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Surgical Management of Acute Corneal Hydrops Complicating Keratocone: Experience at the Diamniadio Children's Hospital (Senegal)

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Abstract

Background: Acute corneal hydrops is an uncommon but sight-threatening complication of keratoconus resulting from a rupture of Descemet's membrane and subsequent stromal imbibition with aqueous humor. Although spontaneous resolution usually occurs, prolonged corneal edema may induce corneal neovascularization and compromise subsequent keratoplasty. Surgical procedures aimed at promoting rapid corneal recovery have recently gained increasing interest. **Objective:** To report the surgical experience of the Ophthalmology Department of Diamniadio Children's Hospital in the management of acute corneal hydrops associated with keratoconus. **Methods:** A retrospective descriptive study was conducted including all patients diagnosed with acute corneal hydrops secondary to keratoconus between January 2020 and Avril 2026 Demographic, clinical, imaging, therapeutic and follow-up data were collected from medical records and analyzed using Microsoft Excel®. Medical therapy was initiated in all patients, while intracameral air injection combined with pre-Descemetic compression sutures was performed whenever indicated. **Results:** Sixteen patients were included. The mean age was 15.6 years with an equal male-to-female ratio. Bilateral involvement occurred in two patients (12.5%). All patients had previously diagnosed keratoconus associated with chronic eye rubbing. Sudden visual loss, photophobia and ocular pain were present in every case. Anterior segment OCT confirmed Descemet's membrane rupture. Thirteen patients (81.25%) underwent intracameral air injection associated with compression sutures. Mean healing time was two months. At three-month after surgery follow-up, complete corneal healing with residual scar and no corneal neovascularization was achieved in all operated cases. One patient experienced partial suture loosening. **Conclusion:** Compression sutures associated with intracameral air injection appear to be a safe, effective and affordable sur-

gical option for acute corneal hydrops, allowing faster healing while minimizing corneal vascularization.

Subject Areas

Ophthalmology

Keywords

Keratoconus, Acute Corneal Hydrops, Descemet Membrane, Compression Sutures, Anterior Segment OCT

1. Introduction

Keratoconus is a progressive corneal ectasia characterized by thinning and protrusion of the cornea, which cause irregular astigmatism and a gradual decline in visual acuity. It is the most common primary corneal ectasia and occurs primarily in adolescents and young adults. Its progression is influenced by several environmental and genetic factors, including chronic eye rubbing, allergic eye diseases, and vernal keratoconjunctivitis, which is particularly common in sub-Saharan African countries.

AH occurs in approximately 3% of keratoconus (KC) [1]. It results from a spontaneous rupture of Descemet's membrane, allowing aqueous humor to pass into the corneal stroma, leading to massive edema that causes a sudden decline in visual acuity, intense photophobia, and eye pain. The diagnosis is primarily clinical.

Conservative treatment traditionally relies on lubricants, hypertonic solutions, cycloplegics, and topical corticosteroid therapy. However, spontaneous resolution of the edema generally takes two to four months, during which time the risk of corneal neovascularization is increased, potentially compromising the prognosis for a future corneal transplant [2]. These limitations have led to the development of surgical techniques designed to accelerate healing, including pneumodescemetopexy via injection of air or expandable gases, pre-Descemet's compressive sutures, and, in certain situations, various keratoplasty techniques.

Among these approaches, the combination of an intracameral air injection with compressive sutures is a relatively simple, inexpensive technique that is particularly well-suited to resource-limited settings. By bringing the edges of the Descemet's membrane tear closer together while promoting its reattachment to the posterior stroma, this method may reduce the duration of edema and limit the occurrence of secondary complications.

However, data from Africa regarding this therapeutic strategy remain limited. In this context, we report on the experience of the Ophthalmology Department at the Diamniadio Children's Hospital in the surgical management of acute corneal hydrops complicating keratoconus in a pediatric and adolescent population.

2. Patients and Methods

2.1. Study Setting and Design

This was a retrospective, descriptive, and analytical study conducted in the Ophthalmology Department of the Diamniadio Children's Hospital (HED), a referral center for the management of pediatric ophthalmic conditions in Senegal.

The study was performed from January 2020 to April 2026.

2.2. Study Population

The study included all patients presenting with acute corneal hydrops complicating keratoconus who were treated during the study period.

The diagnosis of keratoconus was based on clinical, biomicroscopic, and tomographic data available in the medical records.

A diagnosis of acute corneal hydrops was made based on the combination of a sudden decline in visual acuity and diffuse corneal stromal edema observed with a slit lamp, and/or evidence of a Descemet's membrane rupture on OCT of the anterior segment.

