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Severe Keratoconus: Watch Out for Complications!

Rim El Hachimi [a*], Rida El Hadiri [a], Tachfouti Samira [a], Abdellah Amazouzi [a], Nourreddine Boutimzine [a] and Lalla Ouafa Cherkaoui [a]

[a] *Department of Ophthalmology, A Speciality Hospital of Rabat, Mohamed V University of Rabat, Morocco.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Case Report

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ABSTRACT

Keratoconus is an evolving condition. The speed and severity of the course differs from patient to patient. We report the clinical observation of a 36-year-old patient with a history of severe atopy and who presents a neglected bilateral keratoconus. The clinical examination found sign of Munson Rizzuti, the corneal protrusion being more marked in the left eye. Biomicroscopic examination revealed corneal opacity in the central right eye with marked corneal protrusion and thinning. In the right eye, there was stromal corneal opacity with neovascularization, superficial and deep scar lines, epithelial microcystic edema and an intrastromal cyst. This finding correspond to anterior segment OCT Sandali stage 4 in both eyes. Penetrating keratoplasty was proposed to the patient for treatment. Subconjunctival injections of 2.5 mg bevacizumab were also undertaken at 1 month intervals. The advent of modern imaging techniques has enabled early diagnosis of keratoconus as well as its monitoring and screening for complications. New classifications aim to stage the pathology and to better codify the management. The most serious complication is the

**Corresponding author: E-mail: Rimelhachimi@gmail.com;*

occurrence of corneal hydrops. Adequate management of the latter avoids complications including fibrosis and neovascularization, which improves the prognosis of a subsequent keratoplasty which remains the last resort in these patients.

Keywords: Advanced keratoconus; hydrops; neovascularization; keratoplasty.

ABBREVIATIONS

DALK : Deep Lamellar Anterior Keratoplasty
PKP : Penetrating Keratoplasty
DSAEK : Descemet Stripping Automated Endothelial Keratoplasty
DMEK : Descemet Membrane Endothelial Keratoplasty
CXL : Crosslinking

1. INTRODUCTION

Keratoconus is a progressive disease characterized by thinning and protrusion of the cornea. Involvement is irregular and asymmetrical in the majority of cases [1]. The evolution of Keratoconus remains unpredictable and variable. The evolution of topographic, tomographic and biomechanical corneal imaging techniques helps to better understand the pathology and to better codify management.

We report a clinical case of a 36-year-old woman with a history of severe atopy who presented with severe bilateral keratoconus.

We aim to report a serious case of spontaneous evolution of keratoconus towards neovascularization and fibrosis, and to show the seriousness of the patient's therapeutic non-compliance in these cases of progressive keratoconus. This manuscript aims is also to objectify the mandatory role of imaging (OCT of the cornea) to classify and objectify the severity of the pathology as well as to plan an adequate management.

2. CASE PRESENTATION

This is a 36-year-old patient with a history of severe atopy who has had a decline in visual acuity for 9 years, aggravated 3 years ago by photophobia and bilateral eye pain. Visual acuity was reduced to near counting fingers on the left and 1/6 on the right with normal IOP. The clinical examination found sign of Munson Rizzuti, the corneal protrusion being more marked in the left eye (Fig. 1a and b). Biomicroscopic examination revealed corneal opacity in the central right eye with marked corneal protrusion and thinning. In the right eye, there was stromal corneal opacity with neovascularization, superficial and deep scar lines, epithelial microcystic edema and an intrastromal cyst (Fig. 2a and b). Midstromal neovessels forming vascular trees with loops at their ends (Fig. 3a and b). The patient was put on topical steroids.

