

Role of Remifentanil in Prevention Increase of Intraocular Pressure after Suxamethonium Injection

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ABSTRACT

Background: Succinylcholine is used to facilitate rapid tracheal intubation in patients who are at risk of aspiration of gastric contents. However, administration of succinylcholine and tracheal intubation are associated with an increase in intraocular pressure (IOP). Opioids generally attenuates this increase in IOP but may be associated with respiratory depression. Remifentanil has a rapid onset (time to peak effect 60-70 s), is metabolized rapidly and therefore respiratory depression should be short-lived. We have studied the efficacy of remifentanil in preventing an increase in IOP after administration of succinylcholine and tracheal intubation in a double-blind, randomized study.

Aim: To evaluate the role of REMIFENTANIL in decreasing IOP after succinylcholine injection and tracheal intubation (RAPID SEQUENCE INDUCTION).

Patient and method: It is a prospective, randomized double blinded clinical trial, done on 36 patients who had elective surgery in ophthalmology department, after taking patients consent, we had studied changes in IOP after succinylcholine injection and tracheal intubation 3 different times, by dividing patients in two groups, group R who takes Remifentanil 1 µg/kg and propofol 2mg/kg induction, and group C who received 5 ml normal saline with propofol 2mg/kg induction.

Results: Patients respond well, IOP had been decreased significantly in remifentanil group. We found that P-Value between the two groups were less than 0.05.

Conclusion: Remifentanil has significant role on decreasing IOP in rapid sequence induction and tracheal intubation.

KEYWORDS: rapid sequence induction, remifentanil, suxamethonium.

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INTRODUCTION

The tissue pressure of the intraocular contents is called the intraocular pressure (IOP). The normal range for IOP is 10–20 mm Hg and is maintained at this level throughout life and between the sexes, though there is some diurnal and seasonal variation. Control of IOP within the correct physiological range is necessary to maintain the anatomical conditions necessary for optimal refraction and thus vision.

Of all the factors detailed, the most important in determining IOP acutely is the episcleral venous pressure, which is determined by CVP. A raised episcleral venous pressure would lead to vitreous chamber venous engorgement and a reduction in aqueous humor drainage, both of which will raise IOP.

Therefore, the use of the reverse Trendelenburg position and the avoidance of venous congestion caused by neck positioning or tube ties around the neck are important factors in controlling IOP.

Succinylcholine is yet with no question most rapid onset providing ideal intubating conditions with a short duration of effect. It has, however, long been known to cause an increase in IOP of approximately 8-10 mmHg for about 5-10 min after administration.

The rise in IOP due to succinylcholine occurs after the initial reduction in IOP which accompanies administration of an induction agent. IOP does not usually rise after the administration of succinylcholine to pre-induction baseline

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values, though this cannot always be relied upon. This has led to a long-standing debate about the appropriateness of its use for patients with open globe injuries. The decision to use succinylcholine in an emergency case or in a patient at high risk of aspiration should be one based on the balance between the risk to the eye and benefit in terms of prevention of aspiration or failed intubation.

The cause of the rise in IOP due to succinylcholine has traditionally been ascribed to the increase in extra-ocular muscle tone caused by the drug. This notion has been challenged by some investigators who have shown an increase in IOP after succinylcholine with the extra-ocular muscles detached in subjects undergoing enucleation.

Opioids are used to prevent the rise in IOP which accompanies intubation, in addition to providing intra- and postoperative analgesia. The mechanisms by which opioids may decrease IOP include relaxing extra-ocular muscles and miosis (improving aqueous drainage). They may also decrease IOP by reducing arterial pressure, though only if systolic blood pressure falls to less than 90 mmHg.

PATIENTS AND METHODS

After obtaining approval from Iraqi medical board council, and obtaining verbal consent from 36 patients to do the study ASA 1, 2 undergoing elective eye surgery, we did a double-blind randomized study, which was carried out in GHAZI AL-HARIRI TEACHING HOSPITAL in Ophthalmology department between October 2012 and August 2013.

Exclusion criteria:

- Allergy to study drug.
- Patient refusal.
- Emergency eye surgery.
- Chronic opioid use.
- Eye surgery in 6 months.
- Anticipated difficult airway.

Study drugs were REMIFENTANIL 1 µg/kg for R group patients, and normal saline for control group.

These drugs prepared and aspirated in two 5 ml syringes which labeled with different codes referred to study drugs, not revealed until completing measuring.