Records that were incomplete or had a follow-up period of less than three months were excluded from the study.

2.3. Variables Studied

The variables collected included:

Demographic data: age; sex.

1) *Clinical Data*

History of keratoconus; unilateral or bilateral nature of the hydrops; history of eye rubbing; history of ocular trauma; functional symptoms; baseline visual acuity; biomicroscopic examination findings.

2) *Imaging Data*

When performed, optical coherence tomography of the anterior segment (OCT-AS) made it possible to confirm a Descemet's membrane rupture; assess its extent; detect intrastromal bubbles; guide the treatment strategy.

3) *Therapeutic Data*

The modalities of medical and surgical treatment were analyzed.

4) *Outcome Data*

The following parameters were studied: healing time; postoperative complications; final visual acuity; final corneal appearance; presence of corneal neovascularization.

2.4. Therapeutic Data

Upon diagnosis of acute corneal hydrops, all patients received symptomatic medical treatment consisting of: preservative-free eye lubricants; hypertonic solution to promote resorption of stromal edema; sedative therapy when intraocular pressure warranted it; topical corticosteroid therapy to limit the inflammatory response and the risk of corneal neovascularizationand a cycloplegic agent to relieve

pain and ciliary spasm.

Patients were followed up twice a week for one week to assess clinical progress and determine whether surgical intervention was necessary. If there is no clinical improvement in the edema after one week of medical treatment, surgical treatment is performed.

2.5. Surgical Technique

The procedure was performed in the operating room under anesthesia appropriate for the patient's age and under strict aseptic conditions.

After establishing a sterile surgical field, a self-sealing corneal paracentesis was performed at the 9 o'clock position using a 15˚ blade.

A sterile 3 ml air bubble was then slowly injected into the anterior chamber. This step facilitated visualization of the edges of the tear and allowed for better identification of the path of the future compressive sutures.

Non-transfixating pre-Descemet sutures were then placed using 10/0 monofilament nylon.

The sutures were placed perpendicular to the axis of the Descemet's membrane tear, at the junction between the edematous and transparent portions of the cornea, maintaining a spacing of approximately 1 to 2 mm from the edges of the tear. The number of sutures performed depended on the size of the presumed tear in Descemet's membrane.

The knots were carefully buried in the superficial stroma.

At the end of the procedure, the integrity of the anterior chamber was verified before instilling antibiotic and corticosteroid eye drops.

The sutures were removed as scheduled three months postoperatively after clinical confirmation of healing.

2.6. Postoperative Follow-Up

Patients were seen regularly on the first day, one week, one month, two months, and three months after surgery.

Each follow-up visit included: measurement of visual acuity; biomicroscopic examination; assessment for ocular hypertension; assessment of corneal edema resolution; screening for corneal neovascularization;

Healing was considered complete upon the complete resolution of corneal edema, with reattachment of Descemet's membrane and stabilization of the residual corneal scar after slid lamp examination.

2.7. Statistical Analysis

Data were entered and analyzed using Microsoft Excel® software (Microsoft Corporation, Redmond, WA, United States).

Quantitative variables were expressed as mean ± standard deviation or median, depending on their distribution.

Qualitative variables were presented as counts and percentages.

Due to the small sample size, only a descriptive analysis of the data was performed.

2.8. Ethical Considerations

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

The protocol was approved by the Ethics Committee of the Diamniadio Children's Hospital.

Data were collected anonymously and confidentially. Information that could identify patients was removed prior to analysis.

The patients' legal guardians were informed of the anonymized use of clinical data and photographs for scientific purposes and publication.

3. Results

3.1. General Characteristics of the Population

During the study period, 16 patients (18 eyes) with acute corneal hydrops complicating keratoconus were included.

The mean age of the patients was 15.64 years (range: 12 - 18 years). The gender distribution was equal, with 8 boys and 8 girls, resulting in a sex ratio of 1.

The condition was unilateral in 14 patients (87.5%) and bilateral in 2 patients (12.5%).

All patients had a known diagnosis of keratoconus prior to the onset of hydrops.

3.2. Contributing Factors

Repeated eye rubbing was observed in all patients (100%).

Ocular trauma preceding the onset of hydrops was reported in 2 patients (12.5%).

All patients presented with clinical signs of endemic tropical limbo-conjunctivitis (ETLC).

3.3. Clinical Presentation

All patients presented with a sudden decline in visual acuity associated with eye pain and photophobia.

The best-corrected visual acuity was limited to counting fingers at one meter (CF at 1 m) in all patients.

