase in IOP after succinylcholine and intubation, but it was not statisticaly significant in both the study groups. In the control group IOP never reverted back to their original values. Both doses of Dexmedetomidine were found to be effective in preventing rise in IOP and hemodynamic stability was better at dose of 0.4 mcg/kg. Both doses of dexmedetomidine were effective at reducing the sympathetic response to laryngoscopy and intubation.

Table 1: Age Ratios

Group	Age (in years)	
	Mean	SD
Control Group	37.1	8.0
D4 Group	38.2	9.1
D6 Group	39.4	9.8

The control group had a mean age of 37.1 years with a standard deviation of 8.0 years, while the D4 group's mean age was 38.2 years and the D6 group's mean age was 39.4 years. None of the three groups displayed a statistically significant variation in their distribution of ages.

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Table 2: Gender Ratios

Group	Sex			
	Male		Female	
	No	%	No	%
Control Group	10	40	5	20
D4 Group	10	40	10	40
D6 Group	5	20	10	40

Men comprised 40% of the sample for the control group, 40% for D4, and 20% for D6. Females made up 20% of the control group, 40% of the D4 group and 40% of the D6 group. According to the data presented above, there is no discernible difference in the percentage of males to females within the three categories. The three groups had almost the same gender breakdown.

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

Group	Height		Weight		BMI	
	Mean	SD	Mean	SD	Mean	SD
Control Group	151.2	2.8	52.4	5.9	21.6	2.2
D4 Group	155.0	3.5	53.2	5.7	21.9	2.5
D6 Group	157.2	3.7	51.4	4.8	21.1	2.3

Body mass index, height and weight data for the three groups are displayed in the table. The average person in the control group weighed 52.4 kg, while those in the D4 and D6 groups weighed 53.2 and 51.4 kg, respectively. The average heights of people in the control, D4 and D6 groups were 151.2 cm, 155.0 cm, and 157.2 cm. The average body mass index (BMI) of the control group was 21.6, while those in D4 were 21.9% and D6 were 21.1%. All three groups had roughly the same distribution of height, weight, and body mass index.

Table 4: Characteristics of the ASA

Group	ASA			
	1		2	
	No	%	No	%
Control Group	10	40	05	20
D4 Group	10	40	10	40
D6 Group	05	20	10	40

There were no discernible differences in the ASA distribution among the three groups, with all three groups exhibiting similar patterns.

Table 5: Time Required for Operation

Group	Duration of surgery (minutes)	
	Mean	SD
Control Group	90.6	22.4
D4 Group	90.96	24.8
D6 Group	90.56	24.7

In the three groups, average surgical times were similar. The average time it took to perform surgery in the control group was 90.6 minutes, while in the D4 and D6 groups it was 90.96 and 90.56 minutes, respectively.

The three groups started out with similar levels of intraocular pressure. The premedication groups D4 and D6 demonstrated statistically significant reductions in IOP compared to the control group. By comparing D4 and D6, the latter was found to reduce IOP more than the former, although the difference was not statistically significant. After Propofol induction, all three groups experienced a drop in mean IOP, albeit the difference between the control group and D4 and D6 was statistically significant. In all three groups, the mean IOP rose following succinylcholine and intubation, however in D4 and D6 it never reach preoperative values. There was a statistically significant change in IOP after succinylcholine administration and again after 1 and 5 minutes of intubation.

Average heart rates at rest were similar across the three groups. After dexmedetomidine premedication, both groups' mean heart rates decreased, although the D6 group's decrease was larger. Once succinylcholine was given and intubation was performed, the average heart rate in the study groups was considerably lower than in the control group. After intubation, however, there was no significant difference in mean heart rate between the D4 and D6 groups.

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Discussion

Anesthetist's primary role, in a patient with penetrating eye injury and full stomach, is to prevent intraocular pressure from rising while also securing the airway as quickly as possible. The use of succinylcholine, which aids in rapid sequence induction, may lead to an increase in intraocular pressure. Both laryngoscopy and endotracheal intubation, used in the administration of general anesthesia, are unpleasant stimuli that can trigger the body's stress response and physiological reactions. Symptoms of these include an increase in heart rate, blood pressure, intraocular pressure, and other conditions. Although a rise in intraocular pressure is temporary and can vary from person to person, it can be a major and potentially fatal issue in patients with open globe injuries [10-12].

