

The Histological Study of the Structures of the Anterior Chamber Angle in the Children of Different Gestational Age Under the Normal Conditions and in the Presence of Congenital Glaucoma

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Abstract

Purpose: To obtain and research sample of anterior chamber angle in child in different gestational age in normal and congenital glaucoma; to investigate the pieces of tissues removed during sinus trabeculectomy in babies with glaucoma, which were burned in different gestational age.

Materials and Methods: Histology of anterior chamber angle was performed in five enucleated eyes; intravital investigation of trabecular meshwork was made in two cases of mature babies and one case of premature baby.

Results: Histology of enucleated globes shows the main structures of anterior chamber angle: cornea, Descemet's membrane, trabecular meshwork, Schlemm's canal, iris.

The morphology of anterior chamber angle in congenital glaucoma has some features: anterior chamber angle is blocked with permanent fibrous membrane, which penetrates in trabecular meshwork. Trabecular meshwork consist of thickened and rough tissue.

Histology of fetal eyes in different gestational age shows obvious open anterior chamber angle, trabecular meshwork is cellular and well developed, fragmentation of Descemet's membrane near the trabecular meshwork. There was no any signs of fibrous. There were no histological signs of fibrosing of the trabeculae.

Conclusion: Intravital investigation of trabecular meshwork has some features and depends on the gestational age in birth. In mature babies with congenital glaucoma is the hypoplasia of trabecular meshwork, which covered with the rough fibrous membrane in some places and it is coincide with histology of enucleated globes. In premature babies the trabecular meshwork is fibrous and appear after the birth of premature baby, what is caused by the proliferation in such babies.

Keywords: Congenital Glaucoma; Histology of the Anterior Chamber Angle; Premature Babies

Introduction

Congenital glaucoma currently continues to be one of the most significant problems in pediatric ophthalmology, often accompanied by loss of visual function at an early age [1-3]. The role of the anterior chamber angle pathology in the pathogenesis of ophthalmic hypertension in congenital glaucoma has been studied and proven by a number of studies [4-6]. Nowadays, the main reasons for the development of congenital glaucoma are the presence of unresolved mesodermal tissue in the anterior chamber angle and the underdevelopment (hypoplasia) of trabecular meshwork. Recently, owing to modern diagnostic methods, the histological picture of the normal chamber angle and the anterior chamber angle of the child with congenital glaucoma leaves no doubt about the presence of non-resolved tissue that prevents the outflow of fluid from the eye [7,8]. However, the main problem of histological examination of the anterior chamber

angle of the eye is the possibility of obtaining preparations of only enucleated eyes [9] and for the most part these are preparations of the normal anterior chamber angle obtained by removing the eye with retinoblastoma. It is very difficult to obtain and investigate the preparation of the anterior chamber angle for enucleated eyes with congenital glaucoma [10] in a child and such studies are very rare in the available literature [5,6]. *In vivo* diagnostics of the state of the trabecular meshwork using histological research methods in children with congenital glaucoma who were born at different gestational periods, in turn, is also associated with certain difficulties.

Purpose of the Study

To obtain and investigate anterior chamber angle preparations in children at different gestational age under the normal conditions and in the presence of congenital glaucoma, as well as tissue fragments removed during the performance of antihypertensive filtering operations (sinusotrabelectomy) in children with glaucoma at different gestational age.

Materials and Methods

A histological examination of the anterior chamber angle was performed on 5 preparations of enucleated eyes: 3 preparations were enucleated eyes of antenatally dead fetuses at the 29th, 32nd and 34th weeks of gestation. One sample was obtained as a result of enucleation of the eye in a mature baby for 10 months with retinoblastoma and one preparation of the enucleated eye for a congenital pathology of the eye present in a full-term three-month-old baby: diffuse retinal hamartoma and decompensated congenital glaucoma. During macro- and microscopic examination of this eye preparation, the retinal tumor was completely localized in the vitreous cavity of the eye, without leading to an iris with lens anterior displacement, which made it possible to regard the child's clinical picture (characteristic signs of buphthalmus) as a variant of the development and clinical of the primary congenital glaucoma.

A suitable native material of tissue fragments that were removed during antihypertensive operations of the filtration type was obtained for the study in 8 eyes in 7 children born on time and in 5 premature children (5 eyes).