All patients are premeditated with midazolam 1-2 mg 10 minutes before induction, and tetracaine 0.5% local drops to the normal eye (non-operated) to facilitate IOP measuring.

Patients were allocated randomly to two groups :

1. Group R received anesthetic induction with propofol 2 mg/kg slow injection over 30 sec., REMIFENTANIL 1 µg/kg and Succinylcholine 1.5 mg/kg.
2. Group C (control) received anesthetic induction propofol 2 mg/kg slow injection over 30 sec., 5 ml N.S. AND Succinylcholine 1.5 mg/kg.

Both groups maintained on halothane and mechanical ventilation-controlled pressure mode 15 cm H₂O.

4 patients were dropped from the study due to receiving hemodynamically active drugs which effect study measurements.

With continuous monitoring during the time of eye surgery for MAP, HR, SPO₂, ECG.

In the study SCHIOTZ tonometer had been used to measure IOP for the normal eye non operated by ophthalmologist resident .

The anesthetist performing induction and the ophthalmology surgeon were unaware of which study had been administered.

The measurement data was recorded 3 times :

1. After induction with propofol and STUDY drug (before Succinylcholine injection)
2. After intubation (1 min after Succinylcholine injection)
3. During maintenance (5 min after Succinylcholine injection)

The measurement data in the 2 groups were :

1. IOP.
2. MAP.
3. HR.

RESULTS

By using IBM SPSS programmed application, study data analyzed statistically .

P- Value was 0.05 considered statistically significant .

The two groups measurement data were compared to each other, by (repeated- measures analysis of variance ANOVA – general linear model), FOUND P- value was 0.0001 between two groups in all times recorded for IOP as shown by following tables and graphs .

P-value was 0.0003 between two groups in all times recorded for MAP as shown by following tables and graphs.

P-value was 0.0002 between two groups in all times recorded for HR as shown by following tables and graphs .

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Table 1: Descriptive statistics of intra-ocular pressure.

TIME OF MEASUREMENT	Group									
	remifentanyl R					control C				
	N		Mean	Std. Deviation	Variance	N		Mean	Std. Deviation	Variance
	Valid	Missing				Valid	Missing			
before scholine IOP	16	0	13.9063	1.74374	3.041	16	0	14.1250	2.05345	4.217
1 min after scholine IOP	16	0	13.2500	1.23828	1.533	16	0	20.3125	2.96015	8.763
5 min after scholine IOP	16	0	12.9875	1.32759	1.762	16	0	17.6875	2.38659	5.696
P-VALUE	0.001									

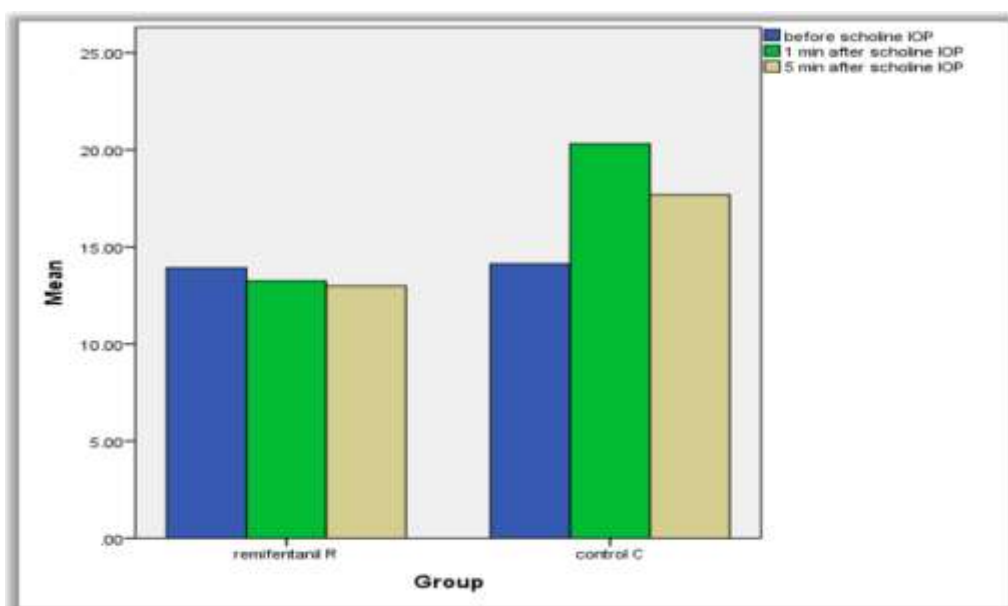


Figure 1: comparison between 2 groups in IOP in 3 different times.

