



Research Article

# Pediatric Glaucoma: Epidemiological, Diagnostic and Therapeutic Aspects in Surgically Treated Cases

Zana Diabaté<sup>1\*</sup>, Bilé PEFK<sup>2</sup>, Goulé AM<sup>1</sup>, Godé LE<sup>1</sup>, Babayeju RLO<sup>1</sup>, Ouattara Y<sup>1</sup>

<sup>1</sup>Ophthalmology Department at the Teaching Hospital of Bouaké, Côte d'Ivoire

<sup>2</sup>Ophthalmology Department at the Regional Hospital Centre of Bouaké, Côte d'Ivoire

\*Correspondence author: Zana Diabaté, Ophthalmology Department at the Teaching Hospital of Bouaké, Côte d'Ivoire;  
Email: [doczdiabate@gmail.com](mailto:doczdiabate@gmail.com)

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## Abstract

**Introduction:** Pediatric glaucoma is ocular hypertension present at birth or developing subsequently. Its clinical presentation is highly variable. Depending on age and etiology, it is classified into primary glaucoma and secondary glaucoma. The aim of this study was to determine the epidemiological, clinical, paraclinical, therapeutic and evolutionary characteristics of pediatric glaucoma in Côte d'Ivoire.

**Materials and Methods:** The study included patients aged between 0 and 15 years who had been diagnosed with childhood glaucoma. This was a retrospective, descriptive study based on the analysis of patient records from the Ophthalmological Medical Center of Abidjan between January 1, 2018 and December 31, 2022-a period of five years. Epidemiological, clinical, therapeutic and outcome-related parameters were evaluated.

**Results:** A total of 20 medical records of children diagnosed with glaucoma were analyzed. Among our patients, 55% were male, resulting in a sex ratio of 1.22. The mean age was 11.78 years. Decreased visual acuity was the most common presenting symptom, observed in 80% of cases. Half of the patients had visual acuity greater than 6/10 in both eyes. Pre-treatment Intraocular Pressure (IOP) exceeded 21 mm/Hg in 75% of patients in the right eye and in 55% in the left eye. Juvenile glaucoma was the predominant form, accounting for 90% of cases. All patients underwent trabeculectomy. Mean intraocular pressure decreased from 23.62 mm/Hg preoperatively to 17.35 mm/Hg postoperatively.

**Conclusion:** Pediatric glaucoma poses a serious threat to visual prognosis. Hence, early diagnosis and prompt, effective management are crucial to preserving vision and improving long-term outcomes for affected children.

**Keywords:** Pediatric Glaucoma; Epidemiology; Diagnosis; Management; Côte d'Ivoire

## Introduction

Pediatric glaucoma is ocular hypertension present at birth or developing subsequently, due to an anomaly of the iridocorneal angle or anterior segment of the eye. Its clinical presentation is highly variable. Depending on age and etiology, it is classified into primary glaucoma (congenital or juvenile) and secondary glaucoma (non-acquired or acquired) [1].

In children aged 0 to 15 years, two main types are distinguished: congenital glaucoma and juvenile glaucoma. Congenital glaucoma, by definition, is ocular hypertension present at birth. It is a condition present from the first days of life or appearing within the first three years. It is relatively rare, with an incidence ranging from 1 in 18,000 to 1 in 2,500 live births, depending on geographic region [2]. Juvenile glaucoma, on the other hand, is a form of chronic open-angle glaucoma occurring between the ages of 3 and 35. It is more common in males (65%) and is most often bilateral (70%) [3-5]. However, there is no universal

consensus among authors regarding the upper age limit for diagnosis; the age of 3 years remains the only widely accepted criterion to differentiate juvenile glaucoma from congenital glaucoma, as ocular hypertension occurring after age 3 does not typically alter the external appearance of the eye [6].

