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Research Article

The Advantages of Combined Regional and General Anesthesia in Ophthalmic Surgery in Children

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Abstract

Background: Regional anesthesia is a common procedure in an adult patient undergoing ophthalmic surgery but it cannot be done alone in the pediatric age group. General anesthesia is accompanied by complications intra- and post-operatively.

Objectives: to determine whether or not using regional anesthesia in combination with general anesthesia in pediatric eye procedures improves patient outcomes.

Methods: Forty children, with an age range of 6 - 12 years were included in the study that was conducted at Ghazi Al-Hariri Hospital / Department of Ophthalmology and Ibn Al-Haytham (Ophthalmology Hospital), both teaching hospitals, from December 2018 to October 2019. These children were allocated into one of two groups: GA (general anesthesia), and GA-R (general anesthesia-regional anesthesia). Heart rates, mean arterial blood pressure, oculo-cardiac reaction, and postoperative nausea and vomiting were measured. All required approvals were obtained from the scientific committee of the Iraqi Board for Medical Specializations. Statistical analysis was done using SPSS V26, with a P value of <0.05 considered significant.

Results: None of the patients developed oculo-cardiac reactions or needed additives to the anesthesia given during surgery in the GA-R compared to the GA group. Intra-operative measurements of heart rates and mean arterial blood pressure were lower in the GA group than in the GA-R group (p<0.05). In comparison to the GA group, the GA-R group had a lower incidence of postoperative nausea and vomiting (p<0.05). A greater number of patients in the GA group needed analgesia than in the GA-R group.

Conclusion: The use of regional anesthesia as a peribulbar block with general anesthesia is a safe and successful procedure in pediatric ocular surgeries.

Keywords: Regional Anesthesia; General Anesthesia; Peribulbar block; Oculo-cardiac Reaction.

Introduction:

Ophthalmic surgery is a frequent treatment performed on children, and the conventional method of pain management is general anesthesia (1). Consequences, both intra- and post-operative, associated with various anesthetics complication, including the oculo-cardiac reflex (OCR), postoperative nausea and vomiting (PONV), postoperative irritation, and discomfort, are serious issues in juvenile ocular procedures. Additionally, repeated sobbing and squinting might be harmful to the intraocular pressure (IOP) and the corneal sutures (2, 3) .The OCR is a trigeminal vagal response that is triggered by tension on the extraocular muscles, compression mostly on the orbit, trauma, or an orbital hematoma (4). Other triggers of the OCR include hypercarbia and cerebral hypoxia. Mild anesthesia may also play a role (6). During strabismus surgery, there has been a documented incidence of transient cardiac arrest of around 1 in 2200 patients (7).

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There have been reports of arrests in the sinoatrial node and fibrillation in the ventricular node (8, 9) . PONV is a common problem following ophthalmic surgery. Repeated vomiting can affect the integrity of corneal sutures, increase the cost because of the use of antiemetic drugs, and prolong the postoperative stay. PONV is mediated by the oculo-emetic pathway which shares the afferent limb of the reflex arc with OCR (11-12).
Using a double injection peribulbar block is useful in lowering postoperative pain in patients who have had ocular surgeries (3, 13). Since peribulbar block generates a hypotonic eye, it is not often employed in strabismus surgery (14).
However; regional anesthesia is a common procedure in adult patients undergoing ophthalmic surgery but it cannot be done alone in the pediatric age group. Double injection peribulbar block as an adjuvant to general anesthesia has been investigated and reported to be effective. However, this technique is risky as it is administered invisibly and may result in globe perforation and intravascular injection.
In children, the double injection peribulbar block carries potentially more risks than in adults owing to

the fact that there are important anatomical differences between the two age groups. The size of the eye relative to the bony orbit is much greater in childhood. The eye occupies almost 50% of the volume of the bony orbit at birth and 33% at 4 years, while the adult eye takes up only 22% of the orbital volume.(1-15-18) There is little evidence concerning its usage in the pediatric age group. Hence, the recent study attempted to overcome these complications by using regional anesthesia as an adjuvant to general anesthesia in ophthalmic surgery in children.

