

THE OCULO-CARDIAC REFLEX IN EYE MUSCLE SURGERY

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THE OCCURRENCE of reflex cardiac disturbances as a result of traction on the extraocular muscles has been recognized for over fifty-five years. Sorenson and Gilmore (1) reported a case of cardiac arrest attributed to the oculo-cardiac reflex and studied cardiac rate and rhythm changes in 16 additional cases. This report emphasized the need for further study of this reflex, and the importance of finding a means of preventing the difficulties which might arise as a result of its activation.

Several investigators have tried to localize the anatomical pathway of this reflex. Aschner (2) and Lyle (3) believe that following traction on an eye muscle the nerve impulse travels over the ophthalmic branch of the trigeminal nerve, then to the vagal centers, and then down the vagus to the heart. Sabena and Posteli (4) pointed out that parasympathetic fibers have been found in the first division of the trigeminal nerve, the ciliary ganglion, and the ciliary nerve. These authors believe that the oculo-cardiac reflex is mediated primarily over the parasympathetic nervous system.

The purposes of this study were to determine the incidence of cardiac disturbances associated with traction on the eye muscles, and to determine whether hypoxia or hypercarbia must be present before the reflex can be activated. In addition, an investigation concerning the prevention of the cardiac effect was undertaken.

TECHNIQUE

The study was carried out on 62 unselected patients, ranging in age from seven months to thirty-five years. All were healthy individuals with no evidence of cardiac or respiratory disease.

Premedication for children was usually secobarbital, 1 mg. per pound, and meperidine, 1 mg. per pound, and atropine or scopolamine, 0.005 mg. per pound. For adults, premedication usually consisted of meperidine, 100 mg., and scopolamine, 0.4 mg. The patients were anesthetized with either divinyl ether-diethyl ether-oxygen or thiopental-curare-nitrous oxide-oxygen. The selection of agents was based upon age and weight of the patient. Those patients over 4 or 5 years of age and over 40 or 50 pounds received thiopental-curare-nitrous oxide-oxygen. The remainder received divinyl ether-diethyl ether-oxygen. Endotracheal intubation was accomplished in all patients.

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An operating room cardioscope connected to a direct-writing electrocardiograph was attached to each patient and observed continuously throughout the procedure. The standard limb leads were recorded for each patient before and after the induction of anesthesia, and prior to, and during surgery, thus obtaining a permanent record of the cardiac disturbances which occurred. Electroencephalographic tracings were made in many cases to evaluate the depth of anesthesia at the time of traction on the eye muscles. Arterial blood samples were collected from 12 patients during surgery and analyzed for oxygen and carbon dioxide content.

RESULTS

In order to establish the over-all incidence of the oculo-cardiac reflex, a group of 28 patients was studied during eye muscle surgery (table 1). Twenty-three patients (82.1 per cent) showed evidence of changes in cardiac rhythm indicated by slowing of the pulse rate 10 to 50 per cent. Nine patients had additional disturbances including nodal rhythm, atrioventricular block, and bigeminal rhythm.

TABLE 1
CHANGES IN CARDIAC RHYTHM FOLLOWING TRACTION ON EYE MUSCLES
DURING ANESTHESIA AND SURGERY

	Number of Patients	Changes in Rhythm	Per Cent Changes
Controls	28	23	82.1
Retrobulbar block	17	12	70.6
Intravenous atropine	17		
Within 1st half-hour		1	5.9
Within 2nd half-hour		4	23.5
Total	62		

An evaluation of the incidence of changes in cardiac rhythm following traction on specific muscles indicates that traction on the right and left medial rectus muscles was most likely to produce changes (86 per cent), while traction on the lateral recti produced only occasional changes (40 per cent).

Included in the series of 28 patients were 12 in which arterial oxygen saturation and carbon dioxide content were determined by blood gas analysis. This was undertaken to determine the possible role of hypoxia and hypercarbia in the production of the oculo-cardiac reflex. Twenty samples were drawn, some as controls, and some at the time of traction on the muscles. Disturbances in cardiac rhythm were noted in 9 of these 12 patients. All of the determinations of oxygen saturation and carbon dioxide content were within the range of normal.

In this series, the premedication dose of atropine or scopolamine varied between 0.1 mg. and 0.4 mg., depending on the weight and the

age of the patient, and was given one-half hour to two hours prior to operation. The variation in the time of administration, and whether atropine or scopolamine was used, had no demonstrable effect upon the incidence of the oculo-cardiac reflex. The dose of atropine required to produce complete vagal blocking in an adult is 2.0 to 3.0 mg. (5), quantities significantly larger than those given to these patients.