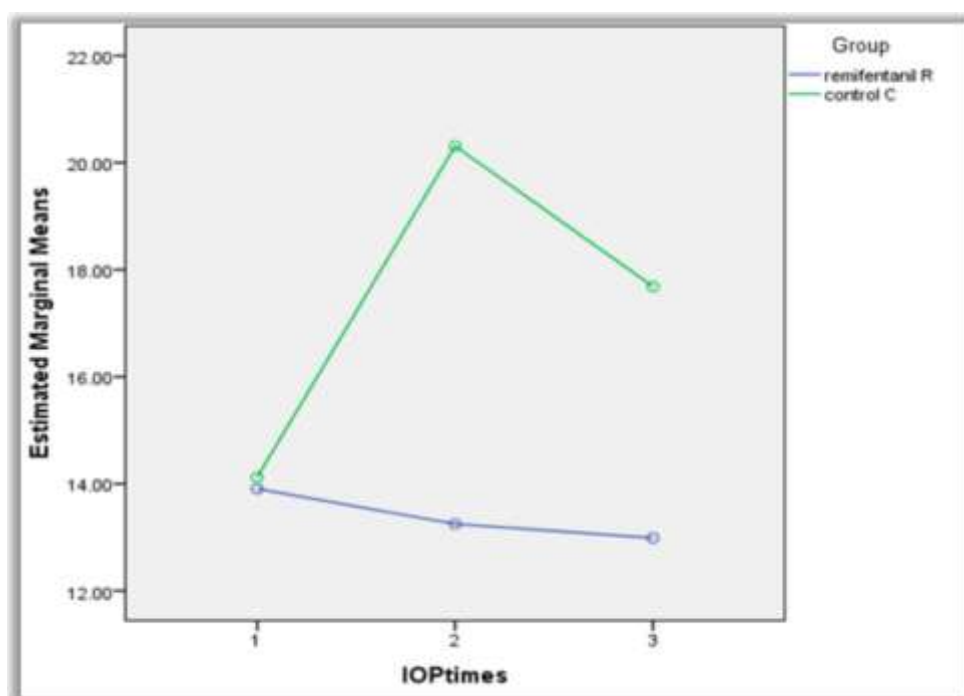


Figure 2: diagram for comparison between 2 groups in IOP 3 times using ANOVA.

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Table 2: Descriptive statistics of mean arterial pressure.

TIME OF MEASURING	Group									
	remifentanyl R					control C				
	N		Mean	Std. Deviation	Variance	N		Mean	Std. Deviation	Variance
	Valid	Missing				Valid	Missing			
before scholine MAP	16	0	77.1250	7.94040	63.050	16	0	71.3125	9.98478	99.696
1 min after scholine MAP	16	0	68.1875	8.41601	70.829	16	0	77.3750	9.73567	94.783
5 min after scholine MAP	16	0	65.3750	6.81053	46.383	16	0	81.8125	9.24640	85.496
P-VALUE	0.003									