The diagnosis of congenital glaucoma is based on a clinical triad consisting of buphthalmos (enlarged eye), epiphora (excessive tearing) and photophobia. This triad is often followed by megalocornea (enlarged cornea) and corneal edema. The cornea may appear cloudy or even bluish. In juvenile glaucoma, diagnosis relies on the classic triad of ocular hypertension, optic disc cupping and visual field defects. In either case, examination under general anesthesia may occasionally be necessary to confirm the diagnosis and determine the appropriate surgical approach [7].

Management of pediatric glaucoma involves medical, surgical and sometimes physical therapies. Medical treatment may be the first-line approach in mild cases, but surgical intervention is often ultimately required [8,9].

The aim of this study was to improve understanding of pediatric glaucoma in Côte d'Ivoire and to enhance its clinical management.

### Methodology

This was a retrospective, descriptive study based on medical records and outpatient consultation registers during the study period. The study covered a five-year period, from January 1, 2018, to December 31, 2022, using an exhaustive sampling method. It included all medical records of patients aged 0 to 15 years diagnosed with glaucoma, who were operated on and followed up in the department, as well as those seen during consultations at the Ophthalmological Medical Center of Abidjan during this period.

*Inclusion Criteria:* Medical records of patients of either sex, aged between 0 and 15 years, who were seen in consultation, diagnosed with pediatric glaucoma and underwent surgery.

*Exclusion Criteria:* Incomplete medical records of patients included in the study (missing clinical examination, lack of paraclinical data or absence of treatment information) (Table 1).

<b>Sociodemographic Data</b>	Frequency Age Gender
<b>Clinical Data</b>	Reason for consultation Family history of glaucoma Physical signs Type of glaucoma Laterality of glaucoma
<b>Paraclinical Data</b>	Value of Pachymetry
<b>Therapeutic Data</b>	Surgical technique Outcomes Post-treatment evolution

**Table 1:** Variables studied.

Data were collected using a standardized, anonymous, structured questionnaire designed specifically for this study. Data analysis was performed using Epi Info software. Text processing and table creation were carried out using Microsoft Word and Excel. Quantitative variables were expressed as means with standard deviation and extreme values, while qualitative variables were expressed as proportions.

### Ethical Approval

The study was conducted with the approval of the Medical and Scientific Directorate of the Ophthalmological Medical Center of Abidjan and after formal validation of the study protocol by the Vice-Dean in charge of Research at the Faculty of Medical Sciences of Bouaké under number 0064/2024/UAO/CRDM.

## Results

### Prevalence

During the five-year study period, 759 pediatric patients were seen at the center. Among them, 33 cases of pediatric glaucoma were identified. Applying the inclusion criteria, 20 cases of pediatric glaucoma were retained for analysis. The hospital prevalence was 4.3% and the study prevalence was 2.6% (Fig. 1,2 and Table 2).

Ages (Years)	Number of Cases	Percentage (%)
<1	1	5
[1-5]	1	5
[6-10]	4	20
[11-15]	14	70
<b>Total</b>	<b>20</b>	<b>100</b>

**Table 2:** Distribution of patients by age.

The mean age of the patients was 11.78 years, with extremes ranging from 6 months to 15 years. Pediatric glaucoma was more common in children aged 11 to 15 years, representing 70% of cases. Male sex was predominant, accounting for 55% of patients, with a sex ratio of 1.22 (M:F) (Table 3).

Reason for Consultation	Number of Cases n=20	Percentage (%)
<b>Decreased Visual Acuity</b>	<b>16</b>	<b>80</b>
<b>Photophobia</b>	<b>13</b>	<b>65</b>
<b>Tearing (Epiphora)</b>	<b>9</b>	<b>45</b>
<b>Blurred Vision</b>	<b>8</b>	<b>40</b>
<b>Headaches</b>	<b>7</b>	<b>35</b>
<b>Ocular Pain</b>	<b>3</b>	<b>15</b>
<b>Leukocoria</b>	<b>2</b>	<b>2</b>
<b>Buphthalmos</b>	<b>2</b>	<b>2</b>

**Table 3:** Distribution of patients according to the reason for consultation.

Decreased visual acuity was the most commonly reported reason for consultation, observed in 80% of patients. The majority of patients - 13 (65%) - had a family history of glaucoma, compared to 7 patients (35%) who did not (Table 4).

