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Effect Of Extraocular Muscle Surgery On Intraocularpressure

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Abstract: ***Extra ocular muscles (EOM) have their contribution in maintaining intra ocular pressure (IOP) and hence surgery on these muscles can bring some changes in IOP. An attempt is made in the present study to observe the alterations in IOP during various strengthening and weakening procedures of EOM during squint surgeries and also to know if there is any significance of the amount of surgery on IOP changes.***

Keywords: Extra ocular muscles (EOM), Resection, Recession, Disinsertion, Arc of contact.

1. Introduction

Extraocular muscle surgery is being done routinely for the correction of various forms of strabismus. Numerous studies in the past have indicated that contraction of extraocular muscles is accompanied by a rise in the intraocular pressure. In view of this it is assumed that surgery on these muscles may produce certain changes in intraocular pressure.

Squint surgery is mostly done under general anaesthesia as majority of the patients are young and also due to that fact that general anaesthesia almost eliminates certain inherent risks of squint surgery, such as ocularcardiac reflex.

In the present study, an attempt was made to analyse the pattern of IOP changes during extraocular muscle surgery under the influence of anaesthesia – general as well as local. The effects of anaesthesia on IOP were evaluated, and against this background, the subsequent IOP changes due to muscle surgery were studied.

In this study an attempt was also made to assess the changes of IOP in relation to the amount of surgery.

2. OBJECTIVES:

1. Comparison of IOP changes preoperatively and after induction of general anesthesia
2. Comparison of IOP changes preoperatively and after induction of local anesthesia

3. METHODOLOGY:

This study was conducted on fifty patients who were admitted after a preliminary assessment into the strabismology unit of Sarojini Devi Eye Hospital, Hyderabad. As 5 patients required surgery in both eyes, total number of eyes studies was fifty five.

The patients belonged to various age groups ranging from 2 to 30 years. 19 of them were females and 31 were male patients.

A detailed history included age of onset, mode of onset and duration of squint, treatment history, past history, family history and history of surgery. Family history of glaucoma was also enquired into.

A routine general examination and local examination was made regarding head posture, a cover test for near and distance, with and without glasses and a prism bar and cover test to know the amount of deviation. Ocular movements[1,5] in all gazes were seen with particular reference to A-V patterns. The state of binocular function was assessed with various tests. Anterior segment evaluation and fundoscopy was done followed by cyclopentolate refraction using appropriate medication.

In each patient, after complete evaluation, the type of surgery was planned preoperatively. 36 patients were posted under general anesthesia. 14 patients who were found to cooperate well were taken up under local anesthesia.

Before induction of anaesthesia, intraocular pressure was recorded with a Perkins hand held applanation tonometer[2]

using sterile fluorecein strips. For patients who were operated under general anaesthesia uniform plane of anaesthesia was maintained in all cases. For patients who were posted under local anaesthesia, premedication with Pethidine (50 mg.) IM and Phenergan (25 mg.) IM followed by facial and ciliary block were administered.

In patients requiring single muscle surgery 4 readings of IOP were taken using a sterilized Perkins hand held applanation tonometer.

1st reading – after induction of anaesthesia and just before the start of the surgery when required plane of anaesthesia was achieved.
2nd reading – after disinsertion of muscle.
3rd reading – after resuturing the muscle.
4th reading – after suturing the conjunctiva.

While recording IOP care was taken to withhold all manipulations and recording was done under identical conditions.

In patients who underwent 2 muscle surgery on the same eye, 3 readings of IOP were taken for the second muscle surgery.

IOP after completion of recession of 1st muscle was taken as basal reading and subsequent readings were compared with this reading.

1st reading – after disinsertion of 2nd muscle.
2nd reading – after resection and resuturing was over.
3rd reading – after conjuctival suturing was done.

4. DETAILS OF SURGERY

1) In 32 patients, lateral rectus recessions were done. As 4 patients required surgery in both eyes, total number of lateral rectus recessions was 36. In 20 cases LR recession was combined with medial rectus resection.

