

Prevention of the Oculo-Cardiac Reflex in Children

Comparison of Retrobulbar Block and Intravenous Atropine

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THE OCULO-CARDIAC reflex has been blamed as a potential trigger mechanism for cardiac arrest during ophthalmic operations under general anesthesia. The reflex has been studied during operation by several authors, with the result that two methods have been recommended to prevent the reflex: retrobulbar local anesthetic block,¹⁻⁴ and the intravenous injection of atropine.⁵ This is a report of a clinical study comparing the effectiveness of these two methods in children undergoing operation to correct strabismus bilaterally.

Method of Study

One hundred and six healthy children were studied. The patients were divided into two groups, the age distributions of which were similar. Group A, the control group, included those children whose operations were confined to one eye, and where no special measures were undertaken to prevent the oculo-cardiac reflex. Group B, the experimental group, included children undergoing bilateral ocular surgery. The effectiveness of retrobulbar block and the intravenous injection of atropine were compared as follows: (1) 1.0-2.0 ml. of 2 per cent lidocaine (Xylocaine) were given for retrobulbar block to one eye. The block was considered successful if dilatation of the pupil was produced. (2) Atropine, in a dose equal to one-half of that used for premedication, was injected intravenously a few minutes prior to operation on the second eye. Thus, the first eye was protected by the retrobulbar block, and the second by atropine.

Only the usual surgical manipulations necessary for operation were used as stimuli to study the reflex. No attempt was made to

increase these stimuli by exerting unusual traction on the eye muscles. Deliberate pressure was applied to each eyeball, however, before operation on patients in group B, in order to compare the subsequent responses resulting from stimulation of each eye.

Preanesthetic medication consisted of meperidine, 1.0 mg., and atropine 0.005 mg., per pound of body weight. These drugs were injected intramuscularly one and a half hours before surgery. General anesthesia was induced and maintained by inhalation of a mixture of nitrous oxide, oxygen and halothane (Fluothane). After anesthesia had been induced, each child received an intramuscular injection of succinylcholine, and an endotracheal tube was inserted when muscular relaxation was satisfactory. Adequate ventilation was obtained throughout the operation by respiratory assistance or by controlled respiration. The concentration of halothane was reduced following induction of anesthesia and the lightest level of anesthesia maintained which prevented coughing and movement. All of the children awoke rapidly following termination of anesthesia.

The electrocardiogram was observed continuously throughout operation on the screen of a Cambridge Operation Room Cardioscope. Permanent recordings were obtained with a Cambridge Simpli-Scribe electrocardiograph, connected to the Cardioscope. The oculo-cardiac reflex was considered to be present when heart rate decreased abruptly by more than twenty beats per minute.

The significance of the results was determined by the chi-square test.

Results

In the control group A, where no special measures were undertaken to prevent the oculo-cardiac reflex, 32 patients (58 per cent)

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demonstrated a positive reflex. In group B, before blocking agents were used, the oculo-cardiac response could be elicited by deliberate pressure on the globe in 34 patients (67 per cent); and the responses were bilateral and equal with each patient (fig. 1). None of the patients in group B developed an oculo-cardiac reflex during operations on the eye which had been protected by a retrobulbar local anesthetic block. However, during the thirty minutes following intravenous injection of atropine the oculo-cardiac reflex was observed in 14 children (28 per cent). Statistical comparison of the difference between these data revealed a high degree of significance ($P < .002$).

In nearly every instance the electrocardiographic pattern observed during the oculo-cardiac response to stimulation was that of sinus bradycardia. Inversion of P wave occurred five times, and evidence of first degree heart block once. Extrasystoles were not accepted as manifestation of the reflex, since it was not possible to distinguish between those due to the anesthetic technique and those due to the oculo-cardiac reflex.

Discussion

The oculo-cardiac reflex was described first by Aschner⁷ and by Dagnini.⁸ Aschner demonstrated that stimulation of any branch of the trigeminal nerve evoked the reflex. He sectioned the oculomotor, trochlear, abducens and facial nerves, and found that only an intact trigeminal nerve was essential for production of the reflex. The ciliary nerves, branches

of the ophthalmic division of the trigeminal nerve, are thought to contain the afferent fibers of the reflex arc, and the cardiac depressor branch of the vagus is believed to form the efferent limb.⁴ Theoretical consideration suggests that retrobulbar local anesthetic block would anesthetize the ciliary nerves and block the afferent limb of the oculo-cardiac reflex arc.