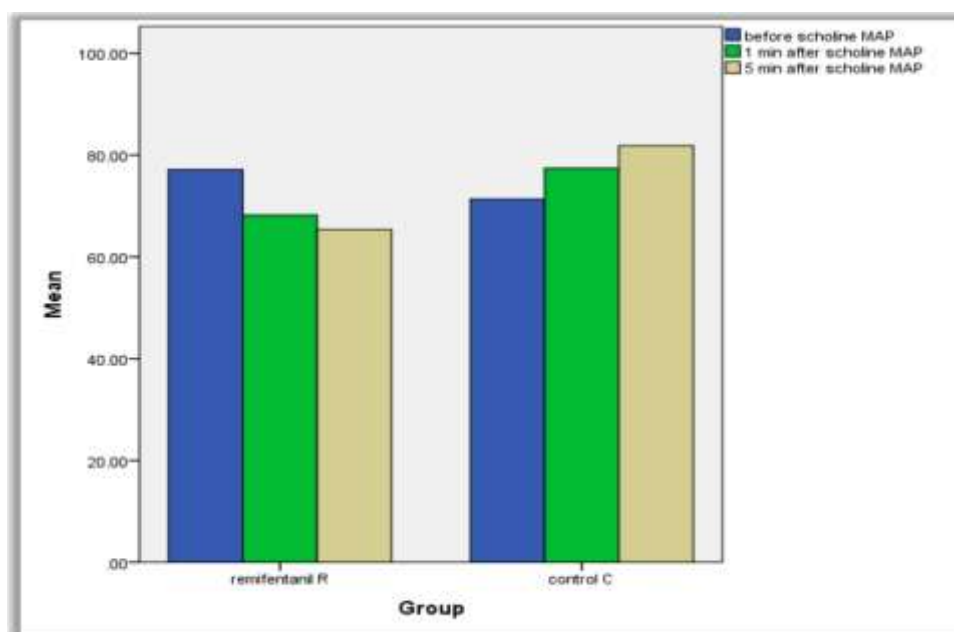


Figure 3: comparison between 2 groups in MAP in 3 different times.

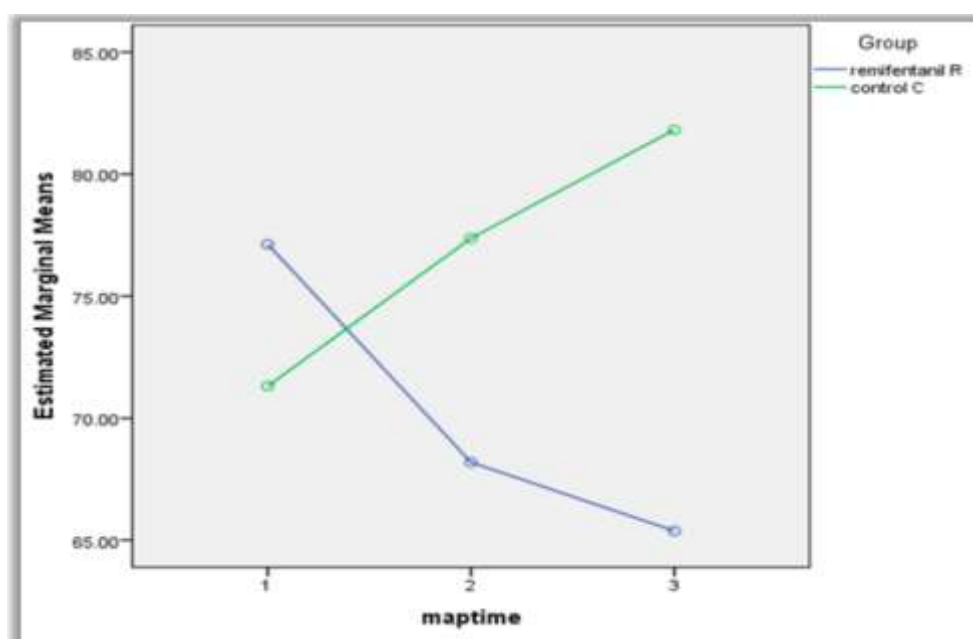


Figure 4: diagram for comparison between 2 groups in MAP 3 times using ANOVA.

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Table 3: Descriptive Statistics of heart rate.

TIME OF MEASURING	Group									
	remifentanyl R					control C				
	N		Mean	Std. Deviation	Variance	N		Mean	Std. Deviation	Variance
	Valid	Missing				Valid	Missing			
before scholine HR	16	0	84.1250	13.10916	171.850	16	0	74.6875	15.31761	234.629
1 min after scholine HR	16	0	75.7500	12.28278	150.867	16	0	83.4375	14.22659	202.396
5 min after scholine HR	16	0	69.9375	9.80795	96.196	16	0	89.5625	12.91495	166.796
P-VALUE	0.002									