Patients and Methods:

A randomized clinical, non-blinded study was conducted at Ghazi Al-Hariri Hospital / Department of Ophthalmology and Ibn Al-Haytham (Ophthalmology Hospital), both are teaching hospitals, from December 2018 to October 2019. Forty children with an American Society of Anesthesiology (ASA) Classification I or II (19), undergoing elective ophthalmic surgeries were enrolled. The institutional ethical committee's approval of the Scientific Council of Anesthesia and Intensive Care of the Iraqi Board was obtained for the study. Parents' consent was given for all patients including their agreement on the type of anesthesia used.

Two types of ophthalmic surgeries were performed: Intraocular (cataract) or extraocular (strabismus).

Inclusion criteria: Children aged 6-12 years, ASA I or II, elective ophthalmic surgeries, and body weight between 15-40 Kg.

Exclusion criteria: Family refusal, prolonged surgery >2 hours, endophthalmitis, eye injury, cerebral palsy, psychological problems, single eye, congenital abnormalities, heart diseases, and drug allergy.

Patients were randomly divided into two groups: Those who received general anesthesia only (GA group, n= 20) and those who received combined general and regional anesthesia (single injection peribulbar block anesthesia) (GA-R group, n=20).

Post-operative pain was recorded using a VAS score. (20)

Post-operative recovery was assessed using a modified Aldrete Score in pediatrics (21) every 5 minutes, and the time to achieve the full score of 9 was recorded. The occurrence of PONV was assessed for 12 hours postoperatively. The complications due to peribulbar block were assessed. The data was analyzed using SPSS version 25. The data was presented as mean, standard deviation or frequencies, as appropriate. The independent t-test (two tailed) was used to compare the means of continuous variables between the study groups. A P value < 0.05 was considered significant.

Results:

There were no significant differences in the demographic characteristics between the two groups (table 1).

Table 1: Demographic and operative variables of the two study groups

Variable	GA group no.=20	GA-R group no.=20
Age (years) - Mean ± SD	7.9±1.4	8.3±1.8
Weight (Kg) - Mean ± SD	25.6±6.5	28.7±5.2
Sex (male/female) - (No.)	10/10	8/12
Type of surgery - (No.)		
Strabismus	11	12
Cataract	9	8
Duration of surgery (minutes) - Mean ± SD	62.1±12.2	59.4±11.6

Among the GA-R group, not a single patient exhibited OCR, in contrast to 12 children among the GA group (60%), ($p<0.05$). There was a need for an atropine prescription for five of them.

None of the GA-R group required intraoperative supplemental fentanyl. In contrast, five patients (25%) in the GA group needed only one dose of fentanyl, ($p< 0.05$).

The mean end-tidal sevoflurane concentrations of the two groups were very close (2.4 ±0.39 vs 2.6± 0.41). At T0 and T1, the Mean arterial pressure (MAP) and heart rate (HR) values for both groups were not statistically significant. In comparison to both its base level and the GA-R group, the values at (T2–T6) for the GA group were statistically substantially higher ($p< 0.05$). (Figures 1 and 2) and (Tables 2 and 3)

