Intraocular Pressure and Axial Length in Children

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The intraocular pressure and the anteroposterior length of the eye are of great clinical importance for the diagnosis and management, before and after surgery, of congenital glaucoma. It is well-known that normal intraocular pressure in children is different from the normal levels in adults.

We performed measurements of intraocular pressure and axial length in 141 children who had been admitted for eye problems other than glaucoma. The intraocular pressures were measured with the Perkins hand-held applanatation tonometer at the beginning of general anesthesia. Simultaneously, A-scan ultra-sound measurements of the axial lengths of the eyes were made.

In 10 children under the age of two years, the intraocular pressure was $11.85 \pm 1.35$ mmHg. In 79 children from two to seven years, the intraocular pressure was $12.80 \pm 1.73$ mmHg. In 52 children from seven to 15 years, the intraocular pressure was $13.31 \pm 1.79$ mmHg. The axial lengths of the eyes in children under the age of two years, from two to seven years, and from seven to 15 years, were $21.31 \pm 0.97$ mm, $22.04 \pm 0.92$ mm, and $23.22 \pm 1.00$ mm, respectively.

These results were considered to be guidelines for measuring intraocular pressure and axial length in children suspected of having congenital glaucoma. The differences of intraocular pressures stated by other authors are due to early measurement of the intraocular pressure at the beginning of general anesthesia.

Key words: axial length, congenital glaucoma, intraocular pressure.

INTRODUCTION

Congenital or infantile glaucoma is a rare disease, but failure to control it can result in blindness for life. Since successful management depends on early recognition, it is important to make a diagnosis of the glaucoma as early as possible. In its early stage, a physician can suspect glaucoma in children who show symptoms of epiphora, blepharospasm, and photophobia.

They may also show signs of corneal enlargement, corneal edema, tears in Descemet’s membrane, and cupping of the optic discs under the influence of increased intraocular pressure (IOP). However, in uncertain cases the diagnosis of congenital glaucoma may be difficult.

It is well-known that the IOP in children differs from that of adults. But in most cases, the IOP of children can be measured under general anesthesia, with the exception of newborn infants. The IOP may be affected by such factors as depth of anesthesia, type of anesthetic agent, and type of tonometry. Therefore, we can more accurately pinpoint the real value of IOP by eliminating or minimizing the effects of those factors described above. It is believed that IOP can be reduced by halothane and other inhalation...
anesthetic agents, as well as by increasing the
depth of the anesthesia. On the other hand, the
use of muscle relaxants and endotracheal tubes
may increase the IOP. Schiotz tonometry would
result in an incorrect pressure value due to the
difference of the corneal curvature and scleral
rigidity between infants and adults.\(^4\),\(^11\)-\(^13\)
Measuring the axial length through ultrasonographpic
biometry is also a valuable technique in the di-
agnosis and follow-up of congenital glaucoma.\(^14\),\(^15\)

We have designed a method to accurately mea-
sure IOP under standardized general anesthesia
and establish normal values of IOP and axial
length in children.

MATERIALS AND METHODS

Intraocular pressure and axial length measure-
ments were made in 141 children admitted to
Seoul National University Children's Hospital for
the operation of blepharoptosis, strabismus, and
epiblepharon, from October, 1988 to March,
1989. We used diazepam syrup (0.2 mg/kg) as a
premedication for those over one year of age and
intravenous pentobarbital sodium (5 mg/kg) as
an induction agent.

We measured the IOP with a Perkins hand-
held tonometer and the axial length with an A-
scan ultrasonogram (Tetronics-Beaverton) as
soon as the patient became calm enough before
the use of muscle relaxants, endotracheal tube,
eye speculum, and other anesthetic agents. In
some irritable cases, halothane (2L/min) was in-
halated with the oxygen (1L/min) through a
mask so as not to press down on the eyeballs.
After we measured the IOP and the axial length,
the anesthetic procedure was done as usual. We
divided the patients into three groups according
to their age (Table 1). In Group I, there were 10
patients (seven males, three females) under two
years of age. In Group II, there were 79 patients
(42 males, 37 females) between two and seven
years old. In Group III, 52 patients (26 males, 26
females) were between seven and 15 years old.
We analyzed the results with the student t-test.