Prophylactic treatment with intravenous atropine was given to 17 patients following the induction of anesthesia and just prior to operation. The amount selected was one-half that used for premedication. During the first half-hour of surgery, only one patient in this group developed a change of cardiac rhythm (bradycardia) during eye muscle traction. When the duration of surgery extended beyond thirty minutes, 4 of the 17 patients developed changes in cardiac rhythm with traction.

The value of retrobulbar block for the prevention of disturbances in cardiac rhythm associated with this type of surgery was studied in 17 patients. The retrobulbar block, using 1 to 2 cc. of 1 per cent lidocaine, in all instances, was performed by surgeons experienced in this procedure. Twelve of these patients (70.6 per cent) developed changes in cardiac rhythm. This percentage is not significantly different from the incidence in the untreated patients (82.1 per cent).

DISCUSSION AND CONCLUSIONS

These studies indicate that in the absence of hypoxia and hypercarbia, changes in cardiac rhythm occur in 4 out of every 5 patients when there is traction on the eye muscles. The presence of hypoxia or hypercarbia, or both, in addition, could be anticipated as a most dangerous combination. Therefore, a clear airway and adequate ventilation are mandatory. This prompted us to intubate the tracheas of all the patients for operative procedures upon the muscles of the eye.

Considering the high incidence of changes in cardiac rhythm, it appears that continuous monitoring of the cardiac rate and rhythm is desirable to avoid serious and perhaps fatal complications during eye muscle surgery. Special attention to the heart by the anesthesiologist is called for at the time of eye muscle traction. In the absence of elaborate equipment, a stethoscope over the heart or a finger on the pulse, with continuous observation of cardiac rate and rhythm, provides the desired information.

Kirsch (6) recently reported that retrobulbar block was effective in preventing the oculo-cardiac reflex during strabismus surgery. In our experience this block had little effect. It is possible that the blocks were technically unsatisfactory, but they were performed by surgeons of experience, and represent the standard procedure. This block is not reliable, in our experience, for the prevention of the oculo-cardiac reflex.

The intravenous administration of atropine prior to the beginning

of surgery greatly reduced the incidence of cardiac changes and was a satisfactory method of prophylaxis. This was especially true during the first thirty minutes following its administration. Increasing the premedication dose of atropine or scopolamine would be less satisfactory, since toxic reactions would be more frequent, especially in children.

SUMMARY

Continuous monitoring of the cardiac rate and rhythm is advisable during eye muscle surgery, since in our experience, disturbances of cardiac rhythm were noted in 82.1 per cent of 28 patients at the time of traction on the eye muscles. The oculo-cardiac reflex occurred in the absence of hypoxia and hypercarbia and appeared more frequently with traction on medial rectus muscles than with traction on lateral rectus muscles.

Retrobulbar block was not satisfactory for preventing the occurrence of the oculo-cardiac reflex in 12 of 17 patients, but the intravenous administration of atropine just before the beginning of surgery afforded thirty minutes of protection in all but one of 17 cases in which it was tried.

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REFERENCES

1. Sorenson, E. J., and Gilmore, J. E.: Cardiac Arrest During Strabismus Surgery, *Am. J. Ophth.* **41**: 748 (May) 1956.
2. Aschner, B.: Ueber einen Bisher noch nicht Beschriebenen Reflex vom Auge auf Kreislauf und Atmung: verschwinden des Radialis-pulses bei Druck auf das, *Wien. klin. Wchnschr.* **21**: 1529 (Oct.) 1908.
3. Lyle, D. J.: *Neuro-Ophthalmology*. Springfield, Illinois, Charles C Thomas, 1954.
4. Sabena, U., and Posteli, T.: Electrocardiographic Researches on Oculo-Cardiac Reflex, *Folia cardiol.* **2**: 301 (Sept.) 1941.
5. Drill, U.: *Pharmacology in Medicine*. New York, McGraw Hill Book Co., Inc., 1954, ch. 27, p. 3.
6. Kirsch, R.: Electrocardiographic Changes During Ocular Surgery and Their Prevention by Retrobulbar Injection, Read before the Annual Meeting of the American Medical Association, Section on Ophthalmology, June 3-7, 1957.

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