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Ultrasound biomicroscopy in anterior chamber angle dysgenesis: A prospective analytical study of 11 eyes

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Abstract

Purpose: To evaluate the role of ultrasound biomicroscopy (UBM) in the analysis of anterior chamber angle dysgenesis in patients with congenital glaucoma.

Methods: A prospective analytical study was conducted including 11 eyes with anterior segment dysgenesis. All patients underwent a complete ophthalmological examination and UBM evaluation using high-frequency probes (35–50 MHz). Morphological parameters of the anterior segment were analyzed.

Results: UBM enabled detailed visualization of anterior segment structures in all cases, revealing characteristic features of angle dysgenesis including anterior iris insertion, trabecular abnormalities, and ciliary body anomalies. UBM provided additional diagnostic information compared to clinical examination alone, particularly in cases with corneal opacity.

Conclusion: UBM is a valuable, non-invasive imaging modality for the assessment of anterior chamber angle dysgenesis. It plays a key role in understanding the anatomical mechanisms of congenital glaucoma and guiding therapeutic decision-making.

Keywords: Ultrasound biomicroscopy; Anterior chamber angle; Angle dysgenesis; Congenital glaucoma; Primary congenital glaucoma; Trabecular dysgenesis; Anterior segment imaging; UBM

1. Introduction

Ultrasound biomicroscopy (UBM), first introduced by Pavlin and colleagues in 1990, has revolutionized the exploration of the anterior segment by enabling high-resolution imaging of structures that are otherwise inaccessible to direct clinical examination [1, 2].

Using high-frequency ultrasound (35–100 MHz), UBM provides detailed visualization of the cornea, anterior chamber angle, iris, ciliary body, and lens, with a resolution reaching 25 µm [1, 2].

Congenital glaucoma is a severe and potentially blinding disease resulting from developmental anomalies of the anterior chamber angle, leading to impaired aqueous humor outflow [3, 4]. These anomalies are often difficult to assess clinically, especially in the presence of corneal edema or opacity.

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UBM has emerged as a key tool for:

- understanding the mechanisms of angle dysgenesis
- improving diagnostic accuracy
- guiding surgical management

The aim of this study was to evaluate the contribution of UBM in the analysis of anterior segment abnormalities in patients with congenital glaucoma.

2. Materials and methods

2.1. Study Design

Prospective analytical study.

2.2. Population

- 11 eyes presenting anterior chamber angle dysgenesis
- Patients managed at the Department of Ophthalmology B, CHU Ibn Sina, Rabat

2.3. Inclusion Criteria

- Congenital glaucoma or suspected angle dysgenesis
- Availability of UBM imaging

2.4. Examination Protocol

All patients underwent:

- Visual acuity assessment
- Slit-lamp examination
- Intraocular pressure measurement
- Fundus examination (when possible)

2.5. UBM Examination

UBM was performed using high-frequency probes (35–50 MHz), allowing detailed imaging of the anterior segment.

The following parameters were analyzed:

- Angle configuration
- Iris insertion
- Trabecular morphology
- Ciliary body structure
- Anterior chamber depth

3. Results

3.1. Clinical Characteristics

The study included 11 eyes with congenital glaucoma or anterior segment dysgenesis.

Common clinical findings included:

- Corneal enlargement (buphthalmos)
- Corneal edema
- Elevated intraocular pressure
- Optic nerve changes

3.2. UBM Findings

UBM provided detailed visualization in all cases, including those with opaque corneas.

Main abnormalities observed:

Table 1 UBM Findings in Angle Dysgenesis

Parameter	Findings
Iris insertion	Anterior insertion in majority of cases
Trabeculum	Thickened, poorly differentiated
Schlemm's canal	Narrow or absent
Ciliary body	Abnormal configuration
Angle opening	Reduced or closed

3.3. Diagnostic Contribution of UBM

UBM allowed:

- Visualization of structures not accessible clinically
- Differentiation between mechanisms of angle closure
- Better understanding of anatomical abnormalities

Especially useful in:

- Opaque cornea
- Pediatric patients
- Complex dysgenesis

4. Discussion

4.1. UBM as a Key Tool in Congenital Glaucoma

Congenital glaucoma results from abnormal development of the anterior chamber angle, primarily due to defective neural crest cell migration and abnormal differentiation of the aqueous outflow pathways [3–6].

UBM provides unique insight into these developmental abnormalities by allowing in vivo visualization of:

- Trabecular dysgenesis
- Abnormal iris insertion
- Ciliary body anomalies

4.2. Correlation with histopathology

Histological studies have shown:

- Thickened trabecular beams
- Reduced intertrabecular spaces
- Abnormal insertion of the iris

These findings correlate strongly with UBM observations, supporting its diagnostic reliability [4, 6, 7].

4.3. Role in Surgical Planning

UBM helps identify:

- Level of outflow obstruction

- Structural anomalies

This allows better selection of:

- Goniotomy
- Trabeculotomy
- Filtering surgery

4.4. Advantages of ubm

- Non-invasive
- High resolution
- Works despite corneal opacity
- Provides dynamic anatomical information

4.5. Limitations

- Operator-dependent
- Limited availability
- Requires patient cooperation

4.6. Clinical impact

Ubm is particularly useful in:

- Early diagnosis
- Atypical cases
- Preoperative evaluation

It significantly improves understanding of disease mechanisms and patient management.

5. Conclusion

UBM is an essential imaging modality in the evaluation of anterior chamber angle dysgenesis.

It allows:

- Precise anatomical analysis
- Improved diagnostic accuracy
- Optimized therapeutic strategies

Its use should be encouraged in all cases of suspected congenital glaucoma.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there is no conflict of interest.

Statement of ethical approval

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

Statement of informed consent

Informed consent was obtained from the patients' parents or legal guardians for the examinations and for the use of anonymized clinical data for scientific publication.

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