We proposed an injection of anti-VEGF in the left eye and a corneal transplant. The patient was then lost to sight for 2 years. Examination found the same visual acuity with worsening stromal fibrosis and neovascularization of the left eye. Refraction is impossible in both eyes. The average keratometry of the right eye is at 79.5 D and that of the left eye at 103.5 D. The maximum keratometry is at 94.2 D at the level of the right eye and at 171 D at the level of the 'right eye. Central corneal pachymetry of the right eye is 178 um and not measurable at the level of the left eye. This correspond to a stage 4 keratoconus of the Amsler-Krumeich classification in both eyes (Fig. 4). Corneal pentacam topography was uninterpretable given the corneal opacity. Anterior segment OCT objectified in the right eye a thickening of the epithelium with hyperreflectivity of Bowman's membrane and a stromal scar, corresponding to Sandali stage 4. The OCT of the left eye shows a significant modification of the corneal structure with scarring and panstromal fibrosis with a residual aspect of the rupture of Descemet's membrane, which corresponds to stage 5B of the Sandali classification (Fig. 5). Penetrating keratoplasty was proposed to the patient for treatment. Subconjunctival injections of 2.5 mg bevacizumab were also undertaken at 1 month intervals.

3. DISCUSSION

“Keratoconus is a progressive, symmetrical, asymmetrical ectatic disease that causes progressive thinning and protrusion of the cornea resulting in irregular astigmatism and decreased visual acuity” [2]. “Keratoconus usually begins at puberty and tends to progress until the third or fourth decade of life. The progression of keratoconus varies between individuals and is more accelerated in younger patients. Spontaneous stabilization can be achieved approximately 20 years after the initial presentation” [3].

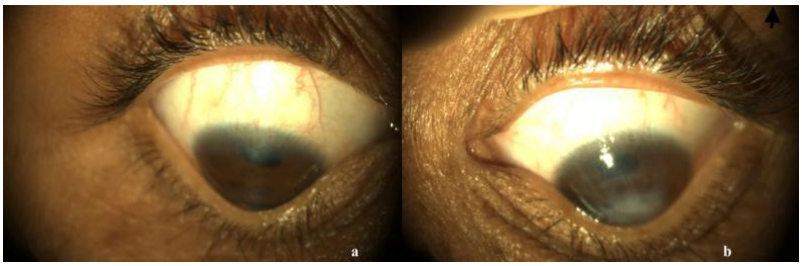

Fig. 1. Munson rizzuti's sign: Corneal protrusion causes angulation of the lower eyelid when the patient looks down. Corneal protrusion in round cone or nipple
a: Right eye; b: Left eye

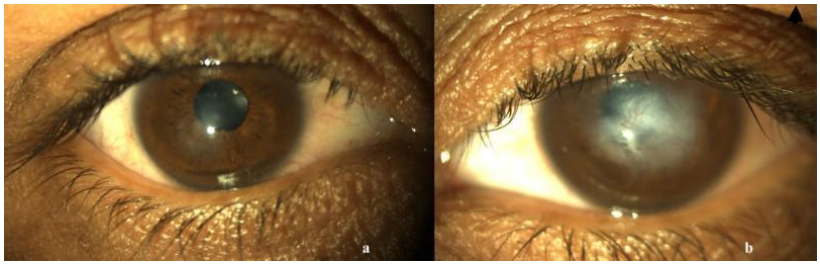

Fig. 2. Stage 4 bilateral keratoconus with sequelae of hydrops in the left eye: Significant corneal opacity with neovascularization
a: Right eye; b: Left eye

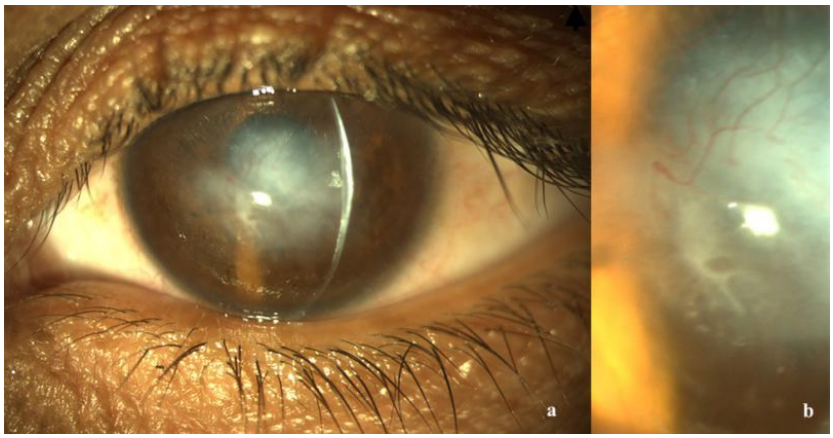

Fig. 3. Midstromal neovascularization forming vascular trees with loops at their ends, epithelial microcystic edema and intrastromal cyst
a: Left eye; b: At high magnification