2) In 23 cases, MR resection was done. Of these in only 3 cases an isolated medial rectus resection was done. In the rest of the cases MR resection was combined with LR recession.

3) Medial rectus recession was done in 12 cases. In 6 cases, isolated MR recession was done. In one case, MR recession was done on both eyes.

4) In 10 cases lateral resection was done. Except in 3 cases, where an isolated LR resection was done, in remaining cases an accompanying medial rectus recession was done.

A limbal cut incision was used in all cases. A 6-0 double armed vicryl suture was used for suturing the muscle as well as conjunctiva.

Postoperative follow up was done after 2 weeks for review of the case and for estimation of IOP.

5. STATISTICAL METHODS

In order to test the statistical significance of the data obtained the following tests are employed.

1) Student 'T' test for samples smaller than 30.
2) 'Z' test for samples containing more than 30 observations.

Out of the 40 eyes of 36 patients that had undergone surgery under general anaesthesia[3], 21 eyes (52.5% of the eyes) showed a fall in intraocular pressure of 4 mm Hg. Following induction. The average fall in intraocular pressure in 40 eyes was also 4 mm Hg. The mean variation of preoperative IOP was 17.37 ± 2.51. Mean variation of IOP following induction of anaesthesia was 13.37 ± 2.54. As the observed difference in the two means is more than 3 times the standard error, the fall in IOP is highly significant in this group (Z=7.06). This fall after induction of anaesthesia is attributable to various factors like increased facility of outflow of aqueous due to depression of hypothalamic centre and relaxation of extraocular muscles resulting from depression of midbrain centre. Identical anaesthetic agents under identical conditions of induction contributed to the uniform fall in IOP in these cases[4].

Among the 15 eyes that had surgery under local anaesthesia the fall of IOP following facial and ciliary blocks ranged from 3-6 mm Hg. With 4 mm H. being the most commonly observed value (40%) followed by 5 mm Hg. Observed in 33% of the eyes. The mean variation of the fall in IOP is 4.26 ± 0.88 mm Hg. According to the 't' value (18.70) the fall is statistically highly significant. The statistical mean obtained in this group (4.26) is similar to that obtained under general anaesthesia and the difference between the means is statistically insignificant (Z=1.005). This could be due to the fact that identical factors operate in both types of anaesthesia like relaxation of extraocular muscles and increased facility of out flow of aqueous.

Against this background of uniform drop of intraocular pressure obtained following induction of both types of anaesthesia general as well as local, subsequent IOP changes accompanying the muscle surgery were studied. In eyes that underwent 2 muscles surgery, the IOP readings after first muscle surgery were considered as basal readings for the IOP values obtained during second muscle surgery.

The mean variation of fall of IOP following disinsertion of lateral rectus in 26 recessions done under general anaesthesia was 3.26 ± 0.77 mm Hg. This fall is statistically highly significant (t=21.44). Similarly in 10 LR recessions done under local anaesthesia, the mean fall following disinsertion (3.1 mm Hg.) was found to be highly significant.

The fall of IOP following disinsertion of muscle might be due to the release of compression effect on the globe by the muscle following its disinsertion. As it was found that the mean fall of IOP following disinsertion of muscle doesn't very significantly between the above two groups (t=0.5926) it may be inferred that the fall IOP is due to the detachment of muscle from the globe per se and is not influenced by the type of anaesthesia.

During eleven medial rectus recession under general anaesthesia, the mean variations of fall of IOP following disinsertions was 2.81 ± 0.6 mm Hg., which is highly significant (t=15.5). Due to the fact that there is no significant difference between the mean of the fall of IOP in this group and that of lateral rectus as shown by 't' value (1.72), it can be inferred that the fall of IOP following disinsertion doesn't vary significantly with the horizontal muscle involved.

The mean variation of the fall of IOP after disinsertion in one group of lateral rectus resections under general anaesthesia (2.88 ± 0.92 mm Hg.) was also highly significant (t=9.33). Similarly, the mean variation of IOP following disinsertion (3.13 ± 0.83 mm Hg.) in a group of medial rectus resection under general anaesthesia is found to be highly significant (t=14.55). But the difference between the mean of the fall of IOP in this group and that of lateral rectus is insignificant (t=0.668) indicating that the mean fall of IOP following disinsertion doesn't vary with the muscle involved.