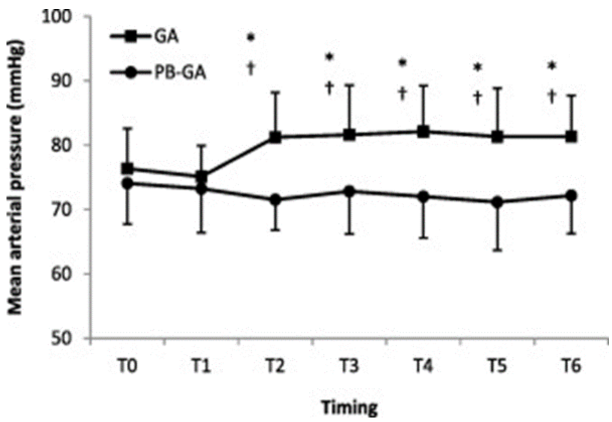

Figure 1: Intra-operative MAP in the study groups

Table 2: Mean intraoperative arterial pressure by time and group

Time	GA group no.=20 Mean ± SD	GA -R group no.=20 Mean ± SD	P-value
T0	90.0 ± 6.43	88.7 ± 7.45	0.350
T1	84.2 ± 4.66	86.6 ± 7.14	0.053
T2	87.0 ± 0.23	87.1 ± 0.16	0.028
T3	86.9 ± 0.20	87.1 ± 0.14	0.007
T4	86.9 ± 0.21	87.1 ± 0.16	0.008
T5	86.9 ± 0.24	87.1 ± 0.19	0.024
T6	86.8 ± 0.23	87.1 ± 0.16	0.006

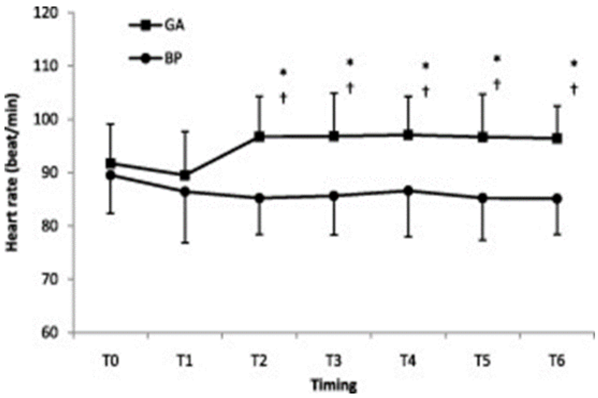

Figure 2: Intra-operative HR in the study groups

Table 3: Mean intraoperative heart rate by time and group

Time	GA group n.=20 Mean ± SD	GA -R group n.=20 Mean ± SD	P-value
T0	89.6 ± 7.3	91.3 ± 14.37	0.562
T1	95.1 ± 6.29	97.2 ± 15.05	0.541
T2	97.1 ± 0.18	96.8 ± 0.22	0.016
T3	97.0 ± 0.13	96.8 ± 0.20	0.015
T4	97.1 ± 0.19	96.9 ± 0.21	0.023
T5	97.9 ± 0.18	96.9 ± 0.26	0.016
T6	97.1 ± 0.16	96.8 ± 0.23	0.006

In the post-anesthesia care unit (PACU) setting, the amount of time it took for either group to get a complete Aldrete score was not similar (76 ± 0.44 minutes in the GA-R group and 24 ± 0.62 minutes in the GA group).
The incidence of PONV during a period of 12 hours post-operative and the number of children who required anti-emetics were significantly lower in the GA-R group [4 (20%) and 0 (0%), respectively, than the GA group 8 (40%) and 2 (10%), respectively], ($P< 0.05$).
Throughout the first 12 postoperative hours, a significantly smaller number of children in the GA-R group needed analgesics in comparison to those in the GA group ($P< 0.05$). When compared to the GA group, the GA-R group had a much longer period before needing their first analgesia ($p = 0.001$), and they also needed less analgesia treatment ($P< 0.05$), Table 4.

Table 4: Postoperative comparison of the two study groups

Variable		GA group no.=20	GA-R group no.=20	p-value
Time to achieve full Aldrete score (minutes)		76 ± 0.44	24 ± 0.62	0.001
Time to first analgesic (hour)		0.36 ± 0.56	1.14 ± 0.72	0.001
Number of cases needing analgesia within the first 12 hours		16 (80%)	8 (40%)	0.0099
Number of analgesic doses administered within the first 12 hours	1	14 (70%)	6 (30%)	0.0114
	2	10 (50%)	4 (20%)	0.0466
Frequency of PONV during the first 12 hours		4 (20%)	0	0.0348
Total number of children needing antiemetic		8 (40%)	2 (10%)	0.0285