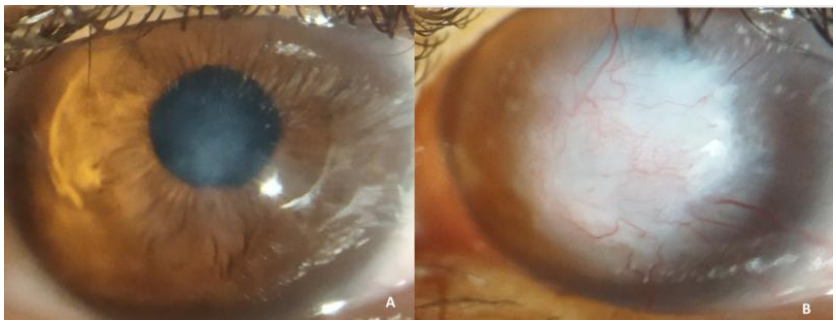

Fig. 4. Worsening left eye corneal neovascularization and stromal fibrosis.
A: Right eye; B: Left eye

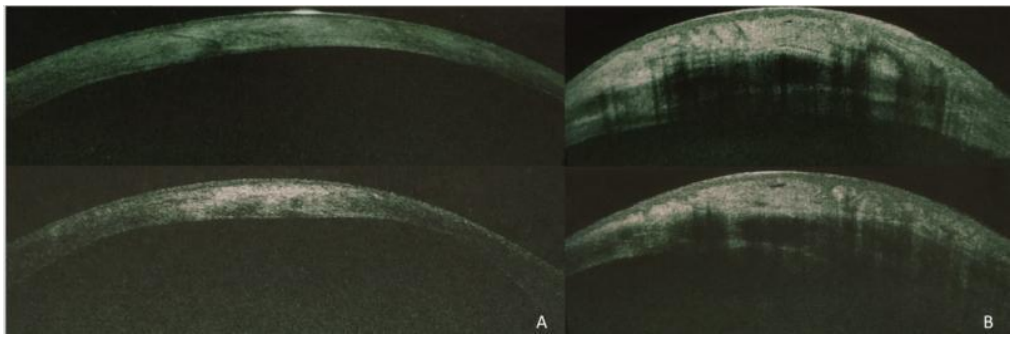

Fig. 5. OCT of cornea: A: Right eye: Thickening of the epithelium with hyperreflectivity of bowman's membrane and a stromal scar, corresponding to Sandali stage 4. B: Left eye: significant modification of the corneal structure with scarring and panstromal fibrosis with residual aspect of the rupture of descemet's membrane, which corresponds to stage 5B of the sandali classification

“Advanced or severe keratoconus may grade towards corneal hydrops following a rupture of Descemet's membrane. This rupture leads to stromal edema and potentially serious corneal scarring” [4]. “Detecting the disease in the early stages is essential to halt progression. Over the past decade, significant advances have been reported in the diagnosis and management of keratoconus” [5].

“Corneal topography and tomography (Scheimpflug imaging or anterior segment optical coherence tomography, OCT) allow (unlike older techniques) assessement of the anterior and posterior face of the cornea, can provide epithelial imaging and analysis of the anterior segment” [6]. “Advances in technology have changed classification systems. The Amsler-Krumeich classification (Table 1), although still valid, does not combine topographic and tomographic indicators or maps and biomechanical parameters. The combination of topographic, tomographic and biomechanical information provides valuable information for the diagnosis and treatment of keratoconus such as Belin-Ambrosio Enhanced Ectasia” [7-8]. “The progression of keratoconus is defined by a modification of at least two of the following parameters (according to the Global Consensus on Keratoconus and ectatic Diseases): Increase in the curvature of the anterior corneal surface; The increase in curvature of the posterior corneal surface; Thinning and/or increased rate of change in corneal thickness” [9].

“Through the use of anterior segment OCT, Sandali and coauthors described a new classification based on the progressive corneal changes occurring in keratoconus throughout the course of the disease, classifing the severity of the disease” [10]. A recent study compared the Amsler-Krumeich classification and Sandali (Table 1). “The results of this comparative study were that the Amsler-Krumeich classification is more appropriate for identifying and longitudinally following patients with early stages of KC, while the Sandali classification for diagnosing and monitoring patients with later stages. advanced, especially when surgical planning must be chosen” [11].