Among 10 medial rectus resections performed under local anaesthesia the mean variation of the IOP (3.2 ± 0.91 mm Hg.) following disinsertion is highly significant (t=11.01). This fall of IOP doesn't vary significantly from that of MR resections under general anaesthesia (t=0.674). This observation is in accordance with our previous observation for LR recessions, suggesting that the type of anaesthesia doesn't influence the fall of IOP following disinsertion and the fall is due to the detachment of muscle from the globe per se.

B.S. Goel (1986) in his study found that there was a significant mean fall of 3.65 ± 0.63 mm Hg., following disinsertion of muscle in recession surgery. He also found the mean fall after disinsertion in resection surgery to be 3.68 ± 0.6 mm Hg., which was also found to be significant. But in studying the effects of disinsertion, he considered both medial rectus and lateral rectus together, unlike the present study where the effects are considered separately for both these muscles.

IOP changes after the completion of recession of lateral rectus were studied in 26 eyes under general anaesthesia. In majority of the recessions, there was fall of 1-2 mm Hg. of IOP from the post-induction value. Only 1 case showed a fall of 3 mm Hg. and in another case there was no fall. The mean variation of the fall in 26 recessions was 1.57 ± 0.64 mm Hg. The fall of IOP obtained in these cases can be considered statistically highly significant (t=12.49).

Among the 10 lateral rectus recessions done under local anaesthesia there was a fall of IOP after completion of recession ranging from 1 to 2 mm Hg., mean variation of the fall being 1.5 ± 0.52 mm Hg., and statistically highly significant (t=9.03). The mean variation of the fall in this group did not vary significantly from that of general anaesthesia (t=0.332), suggesting that the mean variation of the fall of IOP following recession may not be influenced by anaesthesia.

In 11 eyes IOP changes following recession of medial rectus were studied under general anaesthesia. Except for one case which showed no change, the fall of IOP from post induction value ranged between 1-2 mm Hg. The mean variation of the fall was 1.27 ± 0.64 mm Hg., and the fall of IOP obtained statistically highly significant, (t=6.53). The mean fall of the IOP in these cases (1.27 mm Hg.) did not vary significantly from the mean fall of IOP obtained for lateral rectus (t=1.312). Hence it may be inferred that the mean fall of IOP following recession of a horizontal muscle doesn't vary with the muscle involved.

According to Goel the mean fall of IOP following recession of a muscle is insignificant in a total number of 13 recessions, where he considered both medical rectus and lateral rectus together. This insignificant fall could be due to the arbitrary inclusion of medial and lateral recti in one group and the sample being small.

In this study, IOP changes following recession of medial rectus under local anaesthesia was observed in only 2 cases. As the sample is too small, no statistical tests of significance were applied.

9 out of 10 lateral rectus resections that were performed
under general anaesthesia showed a rise of 1-2 mm Hg., from basal value after the completion of resection. Mean variation of the rise was 1.55 ± 0.52 mm Hg. The rise of IOP in this group is statistically highly significant (t=8.82). In the only case of LR resection done under local anaesthesia the rise was 1 mm Hg.

Out of 15 cases of medial rectus resection performed under general anaesthesia, 8 cases (53%) showed a rise of 1 mm Hg. Except for 2 cases where there was no change of IOP rest of the cases showed a rise of 2 mm Hg.

The mean variation of the rise in these cases was 1.2 ± 0.67 mm Hg. The rise is statistically highly significant (t=6.87). The mean of the IOP rise in this group (1.2 mm Hg.) doesn't vary significantly from that of lateral rectus (t=1.345) indicating that the rise is not influenced by the muscle involved.