For a patient with a challenging airway, succinylcholine is preferred over rocuronium, despite both drugs having a very rapid onset of action and effecting a fast onset of muscle paralysis.

Patients scheduled for emergency ophthalmic procedures and patients with elevated intraocular pressure should have their intraocular pressure and hemodynamic response to laryngoscopy and intubation reduced if this is an indication. There are a number of strategies for counteracting succinylcholine's impact on intraocular pressure, but none of them are perfect. Thus, it would be great to have a medicine that can prevent intraocular pressure from rising as a result of succinylcholine, laryngoscopy or intubation while having minimal impact on intubation circumstances or cardiorespiratory parameters [12-14].

Since dexmedetomidine only became available in UAE much after 2012, not many research have been conducted there to determine whether or not it is effective at reducing intraocular pressure (IOP). Hence, the effects of dexmedetomidine on reducing intraocular pressure and dampening the hemodynamic response were investigated. Three groups participated in the study: two groups given differing premedication doses of dexmedetomidine and a control group given normal saline. Fifty people participated in the study, fifteen in control group, Twenty in D4 group and Fifteen in D6 group [14, 15].

In the current investigation, dexmedetomidine was made by adding 100 mcg to 50 ml of normal saline to achieve a concentration of 2 mcg/ml and the necessary dose was administered over the course of 10 minutes. When dexmedetomidine is given as a bolus, the patient's blood pressure briefly rises and their heart rate drops as a reflex. The stimulation of peripheral alpha 2 receptors in vascular smooth muscle causes this effect, which can be mitigated by administering the drug slowly. Hence, the medication was given to the subjects in this trial over the course of 10 minutes. Mowafi *et al*. studied employed an approach to dosing that was comparable to this one [15, 16].

The quick distribution half-life of intravenous dexmedetomidine is roughly 6 minutes, as shown by the drug's established pharmacokinetics. Dexmedetomidine has been used by a number of authors, and it is often given 10 minutes before induction. Due to the drug's pharmacokinetic nature, premedication with dexmedetomidine was administered 10 minutes prior to induction in this research in an effort to reduce the adverse hemodynamic effects and increase in intraocular pressure associated with succinyl choline, laryngoscopy, and intubation. By comparing the two groups, no statistically significant differences were found in terms of age, sex, weight, height, BMI, time after surgery, or American Society for Anaesthesiologist’s (ASA) physical status [14-16].

In the control group, the mean IOP was 16.5 ± 0.8 mmHg, in the D4 group it was 16.7± 0.4 mmHg and in the D6 group it was 16.4 ± 0.8 mmHg. The three groups had similar intraocular pressure at the start. In the control group, normal saline premedication resulted in an unchanged mean intraocular pressure of 16.5 ± 0.8 mmHg. Mean intraocular pressure was 14.4 ± 0.6 mmHg in the D4 group and 14.0 ± 0.1 mmHg in the D6 group after dexmedetomidine premedication, however it was lower in both groups. There was a statistically significant decrease in intraocular pressure (p 0.0001). The average intraocular pressure in the control group dropped by 1.4 mmHg after receiving Propofol, reaching a new low of 15.1± 0.6 mmHg. In the D4 group, the average intraocular pressure dropped to 13.8 ± 0.1 mmHg, while in the D6 group, it dropped to 12.6 ± 0.7 mmHg. Intraocular pressure varied significantly between the two groups, as measured statistically. Succinylcholine administration resulted in an increase in mean IOP of 19.3 ± 1.2 mmHg in Control group. Both groups' mean intraocular pressure increased after succinylcholine administration however both the study group's IOP never surpassed its initial value [15-17].