Further, all eye preparations and fragments of tissue removed were placed in a 10% formalin solution. Then it was fixed in 10% neutral formalin and, after passing through alcohols, it was poured into paraffin according to the standard method. Sections 5 - 7 μm thick were stained with hematoxylin and eosin. Van Gieson was also stained. The study of the preparations was carried out with a Carl Zeiss light-optical microscope, with magnifications of $\times 40$, 400 and 1000.

Results and Discussion

In a histological examination of the anterior chamber angle of the preparations of enucleated eyes, in all cases its main structures were clearly traced: the cornea, Descemet's membrane, trabecular meshwork, Schlemm's canal and iris.

In the presented histological picture of the angle of the anterior chamber of a mature babies 10 months. (Figure 1A and 1B), the final differentiation of the anterior chamber angle in this age range is also noteworthy: the anterior chamber angle is open, wide, the trabecular meshwork with a distinct characteristic porosity, the Schlemm's canal is opened, the fragmentation of the continuous Descemet's membrane is determined when it approaches the trabecular meshwork. At the same time, the morphological structure of the anterior chamber angle of the eye with congenital glaucoma has significant differences from the histological picture discussed above (Figure 2).

In the histological picture shown in figure 2 of the anterior chamber angle of the eye of a mature babies with congenital glaucoma, there are changes characteristic of this disease: the anterior chamber angle is blocked by a continuous fibrosed membrane tightly woven into the trabecular meshwork (Figure 2.1). The trabecular meshwork, in turn, is represented by thickened and coarse tissue (Figure 2.3). There is no the Schlemm's canal (Figure 2.2).

A series of subsequent preparations (Figure 3A-3C) presents a picture of the anterior chamber angle of the eye of the fetus (without clinical signs of glaucoma) at different gestational age: on all histological preparations, the open of the anterior chamber angle, the formed porous tissue of the trabecular meshwork, and the fragmentation of Descemet's membrane when approaching trabecular meshwork. No histological signs of fibrosing of the trabecular meshwork were detected.

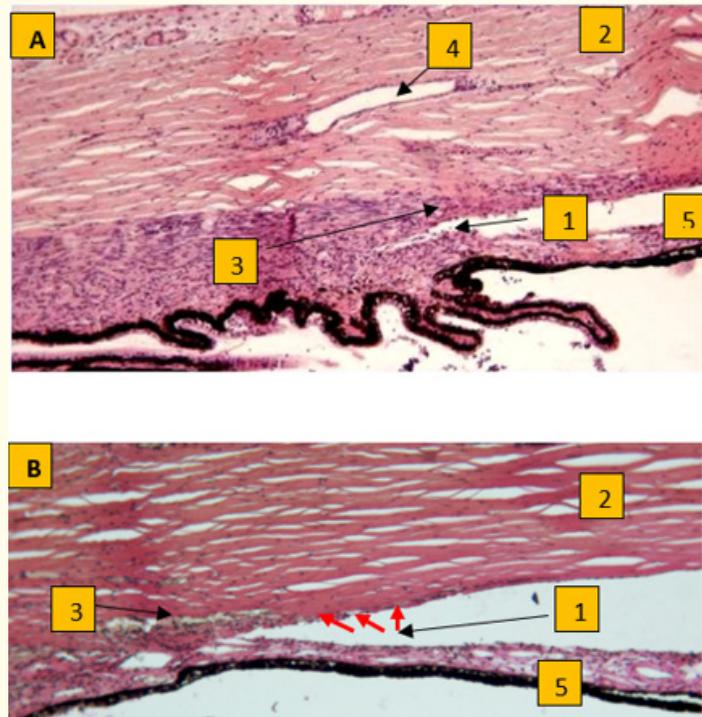


Figure 1A and 1B: The histological picture of the normal anterior chamber angle enucleated due to retinoblastoma of the eye of a full-term baby. A- hematoxylin-eosin stain, B- van Gieson stain. 1- anterior chamber angle, 2- cornea, 3- trabecular meshwork, 4- Schlemm's canal, 5- iris.