The average rise of IOP in 8 cases of MR resection under local anaesthesia was 1.62 mm Hg. The mean variation f the IOP rise was 1.62 ± 0.51 mm Hg., and the rise is statistically highly significant (t=8.92). The statistical mean of the rise under local anaesthesia (1.62) doesn't vary significantly from that of general anaesthesia, (t=1.547). Hence the mean rise of IOP following resection is not influenced by the type of anaesthesia.

From this study it was observed that the mean change of IOP doesn't vary significantly from recessions to resections, (t=0.08 & 0.273) in case of lateral rectus and medial rectus respectively.

The changes of intraocular pressure in recession surgery as well as in resection surgery can be attributed to the role played by extraocular muscles in the maintenance of intraocular pressure. Normally these muscles possess a resting tone by virtue of which they cause indentation of sclera along an arc of contract. This causes compression of the globe which

is further enhanced by the backward pull of the globe against orbital contents affecting the IOP in primary position.

During surgery on these muscles there is removal and reapplication of external force exerted by them on the globe. On disinsertion of the muscle this force is partially withdrawn, resulting in a fall of IOP. When the muscles are resutured, IOP returns to near baseline. But as the muscle force is altered depending on the surgical procedure, level of IOP reached again also varies. In recession where some weakening of muscle is done the arc of contact is reduced and so is the force applied on the globe. Hence the pressure that is reached is lower than the basal. This explains the fall of IOP after recession from the post-induction value. In resection procedures though the arc of contact is the same, there is some strengthening of the muscle, thereby return of IOP to higher than the baseline occurred. Both these changes, the fall and the rise, were statistically significant.

An attempt was also made to study the relationship between the amount of surgery and the change of IOP. In case of recessions it was found that the fall of IOP increased with the amount of recession. But this variation in the IOP fall was statistically insignificant, except in one instance. In case of lateral rectus recessions the average fall in IOP in 14 cases where a recession below 7 mm was done was 1.14 mm Hg., and in 16 other cases of recession between 7 and 8 mm, the average fall was 1.75 mm. Only in this set of observations the increased fall between the two groups is statistically significant (t=2.99). In the rest the change in the fall of IOP is statistically insignificant. Similarly in cases of resections there was an increased rise of IOP as the amount of resection increased. But here also it is found that the increase is statistically insignificant. Hence it can not be conclusively established whether there is any definite relationship between the amount of surgery and the change of IOP.

During entire study it was found that the changes of IOP during muscle surgery do not vary significantly with the type of anaesthesia. Hence it may be inferred that the changes of IOP are due to the surgery on the muscle per se and not influenced by the type of anaesthesia.

It was found that conjunctival suturing has no influence on the intraocular pressure due to the fact that final IOP didn't change after conjunctival suturing except in 2 cases of lateral rectus recession where a rise of 1 mm Hg., was found (insignificant).

Postoperative IOP changes were found to be insignificant, and this could be due to compensatory mechanisms which tend to even out the changes.

6. CONCLUSION

Extraocular muscles contribute significantly in the maintenance of normal intraocular pressure. In the primary position, by virtue of their resting tone, they indent the sclera along an arc of contact, thus affecting the IOP. In extremes of gaze, due to contraction of these muscles and altered arc of contact, there is a rise in IOP.

During surgery on these muscles, certain characteristic changes of intraocular pressure are produced. Apart from the usual changes of IOP seen after induction of anaesthesia in any type of surgery, altered mechanics on the globe caused by surgical procedures on these muscles produce significant changes in the IOP.

The significant fall of intraocular pressure following disinsertion of a muscle is due to removal of external force acting on the globe contributed by the muscle. After resuturing the muscle, due to reapplication of external force acting on the globe IOP tends to return to the baseline. In recession, a little less than the baseline pressure is reached, as the force acting on the globe is a little less due to weakening of the muscle and also due to reduced arc of contact. In resection though the arc of contact remains the same, there is some strengthening of muscles resulting in a IOP higher than the baseline.

From this study it was concluded that significant IOP changes occur during recession surgery as also resections. It was also concluded that these changes are the same under any type of anaesthesia and for any extraocular muscle undergoing surgery.

It is also concluded that the amount of surgery has no significant effect on the magnitude of IOP changes.

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