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Role Of Ultrasound Biomicroscopy In The Evaluation Of Intumescent Cataracts: Morphological Analysis And Surgical Implications

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ABSTRACT

Background: Intumescent cataract is associated with lens swelling leading to anterior segment crowding and secondary angle closure. Clinical evaluation is often limited, making imaging essential.

Objective: To evaluate the role of ultrasound biomicroscopy (UBM) in the morphological assessment of intumescent cataracts and its contribution to surgical management.

Methods: A prospective analytical study including 25 eyes with intumescent cataract complicated by phacomorphic glaucoma. Clinical and UBM parameters were assessed preoperatively.

Results: Mean intraocular pressure was 41 mmHg. UBM revealed reduced anterior chamber depth (1.43 mm), increased lens vault (788 µm), and significant narrowing of angle parameters (AOD500: 0.22 mm; TIA500: 16°). A strong correlation was observed between lens vault and severity of angle closure.

Conclusion: UBM provides precise and objective assessment of anterior segment anatomy in intumescent cataracts, allowing better understanding of pathophysiology and optimization of surgical planning.

KEYWORDS

Ultrasound biomicroscopy; Intumescent cataract; Phacomorphic glaucoma; Lens vault; Angle closure; Anterior segment

INTRODUCTION

Intumescent cataract represents an advanced stage of lens opacification characterized by significant swelling of the crystalline lens due to osmotic imbalance. This results in anterior displacement of the iris-lens diaphragm, leading to a reduction in anterior chamber depth and progressive narrowing of the iridocorneal angle.

This anatomical configuration predisposes patients to acute phacomorphic glaucoma, a potentially sight-threatening condition requiring urgent surgical management. However, clinical evaluation is often limited by corneal edema and media opacity, reducing the reliability of conventional techniques such as gonioscopy.

Ultrasound Biomicroscopy (UBM) is a high-frequency ultrasound imaging modality that allows detailed visualization of anterior segment structures regardless of media transparency. It enables quantitative assessment of parameters such as anterior chamber depth (ACD), lens vault (LV), angle opening distance (AOD), and trabecular-iris angle (TIA).

The aim of this study is to evaluate the contribution of UBM in the morphological assessment of intumescent cataracts and its role in guiding surgical decision-making.

MATERIALS AND METHODS

Study Design

Prospective analytical study conducted at the Department of Ophthalmology B, CHU Ibn Sina, Rabat.

Study Population

A total of **25 eyes** presenting with intumescent cataract complicated by phacomorphic glaucoma were included.

Inclusion Criteria

- Intumescent cataract
- Elevated intraocular pressure
- Clinical signs of angle closure

Exclusion Criteria

- Previous ocular surgery
- Secondary glaucoma unrelated to lens pathology

Clinical Assessment

- Visual acuity
- Intraocular pressure (Goldmann tonometry)
- Axial length

UBM Assessment

Parameters measured:

- Anterior Chamber Depth (ACD)
- Lens Vault (LV)
- AOD500 and AOD750
- TIA500 and TIA750

Statistical Analysis

Descriptive statistical analysis was performed. Quantitative variables were expressed as mean ± standard deviation.

RESULTS

◆ Clinical Characteristics

Parameter	Value
Mean age	75 years
Female predominance	60%
Visual acuity	PL to HM
Mean IOP	41 mmHg
Axial length	21.36 mm

◆ Preoperative UBM Findings

Parameter	Mean ± SD	Normal Range
ACD (mm)	1.43 ± 0.3	2.5–3.5
Lens Vault (µm)	788 ± 120	~500
AOD500 (mm)	0.22 ± 0.05	0.25–0.40
AOD750 (mm)	0.28 ± 0.07	0.30–0.50
TIA500 (°)	16 ± 3	20–30
TIA750 (°)	19 ± 4	30–45

◆ Morphological Interpretation

UBM demonstrated:

- Marked anterior displacement of the crystalline lens
- Significant reduction in anterior chamber depth
- Diffuse angle narrowing with iridotrabecular contact
- Increased lens vault

◆ Correlation Analysis

Eyes with higher lens vault (>750 µm) showed:

- Lower AOD values
- Narrower TIA
- More severe angle closure

DISCUSSION

This study highlights the central role of UBM in understanding the anatomical mechanisms underlying intumescent cataracts.

◆ Lens Vault as a Major Determinant

The mean lens vault (788 µm) was significantly elevated compared to normal values. Previous studies by Nongpiur et al. and Tan et al. demonstrated that lens vault is a key predictor of angle closure, often more relevant than anterior chamber depth.

In our study, increased lens vault was strongly associated with reduced AOD and TIA, confirming its major role in angle crowding.

◆ AOD and TIA: Quantitative Indicators

The reduced AOD500 (0.22 mm) and TIA500 (16°) observed in our cohort indicate severe angle narrowing. These findings are consistent with studies by Pavlin et al., which established UBM-derived AOD as a reliable parameter for angle assessment.

AOD500 appeared more sensitive than AOD750 in detecting angle compromise, reflecting early trabecular obstruction.

◆ Anterior Chamber Depth

The mean ACD (1.43 mm) reflects significant anterior chamber shallowing. However, literature suggests that ACD alone is insufficient to fully characterize angle closure, reinforcing the importance of combined UBM parameters.

◆ Clinical Implications

UBM allows:

- Accurate diagnosis of phacomorphic mechanism
- Risk stratification
- Surgical planning optimization

It provides objective data where gonioscopy is limited, particularly in cases of corneal edema.

◆ Literature Positioning

Unlike most previous studies focusing on isolated parameters, this study integrates multiple UBM measurements, providing a comprehensive analysis of anterior segment changes in intumescent cataracts.

CONCLUSION

Ultrasound biomicroscopy is a highly valuable tool in the evaluation of intumescent cataracts. It provides precise, objective, and reproducible assessment of anterior segment anatomy, enabling better understanding of pathophysiology and improved surgical planning.

Its systematic use should be encouraged in advanced cataract cases associated with angle closure.

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