Visual Acuity (Right Eye)	Number of Cases	Percentage (%)
<1/10	5	25
1/10-3/10	1	5
3/10-6/10	2	10
>6/10	10	50
<b>Not Measurable</b>	<b>2</b>	<b>10</b>
<b>Total</b>	<b>20</b>	<b>100</b>

**Table 4:** Distribution of patients according to visual acuity in the right eye.

Half of the patients had a visual acuity in the right eye greater than 6/10 (Table 5).

Visual Acuity (Left Eye)	Number of Cases	Percentage (%)
<1/10	3	15
1/10-3/10	2	10
3/10-6/10	3	15
>6/10	10	50

<b>Not Measurable</b>	<b>2</b>	<b>100</b>
<b>Total</b>	<b>20</b>	<b>100</b>

**Table 5:** Distribution of patients according to visual acuity in the left eye.

Visual acuity in the left eye was also greater than 6/10 in 50% of cases (Table 6).

<b>Pachymetry (Right Eye)</b>	<b>Number of Cases n=11</b>	<b>Percentage (%)</b>
<b>Thin cornea</b>	5	45.45
<b>Thick cornea</b>	4	36.36
<b>Normal</b>	2	18.19

**Table 6:** Distribution of patients according to central corneal thickness (pachymetry) in the right eye.

Pachymetry performed in 11 patients revealed that 45.45% had a thin cornea (Table 7).

<b>Pachymetry (Left Eye)</b>	<b>Number of Cases n=11</b>	<b>Percentage (%)</b>
<b>Thin cornea</b>	6	54.54
<b>Thick cornea</b>	3	36.36
<b>Normal</b>	2	18.19

**Table 7:** Distribution of patients according to central corneal thickness (pachymetry) in the left eye.

#### *Pachymetry*

Pachymetry was performed in 11 patients and revealed that 54.54% had a thin cornea.

#### *Corneal Status*

In the right eye, the cornea was clear in 14 patients (70%) and edematous in 6 patients (30%). In the left eye, the cornea was clear in 16 patients (80%) and edematous in 4 patients (20%).

#### *Intraocular Pressure (IOP)*

In the right eye, IOP was  $\geq 21$  mmHg in 15 patients (75%) and  $< 21$  mmHg in 5 patients (25%), with a mean IOP of 23.3 mmHg. In the left eye, IOP was  $\geq 21$  mmHg in 11 patients (55%) and  $< 21$  mmHg in 9 patients (45%), with a mean IOP of 23.95 mmHg.

#### *Cup-to-Disc Ratio (C/D)*

The C/D ratio was greater than 0.50 in 17 patients (85%) in the right eye and in 15 patients (75%) in the left eye. A C/D ratio  $\leq 0.50$  was observed in 3 patients (15%) in the right eye and 5 patients (25%) in the left eye.

#### *Type of Glaucoma*

Eighteen patients (90%) were diagnosed with juvenile glaucoma, while 2 patients (10%) had congenital glaucoma.

#### *Laterality*

Glaucoma was bilateral in 18 patients (90%) and unilateral in 2 patients (10%).

#### *Surgical and Medical Treatment*

All patients underwent trabeculectomy. As adjunctive medical therapy, beta-blockers were prescribed in 80% of cases and prostaglandin analogs in 20%.

#### *Post-Treatment Intraocular Pressure*

After treatment, IOP was reduced to below 21 mmHg in 16 patients (80%) in the right eye (mean: 17.55 mmHg) and in 18 patients (90%) in the left eye (mean: 17.15 mmHg), indicating effective intraocular pressure control.

### *Visual Acuity After Treatment*

Post-treatment visual acuity assessment showed that 60% of patients achieved acuity better than 6/10 in the right eye and 65% in the left eye.