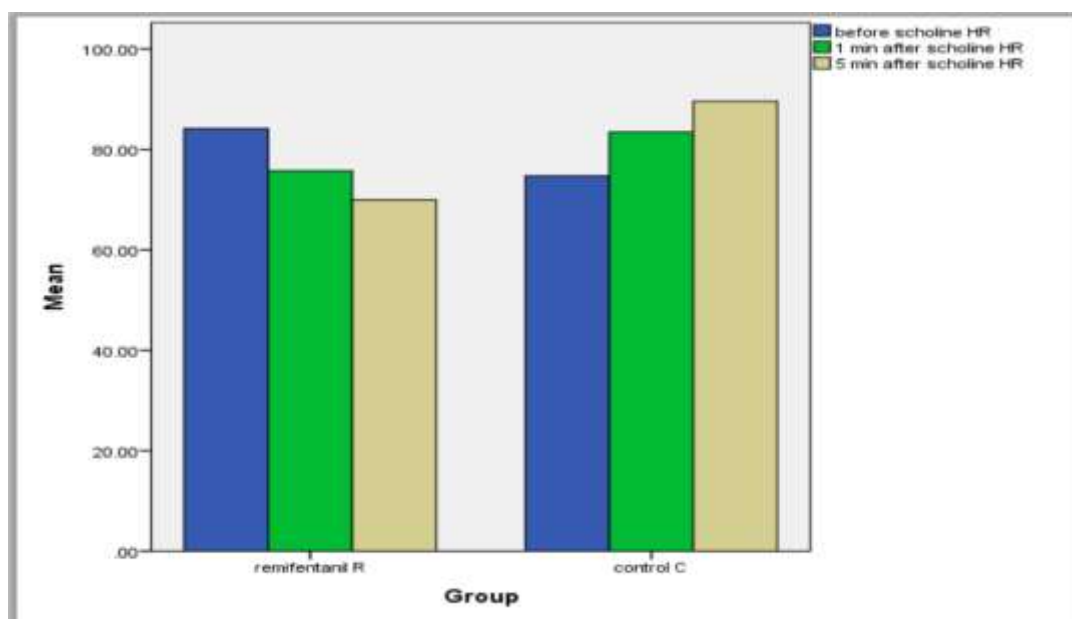


Figure 5: comparison between 2 groups in HR in 3 different times.

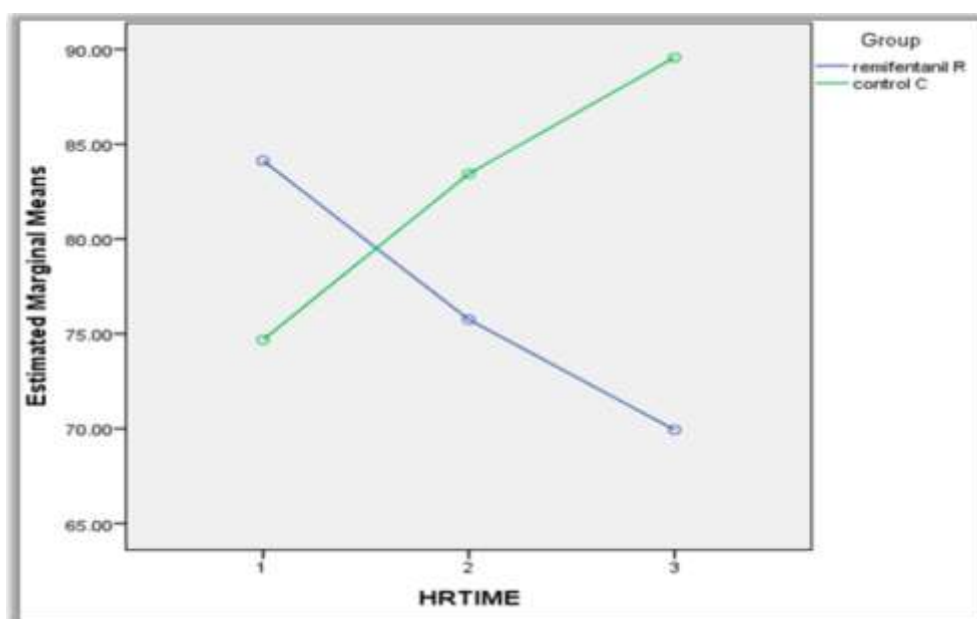


Figure 6: diagram for comparison between 2 groups in HR 3 times using ANOVA.

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DISCUSSION

We observe from above diagrams:

1. Group C (without remifentanyl) IOP overshoot especially 1 min. after Suxamethonium injection then start to decrease, even after 5 min. from Suxamethonium still high, but in group R remifentanyl played a significant role by inhibition the increase in IOP, and gradually decrease IOP, keeping a steady level.

2. Regarding MAP and HR in group C there was impressive increase, due stress response to intubation, but in group R remifentanyl obtund sympathetic reflexes so MAP and HR decrease from basal readings, increasing risk for hypotension and bradycardia, but benefit overweight risk.

This study showed that remifentanyl 1 µg/kg IV, as part of a rapid-sequence induction technique with propofol two mg/kg IV and Suxamethonium 1.5 mg/kg, provided good intubating conditions, decreasing IOP, and abolishing the hemodynamic stress response and over shooting in IOP associated with direct laryngoscopy and intubation.