The intramuscular or intravenous injection of 2 mg. of atropine is the dose believed necessary to effect complete vagal blockade in the adult.^{9, 10} There is little information, however, with regard to children. Bachman and Freeman have implied that infants (from birth to six months of age) require 0.15 mg. of atropine to prevent cholinergic arrhythmias during cyclopropane anesthesia.¹¹ Gaviotaki and Smith¹² suggest that the use of atropine in doses of 0.05 mg./kg. (0.014 mg. per pound), by intramuscular injection, in children over 5 kg. offers a high degree of protection from cholinergic stimuli, for sixty minutes. The small doses of atropine, 0.0025 mg./pound, recommended by Bosomworth, Ziegler and Jacoby to prevent the oculo-cardiac reflex during surgery for strabismus, and used in our study, would be expected, therefore, to offer only partial protection against the development of the reflex.

This anticipated response is borne out by the results of our study. Retrobulbar block provided complete protection against the oculo-cardiac reflex. The intravenous injection of small amounts of atropine significantly decreased the incidence of the reflex, but the protection was significantly less than that of-

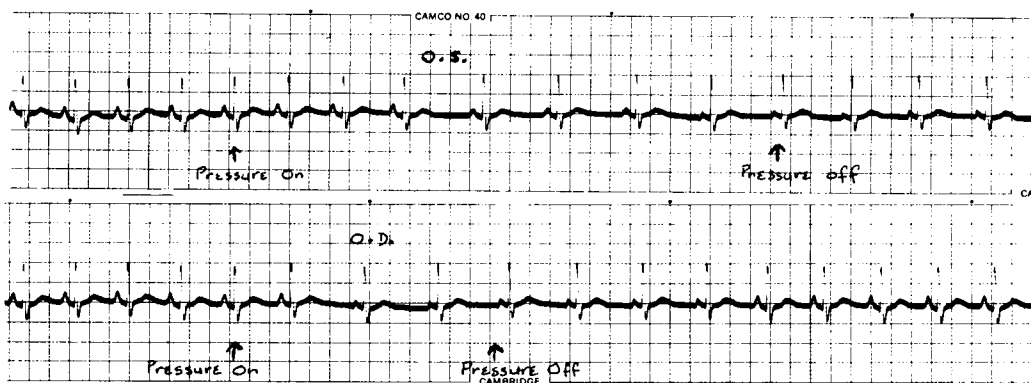


FIG. 1. Electrocardiographic response following pressure on each eyeball of the same patient.

TABLE 1. The Development of the Oculo-Cardiac Reflex in Relation to the Type of Protection Offered to the Eye

	Total Number	Strabismus Operations	
		Number Associated with Reflex	Percentage Incidence of Reflex
Group A atropine for preanesthetic medication	55	32	58
Group B			
(1) Retrobulbar block	51	0	0
(2) Intravenous atropine	51	14	28

ferred by retrobulbar blocks. Larger doses of atropine probably would provide a higher degree of protection as they approached that required to effect complete vagal blockade. Reed and McCaughey,¹³ in fact, have reported recently that the intravenous injection of atropine offered almost complete protection against the reflex. Unfortunately, they did not specify the dose of atropine injected, but the indications are that they were large.

It is difficult to reconcile the results of our study with those of Bosomworth, Ziegler and Jacoby and those of Reed and McCaughey, who reported that retrobulbar blocks were ineffective in preventing the oculo-cardiac reflex. Reed and McCaughey confined their observations to the first five minutes following retrobulbar injection, whereas it was our observation that ten minutes usually were required to achieve a maximal effect. Other authors, however, have described the effectiveness of retrobulbar block in preventing the reflex.¹⁻⁴

It is noteworthy, that in all of the patients described in this study the oculo-cardiac reflex was transient and of little clinical significance. All of these children were protected against hypoxia and hypercarbia by the use of endotracheal anesthesia and supplemented ventilation.

Summary

An investigation was conducted comparing methods recommended to prevent the oculo-cardiac reflex in children during operation for strabismus. In 58 per cent of operations preanesthetic medication with atropine offered no protection for correction of unilateral strabismus. Intravenous injection of atropine, 0.0025

mg./pound, provided some protection, reducing the incidence to 28 per cent. Retrobulbar block with lidocaine prevented the reflex in all instances. These differences are statistically significant.

It is concluded that retrobulbar block is an effective method of preventing the oculo-cardiac reflex, and superior to the intravenous injection of atropine in the doses which have been recommended.