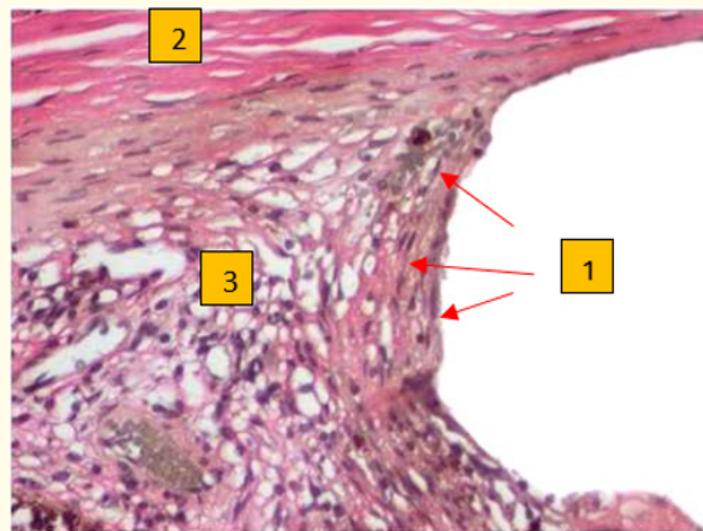


Figure 2: The histological picture of anterior chamber angle of the eye enucleated due to a combined congenital pathology (diffuse retinal hamartoma and congenital glaucoma) of the eye of a mature baby (hematoxylin-eosin stain). 1- anterior chamber angle, 2- cornea, 3- fibrosed trabecular meshwork.

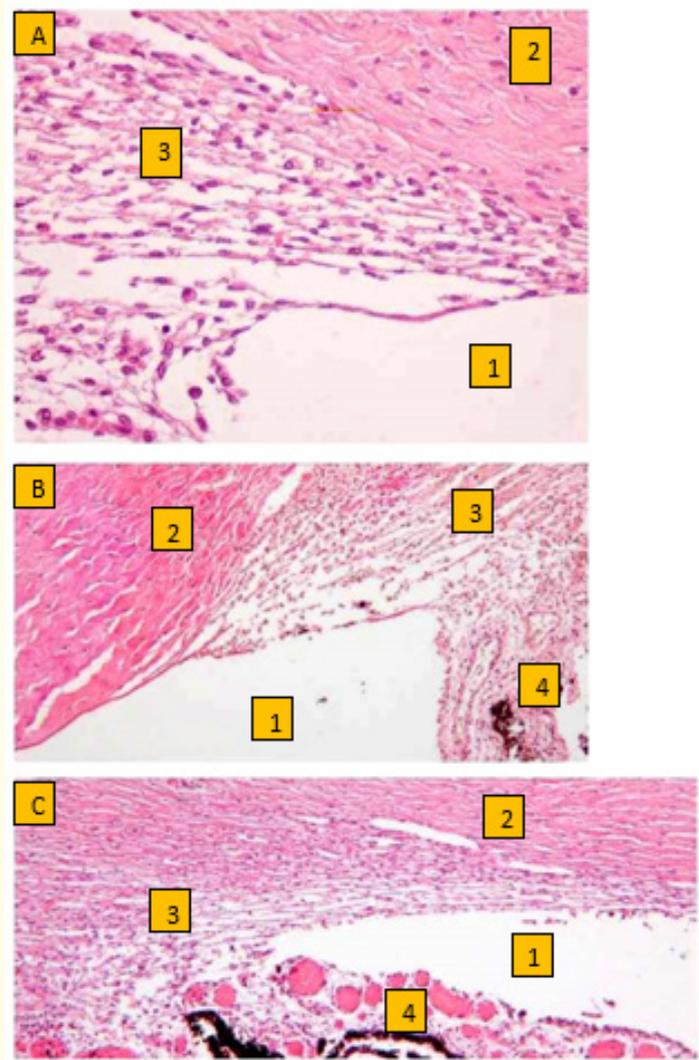


Figure 3A-3C: The histological picture of anterior chamber angle the enucleated eye of the fetus at different gestational age (hematoxylin-eosin stain). A- preparation of the fetal eye at the 29th week of gestation, B- preparation of the fetal eye at the 32nd week of gestation, C- preparation of the fetal eye at the 34th week of gestation. 1- anterior chamber angle, 2- cornea, 3- trabecular meshwork, 4- iris.

