

## Study of Diabetic Eye Disease Using Ocular B-Mode Ultrasonography

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### Abstract

### Original Research Article

Ultrasonography (US) of the eye is a useful tool in diagnosing conditions of the ocular globe it is characterized by availability, ease, and cheapness. This study aims to study the diabetic eye disease using ocular B-mode ultrasonography. A total of 300 (141 females and 159 males) Sudanese patients with long-duration diabetes mellitus were investigated in the period spanning from 2016 to 2019. Nidek (Echoscan US – 4000) ultrasonic unit with a high-frequency transducer 10 MHz was used to examine patients with clinically suspected eye abnormalities at Makkah Eye Complex, Khartoum, Sudan. A Chi-square test was used to assess the relationship between qualitative variables. In 91% of patients with type II the prevalence of significant types of sonographic findings in diabetic eye disease was as follows, males were more affected  $p$ -value (0.01). A Correlation is done between duration of disease and final diagnose, it was found that there was no significant relationship between them  $p$ -value (0.452). There was no significant correlation between type 2 and ultrasound findings  $p$ -value (0.204), there was a relationship between patient history and final diagnose  $p$ -value (0.000), Comparing between controlled and non-controlled DM, there was no significant correlation  $p$ -value (0.224), and (77.3%) of patients are treated with insulin. The study concluded that the ocular B-mode ultrasonography is an effective method of diagnosing diabetic eye diseases by detecting a wide range of diabetic eye disorders.

**Keywords:** Diabetes Mellitus, Eye Disease, Ocular B-mode Ultrasonography.

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## INTRODUCTION

The ocular US has long been the province of ophthalmologists, often using dedicated equipment [1]. However, radiologists are becoming increasingly involved, using general (multipurpose) ultrasound equipment with high-frequency small-parts probes. The cornea, anterior chamber, iris, posterior chamber, and lens rarely require US, because they can be properly evaluated by clinical inspection, ophthalmoscopy, slit-lamp examination, and US biomicroscopy using frequencies up to 50 MHz [2, 3]. The globe lies in the anterior region of the orbit. It is surrounded by fat but separated from it by a membranous sac, the capsule of Tenon. Its attachments include the corneoscleral junction anteriorly and the optic nerve posteriorly.

Tenon's capsule is pierced by the tendons of the extraocular muscle [4, 5]. Nevertheless, any condition that causes opacification of the light-conducting media may obscure visualization of the

posterior segment of the globe at clinical examination, thus requiring the B-mode US to rule out retinal, vitreous, and choroidal detachments, tumors, and other pathologic conditions that affect the posterior segment of the eye.

The US can also provide useful additional information about disease detected in the ophthalmoscope examination. It is the quickest and simplest method of imaging the eye; it is widely available, provides high-resolution images, and enables dynamic study. With appropriate training, qualified professionals can perform the ocular US using a systematic study protocol. Although computed tomography (CT) and magnetic resonance imaging (MRI) is very useful in many ocular and orbital conditions, they cannot scan in real-time, have a poorer spatial resolution, and have a limited role in the evaluation of the vitreous, retina and choroid.

An accurate visual representation of the anatomy and sometimes of the functional state of the patient has been a goal of clinicians for several decades in many medical fields, although this aspect is often still neglected in diabetic patients. Nevertheless, the rapid rise in the prevalence of diabetes to 382 million individuals worldwide during the last 20 years and the expected rise to 592 million by 2030[6] has global implications and requires paradigm-shifting approaches to diagnosis, treatment monitoring, and prevention. Over the long term, hyperglycemic conditions can lead to serious diseases affecting the cardiovascular system, eyes, kidneys, nerves, and teeth [7-11] Also, people with diabetes. Also have a higher risk of developing infections, cognitive impairment and dementia [12, 13], and lower-limb amputations [14]. This study aims to study the diabetic eye disease using ocular B-mode ultrasonography.

## MATERIALS AND METHODS

A descriptive, analytical study, the study took place in Sudan-Khartoum in the ultrasound department of Makkah eye complex, during the period from 2016 to 2019, this study included 300 Sudanese patients with long-duration diabetes mellitus more than 10 years, they have attended the ultrasound department for the ultrasound investigation. All examinations were done by using a Nidek (Echoscan US – 4000) ultrasonic unit, equipped with a high-frequency direct contact 10 MHZ transducer, display on the 110×20 cm graphics sony thermal printer. Initial examinations were done under high gain (80 dB to 100 dB) and low gain (60 dB to 70 dB) sensitivity.

## Technique and study protocol

Ultrasound evaluations of the eye and orbit were performed in the supine or sitting position. The probe was placed directly over the conjunctiva or cornea or placed over closed lids. The former has the advantage of reducing the sound attenuation caused by the lids; however, it requires sterilization of the probe between procedures. A coupling solution was used to provide standoff and avoid attenuation caused by air.