Crosslinking is the treatment that aims to stop the progression of keratoconus, thus avoiding the need for a corneal transplant. “Conventional CXL is recommended in eyes with a corneal thickness of at least 400 microns after de-epithelialization to avoid endothelial toxicity. However, most keratoconic corneas requiring CXL may not meet this preoperative inclusion criterion. Moderate to advanced cases often present with pachymetry below this threshold. There are various modifications to the conventional method to circumvent this problem of thin corneas” [12].

Concerning keratoplasty in advanced cases of keratoconus, penetrating keratoplasty appeared until recently, the treatment of choice. However, technical improvements have increased the popularity of DALK given its advantages (lower risk of rejection, preservation of endothelial cells, avoidance of open surgery and shorter duration of postoperative treatment) [13]. The limits of this attractive technique remain corneal opacities, neovascularization and hydrops [14]. Studies comparing the two techniques report different results regarding the visual outcome of the two techniques. Some of these studies report more satisfactory results of KT, which can be explained by the depth of the DALK dissection [15-16].

Table 1. Comparison of Amsler-Krumeich and Sandali classifications [11]

Amsler-krumeich classification	Sandali classification
STAGE 1 Myopia/astigmatism with eccentric curvature < 5.00 D Mean keratometry value < 48.0 D	**STAGE 1** Thinning of the epithelial and stromal layers at the level of the cone Normal-appearing corneal layers
STAGE 2 Myopia/astigmatism > 5.00 D but < 8.00 D Mean keratometric value < 53.0 D Absence of scars Minimum apical corneal thickness > 400 m	**STAGE 2A:** Bowman's layer hyperreflectivities with epithelial thickening **STAGE 2B:** Hyperreflectivities at Bowman's layer with epithelial thickening and stromal opacities
STAGE 3 Myopia/astigmatism > 8.00 D but < 10.00 D Mean keratometric value > 53.0 D Absence of scars Minimum apical corneal thickness < 400 m but > 300 m	**STAGE 3A:** Posterior displacement of hyperreflective structures at Bowman's layer with increased epithelial thickening Stroma thinning **STAGE 3B:** Posterior displacement of hyperreflective structures at Bowman's layer with increased epithelial thickening Stromal thinning and presence of stromal opacities
STAGE 4: Refraction not possible Mean keratometric value > 55.0 D Central corneal scar Minimum apical corneal thickness < 300 m	**STAGE 4:** Panstromal scar **STAGE 5A:** Acute onset with rupture of Descemet's membrane and tearing of collagen lamellae, large fluid-filled intrastromal cysts and formation of epithelial edema **STAGE 5B:** Healing stage of 5A with panstromal healing with residual appearance of Descemet's membrane rupture.