**Figure 1:** A 1-year-and-3-month-old child with bilateral congenital glaucoma showing cloudy corneas, indicative of corneal edema.



**Figure 2:** A 3-month-old infant with bilateral congenital glaucoma presenting marked megalocornea (enlarged corneas).

### **Discussion**

During the study period, 20 out of 759 patients seen were diagnosed with pediatric glaucoma, yielding a prevalence of 2.6%. Glaucoma is responsible for 12% of cases of blindness, ranking as the second leading cause of blindness after cataracts in industrialized countries and the third leading cause in developing countries. The prevalence of the disease varies significantly across countries, ranging from 2% in France to 7% in Togo [10,11].

The relatively low prevalence observed in our study may be attributed to low attendance rates at specialized ophthalmic centers. This situation likely stems from several factors, including low socioeconomic status, geographical distance from specialized care facilities, frequent reliance on less expensive traditional remedies and widespread self-medication. Our findings are higher than those reported by Tchabi, et al., in Benin, who found a prevalence of 0.08% [12]. In our study, the age group of 11 to 15 years was the most represented, accounting for 70% of cases. The mean age was 11.78 years, with an age range from 6 months to 15 years. In contrast, Rodriguez, et al., in Brazil reported a much lower mean age of 5.04 years [13].

The higher mean age in our series likely reflects the challenges faced by developing countries in early disease detection and management, resulting in delayed diagnosis at more advanced stages of the disease. Males were predominant, representing 55% of cases, with a sex ratio of 1.22.

Our results are consistent with those of Tchabi, et al., in Benin, who also observed male predominance, with a sex ratio of 1.7 [12]. Considering our findings and those reported in the literature, we can conclude that pediatric glaucoma tends to be more prevalent in males. The primary reason for consultation in our study was decreased visual acuity (80%), followed by photophobia (65%) and epiphora (45%). These results are comparable to those of Ako, et al., in Côte d'Ivoire, who also identified decreased visual acuity as the main presenting symptom, reported in 53.64% of cases [14].

This trend can be explained by the insidious progression of glaucoma, which often remains asymptomatic until an advanced stage when visual acuity is already compromised. Additionally, reduced vision is more likely to prompt parental concern compared to earlier, subtler signs such as tearing or light sensitivity [15,16].

A positive family history of glaucoma was found in 65% of patients. This rate is lower than that reported by Ellong, et al., in Cameroon (88.3%) and Alliot, et al., who observed hereditary glaucoma in 100% of cases [3,9]. Studies on the inheritance patterns of glaucoma have demonstrated its genetic component. Heredity is widely recognized as a significant risk factor for pediatric glaucoma, which supports the high familial incidence observed in our cohort [17]. Our results showed that 50% of patients had visual acuity better than 6/10 in both eyes. This preservation of visual acuity suggests that, in many cases, the diagnosis was made at a relatively early stage, allowing for timely intervention before severe visual loss occurred.

The cornea was clear in 70% of cases in the right eye and 80% in the left eye. Loss of corneal transparency is a serious sign in pediatric glaucoma, indicating severe and prolonged ocular hypertension. It reflects irreversible damage to the corneal endothelium and Descemet's membrane, predisposing the cornea to chronic edema. Preoperative IOP exceeded 21 mm/Hg in 75% of patients in the right eye and 55% in the left eye. These values are comparable to those reported by Ellong, et al., and Alliot, et al., who found IOP >22 mm/Hg in 94.7% and 64.3% of cases, respectively [7].

The asymmetry in IOP between eyes may reflect differences in disease progression or measurement variability. An optic cup-to-disc (C/D) ratio greater than 0.5 was observed in 85% of right eyes and 75% of left eyes. Fopoussi, et al., reported that 61% of patients had C/D ratios between 0.6 and 0.8 bilaterally [18]. The high prevalence of significant cupping in our patients indicates advanced glaucomatous optic neuropathy at diagnosis. This may be influenced by individual anatomical variations, intraocular pressure levels, genetic predisposition or environmental factors. Differences across studies may also arise from variations in population characteristics and measurement techniques. Pachymetry was performed in 11 patients (55%). It revealed thick corneas in 4 patients (36.36%) in the right eye and 3 patients (27.27%) in the left eye.