## STATISTICAL ANALYSIS

All measurable data were initially summarized in a comparison table. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 16 for windows (IBM Corporation, Armonk, NY, USA) and Microsoft Excell 2007, the result was presented in the form of graphs and tables.

## RESULTS

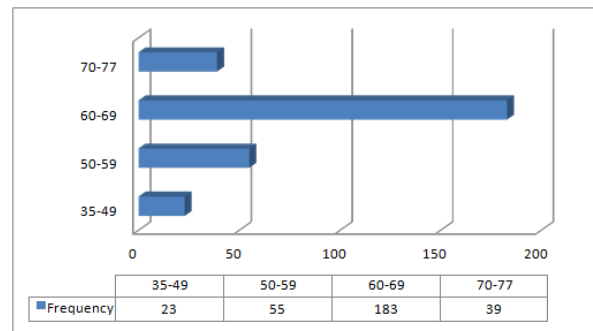


Fig-1: Frequency distribution of age \years

Table-1: Frequency distribution of residence

Residence	Frequency	Percent	Valid Percent	Cumulative Percent
Center	208	69.3	69.3	69.3
East	56	18.7	18.7	88.0
West	15	5.0	5.0	93.0
North	21	7.0	7.0	100.0
Total	300	100.0	100.0	

Table-2: Frequency distribution of duration of DM

Duration \years	Frequency	Percent	Valid Percent	Cumulative Percent
10-19	209	69.7	69.7	69.7
20-29	86	28.7	28.7	98.3
30-35	5	1.7	1.7	100.0
Total	300	100.0	100.0	
Minimum =10, maximum =35, means =15.96±4.90				

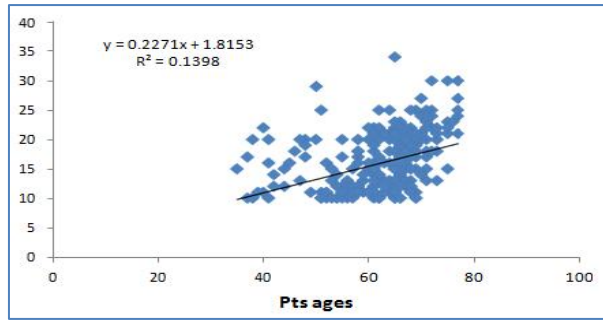


Fig-2: Correlation between duration and patients age

Table-3: Frequency distribution of type of DM

Type of DM	Frequency	Percent	Valid Percent	Cumulative Percent
1	27	9.0	9.0	9.0
2	273	91.0	91.0	100.0
Total	300	100.0	100.0	

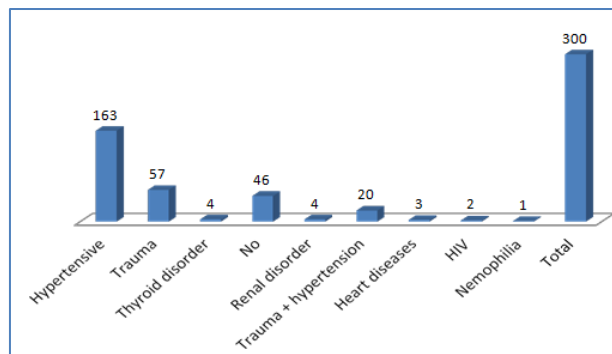


Fig-4: Frequency distribution of clinical history of the patients

Table-4: Frequency distribution of Pathologic US findings

Ultrasound findings	Frequency	Percent	Valid Percent	Cumulative Percent
Hyper-mature cataract	36	12.0	12.0	12.0
Vitreous changes	32	10.7	10.7	22.7
Normal	21	7.0	7.0	29.7
Retinal Detachment	64	21.3	21.3	51.0
Retinal detachment+ Vitreous Hemorrhage	24	8.0	8.0	59.0
Mature cataract	21	7.0	7.0	66.0
Vitreous Detachment	27	9.0	9.0	75.0
Cataract	1	.3	.3	75.3
Vitreous Hemorrhage	38	12.7	12.7	88.0
Retinal cyst	1	.3	.3	88.3
optic nerve changes	3	1.0	1.0	89.3
RD+ vitreous changes	3	1.0	1.0	90.3
Hyper-mature cataract + vitreous changes	3	1.0	1.0	91.3
Retinal changes	1	.3	.3	91.7
High myopia+ hyper-mature cataract	1	.3	.3	92.0
Vitreous detachment +vitreous changes	5	1.7	1.7	93.7
Retinal detachment + mature cataract	8	2.7	2.7	96.3
vitreous changes + axial length defect	1	.3	.3	96.7
axial length defect	2	.7	.7	97.3
lens disorder	2	.7	.7	98.0
high myopia	1	.3	.3	98.3
Hyper-mature cataract + VH	2	.7	.7	99.0
vitreous changes+ vitreous hemorrhage	1	.3	.3	99.3
Hyper-mature cataract + posterior vitreous detachment	1	.3	.3	99.7
high myopia + vitreous changes	1	.3	.3	100.0
Total	300	100.0	100.0	