Discussion

The current research demonstrated that a peribulbar block administered via a single dose injection decreased the risk of OCR, patients undergoing fentanyl necessity, and PONV because once taken in conjunction with general anesthesia in pediatric ophthalmic procedures. Additionally, it lengthened the time until the patient required their first postoperative analgesic medication.
Earlier research (1, 22) in pediatrics employed instruments that were 16 millimeters long while doing double injections of peribulbar blocks. The injection method that was used in this research was carried out using a needle that was relatively short, measuring 12 millimeters in length and having a gauge size of 28. This was done to decrease the risks of side effects associated with longer needles, including bleeding or lacerations of the cornea (23).
The use of a single injection in the current research wasn't associated with the health problems encountered during the double injection system. These complications noted in the double injection method are uncommon but serious, such as injuries to the vascular system or instances of misdirection (23).
Surgeons prefer the peribulbar block because the eyeball becomes centrally located after the block which is of benefit in strabismus surgery, which is associated with a high risk of OCR.
When compared to the GA category, the frequency of OCR was much lower in the GA-R, due to the peribulbar block. This may be related to limiting the sensory limb of OCR and limiting the sensory inputs from muscular tension, which is similar to the results of published research (24, 25).
In accordance with our results, Deb et al. (1) reported that 4% of children in the peribulbar block group experienced OCR compared to 60% in the GA group when they studied the efficacy of a double injection technique for peribulbar block as adjuvant to GA in ophthalmic surgery.
The research carried out by Gupta et al (22) found that the use of a double injection peribulbar block in combination with GA resulted in a reduced occurrence of OCR in people undergoing strabismus surgical procedures. The percentage of children who

experienced OCR was 13% in the GA-R group and 94% in the GA group.

The increased occurrence of oculocardiac reflex in the GA category found in the latter research compared to the current investigation may be attributable to the younger age group (2 – 13 years) since young children have a significant propensity to have higher resting vagal tone than adults do (26). In addition, all of the participants were about to receive strabismus operation, which is a procedure that is recognized to result in a greater rate of OCR (27, 28).

In the present study, the peribulbar block administered with a single injection was sufficient to provide appropriate intraoperative analgesia, as shown by a decrease in the amount of intraoperative fentanyl required and maintained hemodynamics in the GA-R group. These findings are consistent with the findings of earlier studies that looked into the intraoperative analgesic impact that localized blocks had during ocular surgical procedures (1, 3, and 29).

Using a peribulbar block with a single injection as just an adjuvant to GA during the course of the present trial helped reduce the likelihood of PONV. This was in agreement with the results of Gupta et al. (22), who found that using a double injection peribulbar block satisfactorily significantly reduced the PONV in people who had undergone ophthalmic surgical operation while having received GA. The participants in these studies were given GA while having the operation.

Adolescent patients having vitreoretinal procedures who were given a peribulbar block by a single injection in combination with GA had outcomes that were comparable to those described above (30). Research on a single-injection peribulbar block coupled with general anesthesia in children having ocular operations was published by Elgohary et al and reached the same findings (31).

Subramaniam et al (3) reported the rate of PONV to be 54.8% in patients who received double injection peribulbar block, compared to 81.4% in those who had GA. They explained this high incidence across in both groups by the longer duration of the vitreoretinal operation and the diminishing effect of the block.

While looking at the peribulbar block both as an adjuvant to GA and GA by itself, in ocular procedures, Chhabra et al. (14) and Moral et al. (32), were unable to find a difference in PONV, which is inconsistent with our results. The utilization of total intravenous anesthesia (TIVA) may have contributed to this result owing to the antiemetic effects of propofol (33).

Although Shende et al. (24) evaluated the use of the peribulbar block as an adjuvant to GA in surgeries for retinal detachment, researchers suggested that perhaps the duration of the first rescue analgesia was equal in the peribulbar and GA groups.

This finding is in accordance with results reported by Ghali and Btarny in 2010 (32) when they studied the effect of single injection peribulbar block in adults undergoing vitreoretinal. Also, Subramaniam et al. (3) reported similar results when using double injection peribulbar block in pediatrics.