According to the literature, corneas in African and African-descended populations tend to be thinner on average than those of Caucasian individuals. This anatomical difference may lead to underestimation of true intraocular pressure when measured by applanation tonometry, potentially delaying diagnosis and treatment [19]. Juvenile glaucoma was the most common type, accounting for 90% of cases in our study. This finding is consistent with Fopoussi, et al., who reported juvenile glaucoma in 73% of cases [18]. The predominance of juvenile glaucoma in our series may be explained by the lack of routine screening for glaucoma signs in newborns and infants in our region. Given the silent progression of the disease, diagnosis is often delayed until later childhood or adolescence.

Bilateral involvement was observed in 90% of patients. This is consistent with findings from Ellong, et al., and Tchabi, et al., who reported bilateral forms in 87.2% and 92.6% of cases, respectively [7,12]

The literature consistently shows that pediatric glaucoma is predominantly bilateral, underscoring the need for comprehensive evaluation of both eyes in every diagnosed case. Surgical treatment was performed in 100% of patients, with a success rate of 90%.

This rate is comparable to those reported by Tchabi, et al., in Cotonou (89.74%) and Agbeja, et al., in Nigeria (91.1%), confirming the effectiveness of surgical intervention in controlling pediatric glaucoma [12,20].

All patients in our study underwent trabeculectomy. This is consistent with Hassim, et al., in Morocco, where all patients received the same procedure [21]. Trabeculectomy remains the most widely used surgical technique due to its efficacy and relatively low complication rate. It is a guarded filtering surgery, protected by a scleral flap, which helps regulate aqueous outflow and reduce the risk of hypotony [22].

Beta-blockers were the most prescribed medication, used in 80% of patients. This finding aligns with Fopoussi, et al., in Mali, where beta-blockers were the most commonly used topical agent (99%) [18]. The high prescription rate of beta-blockers in our setting is likely due to their availability, affordability and familiarity among clinicians in resource-limited environments.

Mean intraocular pressure decreased from 23.62 mm/Hg preoperatively to 17.35 mm/Hg postoperatively. These results are similar to those reported by Fopoussi, et al., in Mali (from 21 mm/Hg to 15 mm Hg), Essuman, et al., in Ghana (from 30.3 mm/Hg to 18.1 mm Hg) and Zhang, et al., in China (from 31.70 mm/Hg to 19.22 mm Hg) [18,23,24].

This significant reduction in IOP can be attributed to trabeculectomy, which effectively bypasses the trabecular meshwork obstruction and enhances aqueous humor drainage. After treatment, 60% of patients had postoperative visual acuity better than 6/10 in the right eye and 65% in the left eye. These outcomes are comparable to those reported by Rouland, et al., in whom 54% of patients undergoing trabeculectomy maintained visual acuity above 5/10 [25]. The improvement or stabilization of visual acuity in our patients reflects the success of timely surgical intervention and effective intraocular pressure control.

## Conclusion

Pediatric glaucoma is a distinct entity from adult glaucoma by its clinical features and therapeutic challenges. The management of the pediatric glaucoma has continuously improved in developed countries however in our under-resourced healthcare settings marked by difficult socioeconomic conditions this disease remains a significant challenge for both the health system and affected children and their families. Our epidemiological, clinical, paraclinical and therapeutic analysis of pediatric glaucoma revealed that juvenile glaucoma was the most frequent form, predominantly bilateral and that trabeculectomy was the most commonly performed surgical procedure, offering favorable outcomes. It is essential to emphasize to parents the need for lifelong follow-up and the risk of recurrence, which may occur even after many years of clinical stability.

## Conflict of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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