At the same time, along with the study of enucleated eyes, intravital histological examination of the structures of the anterior chamber angle of children with congenital glaucoma born at different gestational age has the significant clinical interest.

Detailed histological examination of the obtained fragments of excised tissues, trabecular meshwork was found in only two cases in mature babies and in one case in a premature baby. The rest of the extracted fragments were mainly cornea or sclera.

In the presented histological picture (Figure 4 and 5A-5D) of a tissue fragment removed from of the anterior chamber angle of a mature baby, cornea, sclera and trabecula meshwork are clearly visible. On the presented preparations, a dense uniform membrane (Barkan's membrane) is seen, coming from the inner surface of the cornea and covering the trabecular meshwork, tightly fused in places. The trabecular meshwork itself is represented by fibers tightly adjacent to each other, similar to the substance of the Barkan's membrane, between which fibrosed connective tissue fibers were determined. Schlemm's canal is open, wide.

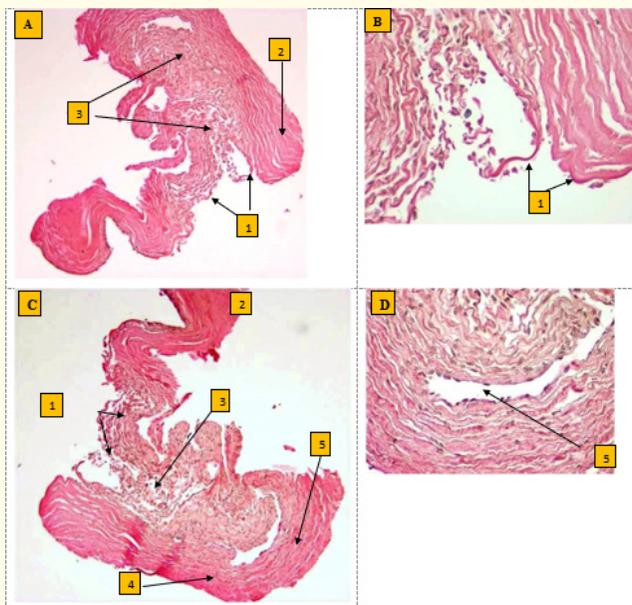


Figure 4A-4D: The histological picture of a tissue fragment removed from the anterior chamber angle of a child with glaucoma while performing a hypotensive filtration operation. Patient N. 4 months: Born on time. In 1 month diagnosed with congenital developed decompensated glaucoma in both eyes. In 1.5 months sinusotrabeulectomy with iridencleisis was performed in both eyes. 1- Barkan's membrane, 2- cornea, 3- trabecular meshwork, 4- sclera, 5- Schlemm's canal.

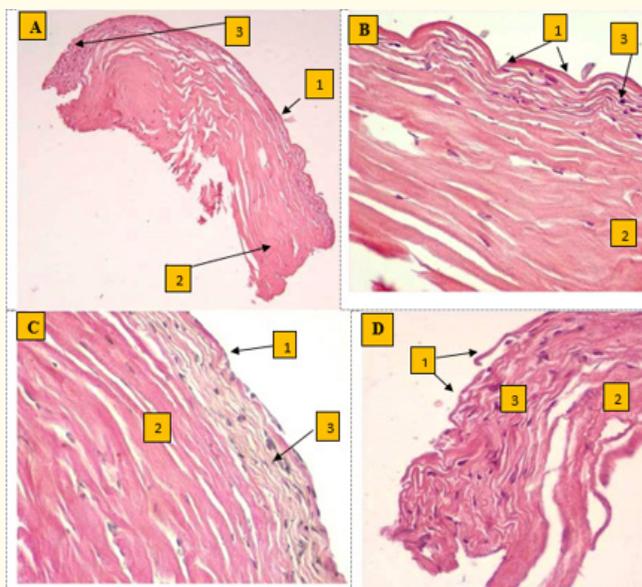


Figure 5A-5D: The histological picture of a tissue fragment removed from the anterior chamber angle of a child with glaucoma while performing a hypotensive filtration operation. Patient G. 12 months: Born on time. In 5 months. diagnosed congenital developed decompensated glaucoma in both eyes. At 12 months repeated sinusotrabeulectomy with iridencleisis was performed in both eyes. 1- Barkan's membrane, 2- cornea, 3- trabecular meshwork.