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References

1. Mendleblatt, F. J., Kirsch, R. E., and Lemberg, L.: A study comparing methods of preventing the oculo-cardiac reflex, *Amer. J. Ophthalm.* **53**: 506, 1962.
2. Kirsch, R. E., Samet, P., Kugel, V., and Axelrod, S.: Electrocardiographic changes during ocular surgery and their prevention by retrobulbar injection, *Arch. Ophthalm.* **58**: 348, 1947.
3. Forrest, W. H., Jr., and Kazelan, P.: Retrobulbar block: evaluation in prevention of oculo-cardiac reflex, *Ohio Med. J.* **56**: 801, 1960.
4. Rhode, J., Arom, E., Bajares, A. C., Anselmi, A., Capriles, K. A., and Rivas, C.: A study of the electrocardiographic alterations occurring during operations on the extraocular muscles, *Amer. J. Ophthalm.* **46**: 367, 1958.
5. Bosomworth, P. P., Ziegler, C. H., and Jacoby, J.: The oculo-cardiac reflex in eye muscle surgery, *ANESTHESIOLOGY* **19**: 7, 1958.
6. Bancroft, H.: Introduction to biostatistics, New York, Paul B. Hoeber, Inc., 1957, p. 131.
7. Aschner, B.: Ueber einen bisher noch nicht beschriebenen reflex vom auge auf kreislauf und atmung: verschwinden des radialis pulses bei druck auf das, *Wienklin Wchnschr.* **21**: 1529, 1908.

8. Dagnini, A.: Intorno ad un riflesso provocato in alcuni emiplegici stimolo della cornea a colla pressione sul bubo oculare, *Bull. Soc. Med. Bologna* **8**: 380, 1908.
9. Crawford, H. J.: Influence of the vagus on heart rate, *J. Pharmacol. Exp. Ther.* **22**:1, 1923.
10. Stewart, W. C., and Currie, H.: The relationship between the dose of atropine and the effects on reflex parotid secretions and heart rate in man, *Canad. Med. Ass. J.* **85**: 780, 1961.
11. Bachman, L., and Freeman, A.: Cardiac rate and rhythm in infants during induction with cyclopropane. Atropine versus scopolamine as preanesthetic medication, *J. Pediat.* **59**: 922, 1961.
12. Gaviotaki, A., and Smith, R. M.: Use of atropine in pediatric anesthesia, *Int. Anesth. Clin.* **1**: 97, 1962.
13. Reed, H., and McCaughey, T.: Cardiac slowing during strabismus surgery, *Brit. J. Ophthalmol.* **46**: 112, 1962.

REGIONAL ANALGESIA A Gordh needle is inserted into a convenient vein of the limb to be operated upon. A blood pressure cuff is placed high on that extremity. The extremity is elevated to empty the vessels as much as possible. The blood pressure cuff is then elevated above systolic pressure. The use of an Esmarch bandage helps in emptying the vessels. An 0.5 per cent lidocaine (Xylocaine) solution is injected into the Gordh needle, the volume depending upon the limb and its size. Forty milliliters have been required for arms and up to 100 ml. for legs. When adequate analgesia is apparent, the operation is performed. This method has been used for analgesia for 30 patients. Fifteen of these patients were considered unsuitable for general anesthesia because of the possibility of full stomach. Analgesia was complete in 21 cases, and in seven there was slight discomfort. Two cases failed "owing to bad technique." (*Holmes, C. McK.: Intravenous Regional Analgesia, Lancet* **1**: 245 (Feb. 2) 1963.)

INTRACRANIAL PRESSURE Continuous measurements of cerebrospinal fluid pressure before and during thiopental-nitrous oxide anesthesia have shown that respiratory depression due to premedication and anesthesia can cause considerable and long lasting increase of intracranial pressure. While this may be tolerated by a normal brain, any increase of pressure seems hazardous in patients with increased intracranial pressure or cerebral edema. Prone position may cause a further increase in intracranial pressure. In order to prevent damage in cases of elevated intracranial pressure and edema of the brain, particular attention must be paid to adequate respiratory volume, proper positioning of the patient and lowering of intracranial pressure by osmotherapy and drainage of cerebrospinal fluid. (*Schmidt, K.: Spinal Fluid Pressure during Barbiturate-Nitrous Oxide Anesthesia with Endotracheal Intubation and its Significance for Anesthetic Management in Patients with Increased Cerebral Pressure and Cerebral Edema, Der Anaesthetist* **12**: 76 (Mar.) 1963.)