This study also showed that intubation without study drug (remifentanyl) Increases in IOP, this probably caused by increasing in episcleral venous pressure (that is determined by central venous pressure), and blood volume of the eye (that is influenced by cerebral blood flow and volume), or by agents that might increase extraocular muscle tone (Suxamethonium). The propofol and remifentanyl combination used in this study would control an increase in IOP and provides good control of hemodynamic response to laryngoscopy and intubation.

Until present day the use of succinylcholine is controversial in patients with penetrating eye injuries. The increase in IOP after administration of succinylcholine may depend on the timing and dose of the drug, special tonic response of the Felderstruktur fibers in the extraocular muscles or a direct effect of succinylcholine on choroidal blood volume or aqueous humour formation. The risk of vitreous expulsion as a result of increased IOP needs to be balanced against the risk of aspiration of gastric contents.

Also, previous studies have shown that laryngoscopy and intubation are associated with a greater increase in IOP than succinylcholine. Coughing, straining, and vomiting can lead to an increase in IOP of 30–40 mm Hg.

Laryngoscopy and intubation lead to a rise of 10–20 mm Hg and this may be prevented by avoiding the hypertensive response to intubation and extubation by deep sedation like opioids.

The mechanisms by which opioids may decrease IOP include relaxation of the intra- or extraocular muscles, and facilitation of outflow or a decrease in production of aqueous humour.

So, remifentanyl should administer with an induction agent during rapid sequence induction to facilitate smooth laryngoscopy and intubation of the trachea, in addition to preventing the hypertensive response and increase in IOP. However, remifentanyl has a short duration of action so other opioids or neuromuscular blocking agents may need to be

administered to prevent coughing which can also result in an increase in IOP when the effects of succinylcholine wear off. Previous studies to evaluate remifentanyl role in decreasing IOP classified chronically: In 1994 Dr. Sung YF et al.⁴ gave patients remifentanyl 0.05 µg · kg⁻¹ · min⁻¹. Six minutes later, intermittent boluses of remifentanyl 0.5 µg/kg were given for 15–20 s at 1-min intervals, until patients were adequately sedated (eyes closed, but rousable to command). IOP at the time of adequate sedation was not different from that at baseline, but IOP at 6 min and before the surgery decreased by 1.5 and 1.2 mm Hg, respectively. The decrease was statistically significant but was considered by Sung et al. not to be clinically meaningful.

High dose remifentanyl infusion and repeated bolus doses >1 µg/kg without propofol and Suxamethonium, increasing risk of hypotension and bradycardia did not concur with my study.

In 1998 Dr. R. Alexander⁵ had studied role of remifentanyl in preventing over shooting IOP after Suxamethonium injection and tracheal intubation studying changes in intraocular pressure (IOP) in 30 patients after succinylcholine (suxamethonium) and tracheal intubation following administration of propofol 2mg/kg and either remifentanyl 1 µg/kg (group R) or saline (groups). IOP was measured before induction, before administration of succinylcholine and the study drug, before intubation and for every 1 min after intubation for 5 min. There was a significant decrease in IOP in after administration of the study drug ($P < 0.006$). Our study results match this study.

In 2000 Dr H.P.NGL. published an article about superiority of remifentanyl over fentanyl in decreasing IOP after scoline injection and intubation.

Forty-five patients were randomized blindly to receive remifentanyl 1 µg kg⁻¹, fentanyl 2 µg kg⁻¹ or placebo 1 min before thiopental, succinylcholine and tracheal intubation. IOP and hemodynamic variables were measured before, 1 min after the test solution, 30 s after thiopental, 30 s after succinylcholine, immediately after intubation and then every 3 min for 9 min. Remifentanyl obtunded the increase in IOP more than fentanyl after succinylcholine and intubation, so it could be suitable for use in open globe injuries.

In 2008 [14] Dr. Sherine F. Hanna had published a study to evaluate the effect of propofol (2 mg/kg)/remifentanyl (4 µg/kg) on intraocular pressure (IOP) when used for rapid-sequence induction without Suxamethonium.

Our study is partially concurring because by using very high dose remifentanyl 4 µg/kg with propofol alone without any muscle relaxant is enough to decrease IOP BUT increase the risk for aspiration during intubation and hemodynamically is unstable (risk of severe hypotension and bradycardia), so it is not suitable for emergency eye surgery like penetrating eye injury.

CONCLUSIONS

In summary, we conclude that administration of remifentanil 1 µg/ kg after induction of anesthesia with propofol 2 mg/ kg prevented an increase in IOP associated with administration of succinylcholine and tracheal intubation.

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