RESULTS

Intraocular pressure

In Group I, the mean IOP was 12.00 ±
1.17mmHg in males, 11.50 ± 1.76mmHg in
females, and 11.85 ± 1.35mmHg in total (range:
10-14mmHg). In Group II, it was 12.57 ±
1.88mmHg in males, 13.06 ± 1.51mmHg in
females and 12.80 ± 1.73mmHg in total (range:
9-16mmHg). In Group III, 13.44 ± 1.78mmHg
was the mean in males, 13.17 ± 1.82mmHg in
females, and 13.31 ± 1.79mmHg in total (range:
9-18mmHg) (Table 2).

<table>
<thead>
<tr>
<th>Group</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>12.00 ± 1.17</td>
<td>11.50 ± 1.76</td>
<td>11.85 ± 1.35</td>
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<tr>
<td>II</td>
<td>12.57 ± 1.88</td>
<td>13.06 ± 1.51</td>
<td>12.80 ± 1.73</td>
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<tr>
<td>III</td>
<td>13.44 ± 1.78</td>
<td>13.17 ± 1.82</td>
<td>13.31 ± 1.79</td>
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SD: standard deviation

There was a tendency for the IOP to increase
slightly as the patients’ ages increased. They were
statistically insignificant between Groups I and II
and between Groups II and III, but there was a
statistically significant increase in IOP between
Groups I and III (p < 0.05).

Axial length

In Group I, the mean axial length was 21.77 ±
0.50mm in males, 20.22 ± 0.33mm in females,
and 21.31 ± 0.97mm in total. In Group II, it was
21.31 ± 0.92mm in males, 21.74 ± 0.83mm in
females, and 22.04 ± 0.92mm in total. In Group
III, 23.29 ± 0.91mm was the mean in males,
23.15 ± 1.11mm in females, and 23.22 ± 1.00mm
in total. As the patients’ ages increased, the axial
length also increased (Table 3).

DISCUSSION

Before the 1960s it was known that the IOP in
children was higher than in adults as a result of
pressure measurement tests performed by Schiotz
indentation tonometry. By applying apllanation
Table 3. Axial length by ultrasonographic biometry, mean ± SD, mm

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tonometry, it was found that the normal IOP in infants is lower than in adults, but in this study the normal IOP of children is not consistent with the authors. Radtke and Cohan report that the IOP in the newborn with applanation tonometer under topical anesthesia is 11.4mmHg. We cannot measure the IOP in children as easily as in newborns or in adults and usually the measurements perform under general anesthesia. Many factors, such as anesthetic agents, intubation, depth of anesthesia, positioning of the face mask, dehydration, relaxation, etc., may affect the IOP. These are important in measuring the IOP in children under general anesthesia, and believe we can minimize the effects of such factors. We didn’t use any premedication in patients under one year of age, and in cases of over one year, we used oral diazepam syrup (0.2mg/kg), Intravenous pentobarbital sodium (5mg/kg) was used to induce anesthesia. It lowered the IOP by depression of the diencephalon, by increased aqueous outflow facility, and by relaxation of the extraocular muscles. However, we think that its influence may be minimal because we measured the IOP as soon as the patients became calm. Muscle relaxants such as succinylcholine were not used because they induced a transient increase in IOP for about 15 minutes. Insertion of endotracheal tube and eye speculum were not done because of the possibility of rise in pressure. Other anesthetic agents were not administered during the measurement of pressure, except in some irritable cases. The above-mentioned method is thought to give us a more accurate value of IOP. Our results are similar to others in that the IOP in children is lower than in adults and tends to increase with age.

Accurate measurements of IOP are very important in diagnosis and follow-up of congenital glaucoma, whereas echometric measurements of axial length give information about what happens in the course of the disease during a prolonged period and are not altered by other factors. Our results are similar to other reports, but small numbers of cases might not be sufficient to regard it as a normal value in evaluating congenital glaucoma. If additional cases are included, the results will be a useful guide for the diagnosis and management of congenital glaucoma.

REFERENCES