On biomicroscopic examination, all patients presented with (**Figure 1(A)-(B)**) conjunctival hyperemia; a perikeratitic ring; diffuse stromal edema and subepithelial bubbles.

Anterior segment OCT confirmed a Descemet's membrane rupture, sometimes associated with intrastromal bubbles (**Figure 2**).

3.4. Therapeutic Management

All patients initially received symptomatic medical treatment combining ocular

lubricants; hypertonic solution topical corticosteroids; cycloplegic agents; hypotonic treatment when indicated.

Thirteen patients (80%) subsequently underwent surgical management involving an intracameral air injection combined with pre-Descemet's compressive sutures (Figure 3(A)-(B)).

The other three patients (20%) continued medical treatment alone due to a course of the disease deemed favorable.

3.5. Postoperative Course

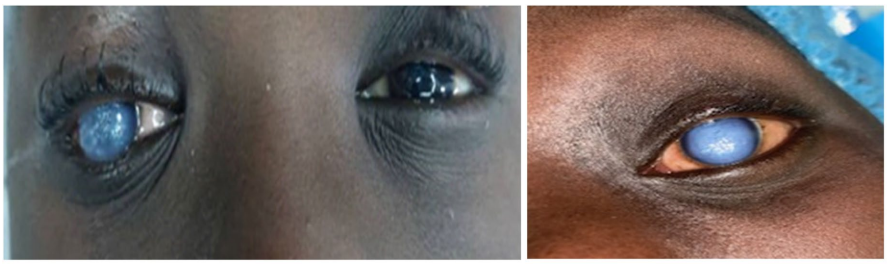
The mean time to healing was two months between three months time healing for patients with medical treatment only.

At the end of a mean follow-up of three months, all patients presented (Figure 4): complete resolution of corneal edema; healing of the Descemet's membrane rupture; residual corneal scarring; no corneal neovascularization.

Best visual acuity remained limited to counting fingers at one meter in all patients at three months.

Only one postoperative complication was observed: partial suture loosening, which required revision surgery but had no subsequent anatomical consequences.

Figure and Captions



(A) (B)

Figure 1. (A)-(B): Initial clinical appearance showing acute corneal hydrops with diffuse stromal edema and subepithelial bubbles in a patient with keratoconus.

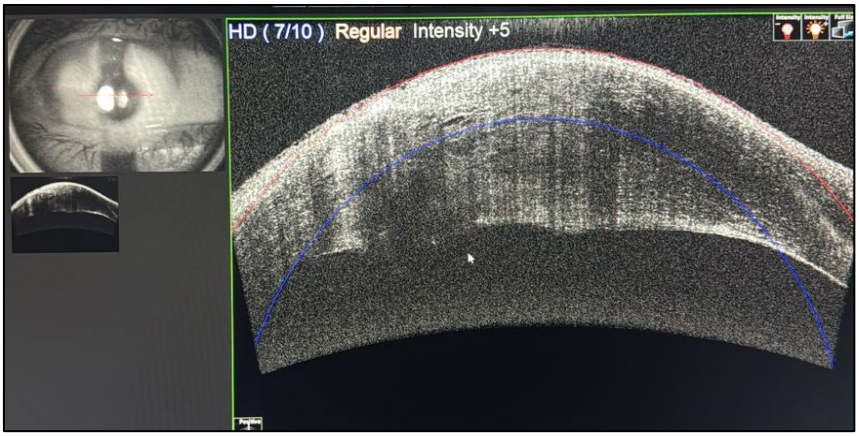
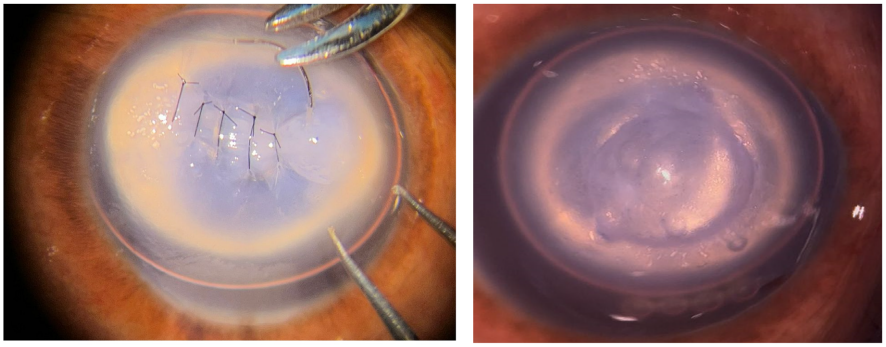


Figure 2. OCT of the anterior segment showing a rupture of Descemet's membrane with intrastromal fluid accumulation.