When compared to the study groups, the increase in IOP in the control group was statistically significant; however, when comparing the D4 and D6 groups, there was no statistical significance. In the control group, mean intraocular pressure increased by 4.1 mmHg after intubation, reaching 20.6 mmHg. The average intraocular pressure (IOP) in the D4 and D6 groups also rose, to 16.4 ± 0.4 mmHg and 15.97 ± 0.5 mmHg, but remained lower than the starting point. Even though the intraocular pressure drop in the D6 group was greater than that in the D4 group, there was no statistically significant difference between the two groups. Intraocular pressure continued to rise after intubation due to the effects of succinylcholine, laryngoscopy, and intubation for at least 5 minutes. Even 5 minutes after intubation, there was a statistically significant difference in mean IOP between the control and study groups [16-18]. Mowafi *et al*. research's into the differences in intraocular pressure between the control and study groups found similar results. Similar results regarding intraocular pressure following dexmedetomidine injection

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were found by Pal C K *et al*. Dexmedetomidine bolus dosage premedication was shown to reduce IOP by 34% by Jakkola *et al*., and in this study, a 12.1% drop was seen in the D4 group and a 14.6% reduction was shown in the D6 group. Similar results were seen in a previous study by Ayoglu *et al*., who found that a bolus of dexmedetomidine reduced intraocular pressure by 3.8 mm Hg compared to baseline [17-19].
The greatest decrease in intraocular pressure was seen in the D4 and D6 groups, at 20.1% and 23.1%, respectively, after Propofol administration in the study group. The maximal decrease in IOP after dexmedetomidine injection has been the subject of research by a number of writers. The average resting heart rates of the two groups were similar at the outset. After being premedicated with saline, the heart rates of those in the control group did not fluctuate much. Nevertheless, pre-treatment with dexmedetomidine resulted in significantly lower heart rates than baseline did in both research groups. The D6 group saw a statistically significant decrease in heart rate compared to the D4 group. The heart rates of those in the control group increased significantly after intubation, with the greatest rise occurring immediately after the procedure. The research conducted by Aho *et al*. also showed similar results. Although heart rates increased in the study groups after intubation, the initial decrease in heart rate due to dexmedetomidine premedication significantly blunted the sympathetic response, such that a comparison of heart rates at different intervals up to 10 minutes after intubation showed a statistically significant increase in the control group at all intervals [18-20]. Dexmedetomidine's ability to slow the heart rate has been noted by a number of authors. Dexmedetomidine was shown to slow the heart rate by 14 beats, as measured by Mowafi *et al*. Ten fewer heartbeats were detected by Scheinin, Ferdi, *et al*. Consistent with these earlier investigations, ours found a significant decrease in heart rate of 12 beats in the D4 group and 15 beats in the D6 group [19, 20].
According to research by Basar *et al*., in the control group, heart rates climbed by 10 beats after laryngoscopy and intubation, but in the dexmedetomidine group, heart rates increased by 8 beats less than baseline. Despite dexmedetomidine's ability to blunt the heart rate increase shown in the research groups, the average heart rate after intubation was higher than pre-intubation levels in both the D4 and D6 groups. However, Aho *et al*. discovered that the heart rate of the dexmedetomidine group also increased relative to the control group [19-21].
Both the study and control groups had similar systolic blood pressure at the start of the experiment. Immediately upon intubation, the patient's systolic blood pressure increased significantly and remained elevated (compared to pre-intubation levels) until 15 minutes later. After being pretreated with dexmedetomidine, systolic blood pressure dropped significantly in both groups compared to the control group. Systolic blood pressure dropped much more in the D6 group than in the D4 group. While a statistically significant increase in systolic blood pressure from the induction level in both the study and control groups following intubation, the difference between the two groups was less in the study group. Although the D6 group demonstrated a lower mean systolic BP value after intubation than the D4 group, the difference was not statistically significant. After intubation, Aho *et al*. also found a considerable increase in blood pressure, 40 mmHg in the control group and 18 mmHg in the dexmedetomidine group. This is consistent with what we found [20-23].

Conclusion
Significant obtundation of the rise in intraocular pressure associated with succinyl choline delivery and intubation could be achieved with either 0.4 mcg/kg I/V or 0.6 mcg/kg I/V of dexmedetomidine diluted in normal saline at a 2mcg/ml concentration administered over 10 minutes prior to induction. Furthermore, it considerably reduced the sympathetic response during laryngoscopy and intubation. However, the dose of 0.4 micrograms per kilogram intravenously produced the desired hemodynamic stability. In cases where a rise in intraocular pressure could be harmful, premedication with dexmedetomidine administered intravenously prior to succinyl choline administration and intubation is an option.

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