In contrast, when Shende et al. (24) investigated the usage of peribulbar block as adjuvant to general anesthesia during retinal detachment surgery, they found out that the time to first rescue analgesic was comparable in peribulbar and GA groups. This could be explained by the use of a lower concentration of bupivacaine (0.25%) in the peribulbar block group and morphine in the GA group as stated by Ghali and Btarny (32).

Conclusion:

Utilization of a local single-injection peribulbar anesthetic drug with GA in pediatric ocular surgeries, is a useful method that may be used as an alternate to GA alone. It results in a low frequency of opioid-related complications, fewer requests for intraoperative opioids, steady intraoperative hemodynamics, fewer instances of nausea and vomiting after surgery, and enhanced postoperative analgesia.

Authors' Declaration

We hereby confirm that all the Figures and Tables in the manuscript are ours. Besides, the Figures and images, which are not ours, have been given permission for re-publication attached with the manuscript.-Authors sign on ethical consideration's approval-Ethical Clearance: The project was approved by the local ethical committee of (the Iraqi Board for Medical Specializations)according to the code number (No, 88624.2.2020).

Conflicts of Interest: None.

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Authors' Contribution:

Study conception & design: (Rand S. Abdul-Sattar & Ali Hadi Mosleh). Literature search: ((Rand S. Abdul-Sattar). Data acquisition: (Rand S. Abdul-Sattar). Data analysis & interpretation: (Rand S. Abdul-Sattar & Ali Hadi Mosleh). Manuscript preparation: ((Rand S. Abdul-Sattar). Manuscript editing & review: (Rand S. Abdul-Sattar **&** Ali Hadi Mosleh).

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مزايا الجمع بين التخدير الموضعي والعام في جراحة العيون عند الاطفال

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الخلاصة

الخلفية: التخدير الموضعي هو إجراء شائع لدى المرضى البالغين الذين يخضعون لجراحة العيون ولكن لا يمكن القيام به بمفرده في الفئة العمرية للأطفال. ويرافق التخدير العام مضاعفات أثناء الجراحة وبعد العملية الجراحية.

الهدف: تحديد ما إذا كان استخدام التخدير الموضعي مع التخدير العام في إجراءات عيون الأطفال يحسن نتائج المرضى أم لا.

الطريقة: تم شمول أربعين طفلاً تتراوح أعمارهم بين ستة أعوام واثني عشر عامًا في الدراسة التي أجريت في مستشفى غازي الحريري/ قسم العيون ومستشفى ابن الهيثم (مستشفى العيون) وكلاهما مستشفى تعليمي، في الفترة من كانون الأول 2018 إلى تشرين الأول 2019، وقسموا إلى مجموعتين: GA (التخدير العام)، و GA-R (التخدير العام - التخدير الموضعي). تم قياس معدلات ضربات القلب (HR)، متوسط الضغط الشرياني (MAP)، تفاعل القلب (OCR) والغثيان والقيء بعد الجراحة (PONV). تم الحصول على جميع الموافقات المطلوبة من المجلس العراقي للتخصصات الطبية. تم إجراء التحليل الإحصائي باستخدام SPSS V26. تعتبر قيمة P <0.05 ذات أهمية إحصائية.

النتائج: لم يصب أي مريض بتفاعل عيني قلبي أو إضافات ضرورية للتخدير أثناء الجراحة في GA-R مقارنة بمجموعة GA . كانت القياسات أثناء العملية لدقات القلب ومتوسط الضغط الشرياني قراءة أقل في مجموعة GA، مجموعة GA-R (p <0.05). بالمقارنة مع مجموعة GA، فإن مجموعة GA-R قد قللت من حدوث الغثيان والقيء بعد الجراحة p <0.05. واحتاج عدد أكبر من المرضى في مجموعة GA إلى تسكين أكثر من مجموعة GA-R.

الإستنتاج: يعد استخدام التخدير الموضعي كحقن حول المقلة مع التخدير العام إجراءً آمنًا وناجحًا في جراحات عيون الأطفال.

الكلمات المفتاحية: التخدير الموضعي، التخدير العام، تخدير محيط العين، منعكس عيني-قلبي