(A) (B)

Figure 3. (A)-(B): Surgical procedure: intracameral air injection followed by the placement of pre-Descemet's compressive sutures perpendicular to the axis of the tear.

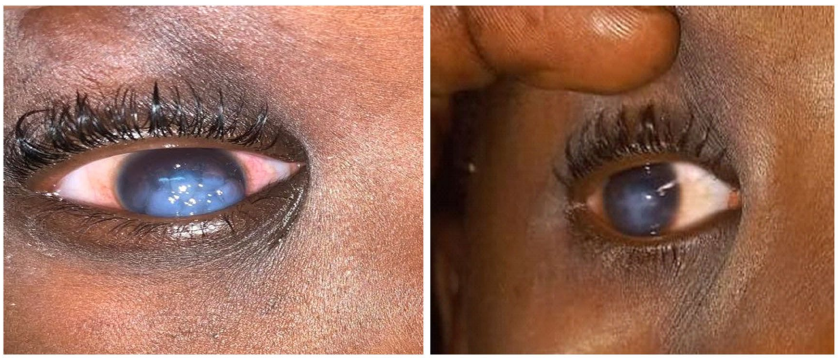


Figure 4. Clinical appearance three months after surgery, showing the patient's appearance on postoperative Day 1 and Day 15 (**Figure 1(B)**).

4. Discussion

Acute corneal hydrops (ACH) is a rare but severe complication of corneal ectasias, primarily keratoconus. It results from a spontaneous rupture of Descemet's membrane, which causes a massive influx of aqueous humor into the corneal stroma, leading to acute edema and significant visual impairment. Although the prognosis is usually favorable, the duration of edema resolution and resulting scarring can compromise visual rehabilitation and the success of any subsequent keratoplasty. Advances in anterior segment imaging and the development of new surgical techniques have profoundly changed the management of this condition in recent years.

In our series, the mean age was 15.64 years, lower than that reported in most studies, where it generally ranges between 20 and 30 years. Hajji *et al.* [3] reported a mean age of 22.5 years in Morocco. This difference could be explained by the high frequency of pediatric forms of keratoconus observed in sub-Saharan Africa, as well as by the high prevalence of LCCET, which promotes rapid progression of ectasia.

The young age of our patients demonstrates the aggressiveness of keratoconus in our setting. Several studies have shown that pediatric keratoconus progresses more rapidly than in adults, with accelerated corneal thinning and a higher risk

of complications such as hydrops.

The gender distribution was balanced (sex ratio = 1), in contrast to data in the literature, which report a male predominance, with a ratio ranging from 2 to 3 [1] [3]. This difference may be due to the small sample size of our series rather than an epidemiological peculiarity.

All of our patients had a known history of keratoconus associated with repeated eye rubbing, while two patients reported a recent eye injury.

Eye rubbing is currently considered the primary factor in the progression of keratoconus. It causes repeated microtrauma, which leads to biomechanical weakening of the cornea and promotes rupture of Descemet's membrane in advanced stages of the disease [1] [4]-[6].

In addition, all of our patients exhibited signs of endemic tropical limbal conjunctivitis (ETLC). This condition, which is common among children in West Africa, leads to chronic itching and eye rubbing, thereby creating a vicious cycle that accelerates the progression of keratoconus. This observation underscores the importance of early and thorough management of ocular allergic diseases in our setting.

Clinically, the triad of sudden decline in visual acuity, photophobia, and pain was present in all of our patients. This clinical presentation is classic and consistent with published series [4].

Slit-lamp examination consistently revealed diffuse stromal edema associated with subepithelial bubbles and conjunctival hyperemia. These signs are directly related to the massive influx of aqueous humor into the corneal stroma following rupture of Descemet's membrane [4].

Anterior segment OCT is valuable when available; it allows confirmation of Descemet's membrane rupture, assessment of its extent, and guidance for the placement of compressive sutures [4] [5].

All of our patients received initial medical treatment combining lubricants, hypertonic solutions, cycloplegics, topical corticosteroids, and hypotonic agents when necessary.

This treatment remains primarily symptomatic [1] [4] [5]. It improves patient comfort but does not treat the Descemet's membrane rupture. Spontaneous resolution of the edema generally takes two to four months, or even longer for extensive ruptures. During this period, the risk of corneal neovascularization and dense scarring gradually increases.