The histological changes found in the anterior chamber angle of a premature baby (Figure 6A and 6B) were differed from the picture described above.

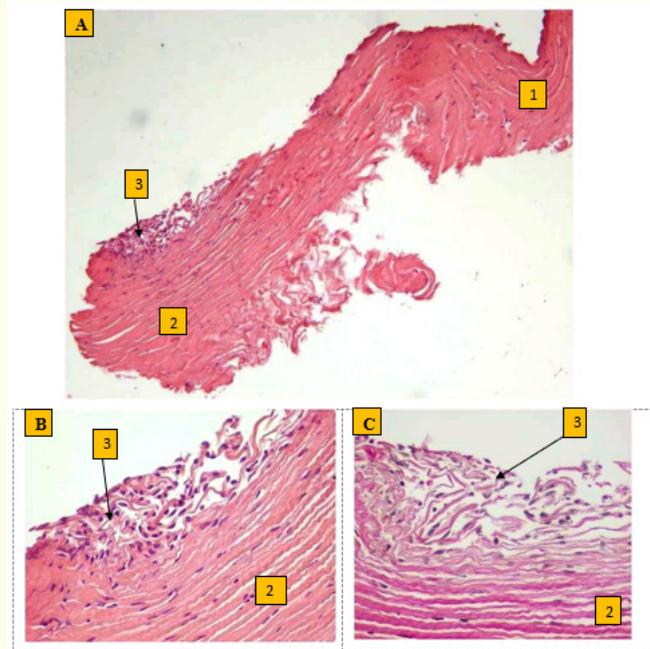


Figure 6A-6C: The histological picture of a tissue fragment removed from the anterior chamber angle of a premature baby with glaucoma while performing a hypotensive filtration operation. Patient A.: Born at 32 weeks of gestation with a body weight of 1500 g. In 1 month, diagnosed retinopathy premature stage III of the active period, performed transpupillary laser coagulation of the retina in both eyes. In 8 months diagnosed congenital developed decompensated glaucoma of the left eye. In 1 year 4 months sinusotrabeulectomy with iridenclysis in the left eye was performed. 1- cornea, 2- sclera, 3- trabecular meshwork.

On a histological specimen, a piece of tissue removed from the eye of a premature baby determines the tissue of the cornea, sclera and trabecular meshwork. At the same time, the trabecular meshwork was not covered by the Barkan's membrane and had a more pronounced cellularity and randomness of the arrangement of fibers, which can be regarded as fibrosing.

Thus, histological studies of the anterior chamber angle in congenital glaucoma in children born at different stages of gestation are distinguished by their results and have important diagnostic value for understanding the mechanisms of development and the further course of the disease in various categories of patients.

Conclusion

1. The characteristic histological signs of the formed normal of the anterior chamber angle: a distinct porosity of the trabecula meshwork, fragmentation of the Descemet's membrane in the anterior chamber, open Schlemm's canal.
2. The anterior chamber angle in children with congenital glaucoma is characterized by its overlapping continuous fibrosed membrane, tightly woven into the trabecular meshwork. The incomplete differentiation of the trabecular meshwork itself is also characteristic - the thickening and roughness of its structures.
3. The histological picture of the anterior chamber angle of the fetus from the 29th week of gestation is characterized by a fairly complete differentiation of its tissues: the formed porous tissue of the trabecular meshwork, the fragmentation of the Descemet's membrane when approaching the trabecular meshwork. There are no signs of fibrotic changes in trabecular meshwork.

4. The intravital study of trabecular meshwork has a number of features and depends on the gestational age of the baby at the time of birth. In children born on time with a congenital form of glaucoma, it is hypoplastic, filled with a homogenized substance. They also revealed a rough membrane in the form of fibrous tissue, sometimes fused with a trabecular meshwork, which coincides with the data from studies of enucleated eye preparations for this pathology and literature data.
5. In preterm infants, trabecular meshwork is characterized by increased cellularity (fibrosis), which is formed after the birth of a premature baby and is apparently associated with proliferative processes characteristic of this category of children. Structural changes in trabecular meshwork may partly explain the late manifestation of congenital glaucoma in premature babies and the features of its clinical course.

Conflict of Interest

The authors declare no conflict of interest.

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