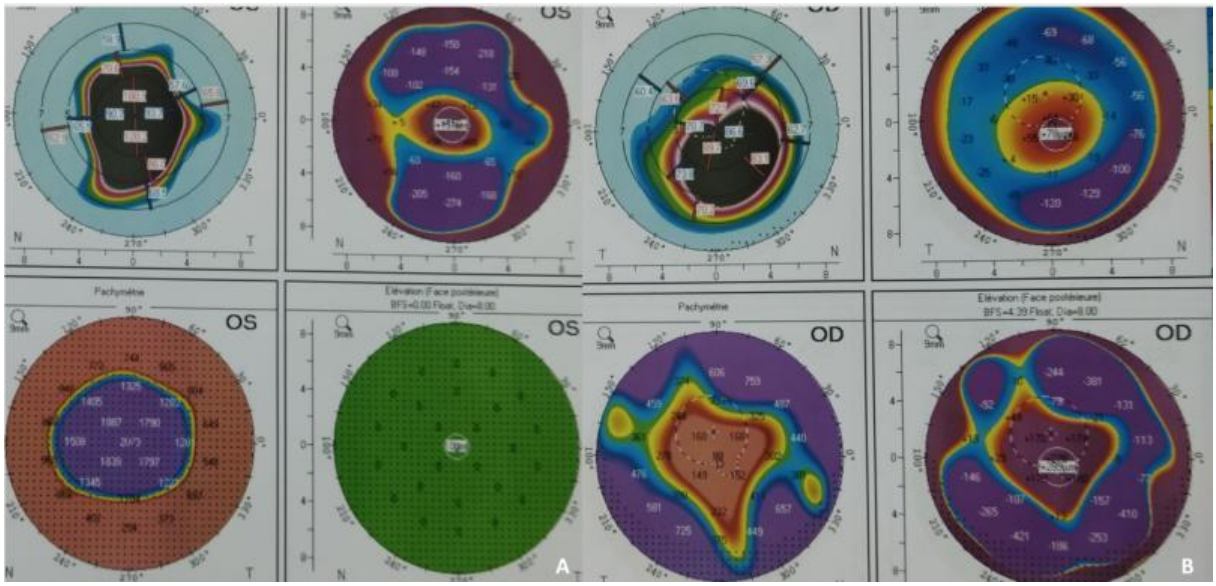

Fig. 6. Topography (pentacam) rendered uninterpretable by corneal opacities.
A: Right eye; B: Left eye

The most threatening complication of these cases of advanced and potentially aggressive keratoconus is the occurrence of hydrops. Hydrops is the development of stromal edema due to descmetic breach manifested by acute loss of visual acuity, photophobia and pain [17]. This is a complication observed in 3% of cases of keratoconus [18]. Different risk factors for corneal hydrops include early onset age, eye rubbing, vernal keratoconjunctivitis, atopy, and Down syndrome [19]. It is a condition that usually resolves without intervention within 2 to 4 months, during which time the patient's vision and comfort are therefore compromised. The longer duration of edema is also more likely to lead to complications such as neovascularization [20]. Treatment regimens for acute corneal hydrops can be divided into conservative, medical, and surgical options.

Medical or conservative treatment is based on the proposed topical, hypertonic saline solution, cycloplegics, topical corticosteroids and positioning in the supine position allows endothelial redistribution on the ruptured descemet. The known time frame for full resolution can take 5 to 36 weeks. This delay depends on the extent of the descemetic tear. However, treatment with subconjunctival injections of anti-VEGF or eye drops can be promising [19].

Pneumodescemetopexy reduces the duration of corneal edema and the risk of complications such as corneal neovascularization, which can compromise subsequent keratoplasty [21]. For more severe cases, compression sutures can be added to intracameral gas injection to improve healing [22]. Thermokeratoplasty is a technique used in the treatment of hydrops, it induces contraction of the central cornea and flatten the prominent cone, accelerates closure of descemet membrane ruptures and prevents further influx of aqueous humor through the membrane of descemet in the intrastroma and leads to rapid absorption of corneal edema, closure of the descemet membrane and scarring of the corneal stroma. Healing of the descemetic breach (noted from the second week) reduces the risk of perforation during DALK [23]. Amniotic membrane transplantation and TKP can also be used in certain situations [24]. Although beneficial, none of these procedures improve final visual acuity and many patients will ultimately require corneal transplantation for visual rehabilitation. PKP, DALK, DSAEK and DMEK have all been used successfully in different contexts of acute hydrops.

4. CONCLUSION

Keratoconus is a progressive and asymmetrical condition. Advances in imaging have enabled early diagnosis and facilitated treatment. However, unscheduled cases continue to be seen in consultation. Advances in imaging, in particular OCT of the anterior segment, have enabled a new classification (the Sandali classification) to better codify management. Effective management of acute corneal hydrops in keratoconus relies on recognition and management of risk factors, prompt and effective treatment of the acute event to reduce the duration of edema and its complications, and ultimately a successful corneal transplantation with acceptable long-term survival rates. Finally, keratoplasty remains the last resort in these advanced stages of keratoconus. Screening and early treatment is the only way for us to prevent an evolution towards complications