4.1. Benefits of Surgical Management

Given the limitations of conservative treatment, several surgical techniques have been proposed to accelerate the resolution of edema. The most commonly used are pneumodescemetopexy via injection of air or expandable gases (SF6, C2F6, or C3F8), pre-Descemet's compressive sutures, drainage incisions, intrastromal injection of autologous plasma, and various keratoplasty techniques for complex cases [1] [5].

In our series, thirteen patients underwent an intracameral air injection combined with pre-Descemet's compressive sutures.

This strategy is based on two complementary mechanisms:

- the air bubble promotes reattachment of Descemet's membrane to the posterior stroma;
- compressive sutures mechanically bring the edges of the tear together, thereby limiting further leakage of aqueous humor.

This approach appears particularly well-suited for large or irregular tears, for which an air injection alone may prove insufficient.

4.2. Anatomical Outcomes

We achieved complete anatomical healing in all patients, with a mean time to healing of two months.

This timeframe is shorter than that typically observed with medical treatment alone, where edema resolution generally takes between two and four months. We achieved complete anatomical healing in all patients, with a mean time to healing of two months and 3 months of healing time if only medical treatment performed. Several authors have shown that surgical techniques can significantly accelerate the resolution of edema while reducing the risk of corneal neovascularization. However, we did not observe any significant difference in visual acuity between the two groups after 3 months.

The complete absence of neovascularization in our series is a particularly encouraging result. This observation is important because corneal neovascularization represents a major risk factor for immunological rejection in the event of a subsequent keratoplasty.

4.3. Complications

Only one postoperative complication was observed: partial suture loosening that required reoperation.

No cases of ocular hypertension, pupillary block, cataract, infection, or corneal perforation were observed.

These results are noteworthy, as the literature reports that pneumodescemetopexy alone may be complicated by acute ocular hypertension due to pupillary block, intrastromal gas migration, traumatic cataract, or endothelial damage, particularly when expandable gases are used.

4.4. Functional Outcomes

Despite excellent anatomical outcomes, the best visual acuity remained limited to counting fingers at one meter in all of our patients.

This lack of immediate visual improvement can be explained by several factors:

Advanced stage of the keratoconus; the presence of a dense central corneal scar following healing; the short follow-up period (three months); the absence of specialized visual rehabilitation (scleral lenses or keratoplasty).

It should be emphasized that the primary goal of hydrops treatment is not immediate visual recovery but the restoration of the cornea's anatomical integrity in order to preserve the potential for future rehabilitation.

4.5. The Benefits of Our Technique in Resource-Limited Countries

One of the main strengths of our approach lies in the use of a simple, reproducible, and inexpensive surgical technique.

Unlike more complex procedures such as DMEK, DSAEK, or DALK, compressive sutures combined with an air injection require neither a corneal graft nor sophisticated surgical equipment. They can be performed in most ophthalmology departments equipped with an operating microscope, which is a major advantage in resource-limited countries.

In regions where access to corneal banks remains limited, this strategy offers a realistic alternative for preserving the corneal integrity of young patients while awaiting potential secondary visual rehabilitation.

4.6. Strengths and Limitations of the Study

This study represents one of the few African series dedicated to the surgical management of acute corneal hydrops. However, certain limitations must be highlighted. The retrospective nature of the study, the small sample size, the absence of a comparison group treated solely with medical therapy, and the limited duration of follow-up do not allow for a definitive conclusion regarding the superiority of this technique. Prospective, multicenter studies, including long-term functional follow-up and a comparison with other therapeutic modalities, would be necessary to confirm these results.

5. Conclusions

Acute corneal hydrops is a severe complication of keratoconus, occurring primarily in young patients and capable of causing long-term impairment of visual prognosis.

In our series, this complication was observed in adolescents with advanced keratoconus, which was consistently associated with repeated eye rubbing and signs of endemic limbal conjunctivitis of the tropics.

Conservative management allows for a spontaneously favorable outcome in the majority of cases, but it carries the risk of prolonged resolution of corneal edema, with an increased risk of neovascularization and significant stromal scarring.

In our experience, the combination of an anterior chamber air injection and pre-Descemet's compressive sutures has enabled effective reattachment of the Descemet's membrane, complete anatomical healing within two months, and the absence of corneal neovascularization at three months.

This technique offers several advantages: it is simple, reproducible, inexpensive, and suitable for settings where access to keratoplasty techniques remains limited. It could represent a promising therapeutic alternative in the early management of

acute corneal hydrops complicating keratoconus.

Prospective studies with larger sample sizes and longer follow-up periods will be needed to confirm these results and assess the actual impact of this strategy on long-term visual prognosis.

Conflicts of Interest

The authors declare no conflicts of interest.

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