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Fournié P. Kératocône. Journal Français d'Ophtalmologie. 2013 ;36(7) :618-626.
2. Rabinowitz YS. Keratoconus. Surv Ophthalmol. 1998;42:297–319.
3. Millodot M, Ortenberg I, Lahav-Yacouel K, Behrman S. Effect of ageing on keratoconic corneas. J Optom. 2016;9(2): 72–77.
4. Maharana PK, Sharma N, Vajpayee RB. Acute corneal hydrops in keratoconus. Indian J Ophthalmol. 2013;61(8):461–464.
5. Kim SW, Sun HJ, Chang JH, Kim EK. Anterior segment measurements using

pentacam and orbscan II 1 to 5 years after refractive surgery. J Refract Surg. 2009;25: 1091–1097.
6. Kanellopoulos AJ, Asimellis G. OCT-derived comparison of corneal thickness distribution and asymmetry differences between normal and keratoconic eyes. Cornea. 2014;33:1274–1281.
7. Kanellopoulos AJ, Asimellis G. OCT corneal epithelial topographic asymmetry as a sensitive diagnostic tool for early and advancing keratoconus. Clin Ophthalmol. 2014;8:2277–2287.
8. Belin MW, Ambrósio R. Scheimpflug imaging for keratoconus and ectatic disease. Indian J Ophthalmol. 2013;61: 401–406.
9. Gomes JA, et al. Global consensus on keratoconus and ectatic diseases. Cornea. 2015;34(4):359–369.
10. Sandali O, El Sanharawi M, Temstet C, Hamiche T, Galan A, Ghouali W, Goemaere I, Basli E, Borderie V, Laroche L. Fourier-domain optical coherence tomography imaging in keratoconus: A corneal structural classification. Ophthalmology. 2013;120:2403–2412.
11. Giuseppe Giannaccare. Comparison of amsler–krumeich and sandali classifications for staging eyes with keratoconus. Appl. Sci. 2021;11:4007. Available:https://doi.org/10.3390/app11094007
12. Rashmi Deshmukh, Farhad Hafezi, George D Kymionis, Sabine Kling, Rupal Shah, Prema Padmanabhan, Mahipal S Sachdev. Current concepts in crosslinking thin cornea. Indian J Ophthalmol. 2019;67 (1):8–15.
13. Pramanik S, Musch DC, Sutphin JE, Farjo AA. Extended long-term outcomes of penetrating keratoplasty for keratoconus. Ophthalmology. 2006;113:1633–1638.
14. Sarnicola V, Toro P, Gentile D, Hannush SB. Descemetic DALK and predescemetic DALK: outcomes in 236 cases of keratoconus. Cornea. 2010;29:53–59.
15. Parker JS, van Dijk K, Melles GR. Treatment options for advanced keratoconus: A review. Surv Ophthalmol. 2015;60:459–480.
16. Lu Y, Grisolia AB, Ge YR, et al. Comparison of femtosecond laser-assisted descemetic and predescemetic lamellar keratoplasty for keratoconus. Indian J Ophthalmol. 2017;65(1):19–23.
17. Prafulla K Maharana, Namrata Sharma, Rasik B Vajpayee. Acute Corneal hydrops in keratoconus. Indian J Ophthalmol. 2013; 61(8):461–464.
18. Yahia Chérif H, et al. Br J Ophthalmol; 2015.
19. Sharma N, Maharana PK, Jhanji V, Vajpayee RB. Management of acute corneal hydrops in ectatic corneal disorders. Curr Opin Ophthalmol 2012;23: 317-23.
20. Jennifer C. Acute corneal hydrops in keratoconus – new perspectives. American Journal of Ophthalmology; 2014.
21. Lanthier A, Choulakian M. Treatment strategies for the management of acute hydrops JFO-3187; No. of Pages 6. 0181-5512/©; 2021.
22. Rajaraman R, Singh S, Raghavan A, Karkhanis A. Efficacy and safety of intracameral perfluoropropane (C3F8) tamponade and compression sutures for the management of acute corneal hydrops. Cornea. 2009;28:317—20.
23. Suxia Li, Mingna Liu, Qin Wang, Ting Wang, Weiyun Shi. Lamellar keratoplasty following thermokeratoplasty in the treatment of acute corneal hydrops. American Journal of Ophthalmology. 2014; 158(1):26-31.
24. Wylegala E, Tarnawska D. Amniotic membrane transplantation with cauterization for keratoconus complicated by persistent hydrops in mentally retarded patients. Ophthalmology 2006; 113:561-4.

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