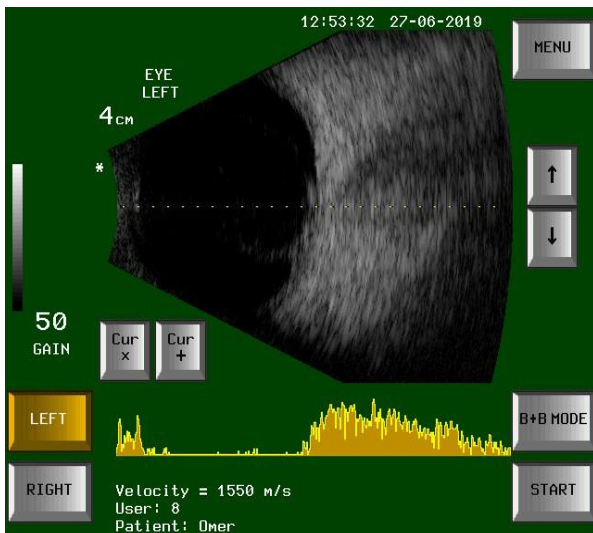


Fig-5: B scan images transverse scanning Patient 67-year-old male shows retinal detachment

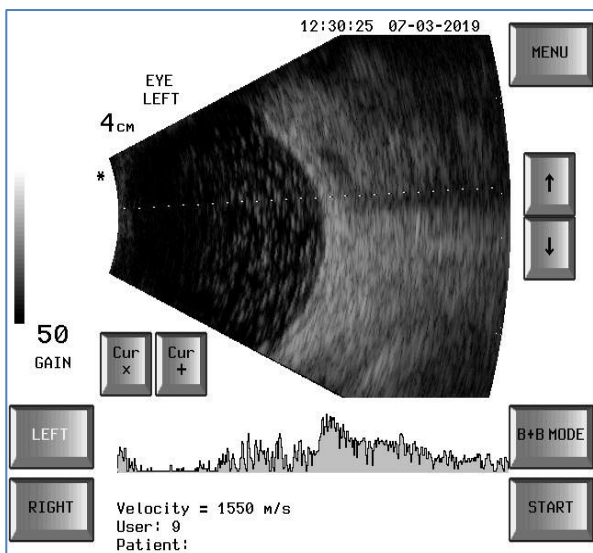


Fig-6: B scan images transverse scanning Patient 65-year-old male shows vitreous hemorrhage

## DISCUSSION

In recent years there have been major advances in ocular imaging particularly in the field of ocular coherence tomography (OCT) and in the last few years we have seen developments such as Angio OCT and steady-state OCT, and there are many advances in wavefront imaging particularly of the anterior segment. However, there remains an imaging modality that has been steadily developing and often forgotten, but it does not rely on optical technology. Ultrasound imaging utilizes technology that can image any part of the eye under any circumstances.

The current study is descriptive-analytical study included 300 diabetic patients complain of eye problems their age ranged between (35-77) years old, they were divided to four groups, the most affected group was the (60-69) year's Figure (1), this was agreed with a study done by (Osman 2017), According to the

gender, the current study found that the male was more affected 159 (53%) than female 141(47%) this result agrees with the study conducted by Christopher R Forrest [15]. The study showed that the most affected patients were lived in a center table (1). This consigned with a study done by Osman [17]. According to the duration of the disease, the study reported that the groups (10-19) years 209 (69.7%), (20-29) years 86 (28.7%) table (2). and (30-35) years were the most affected patients respectively this result agrees with the previous study which was done by Osman [17]. The study found that most of the patients had diabetic type II (91%) Table (3), this result agrees with the study done by Mohamed [16]. According to the history of the patients, a study revealed that most of the patients with diabetes and hypertension (163 patients 54.3%), patients with diabetes and trauma represented 57patients (19%), patients with trauma and hypertension (20%), figure (4) this result agree with done by Osman [17]. The study found that the right eye 155 (51.7%) was more affected than left 145 (48.3%) this result agrees with a study conducted by Abdellateef [18]. The study found a highly incidence of eye problems in ultrasound was retinal detachment 64 (21.3 %) figure (4), followed by vitreous hemorrhage 38 (12.7%) figure(5), hyper mature cataract 36 (12%), vitreous change 32 (10.7%), vitreous detachment 27 (9%), retinal detachment + vitreous hemorrhage 24 (8%), mature cataract 21 (7%), retinal detachment + mature cataract 8 ( 2.7 % ), vitreous detachment + vitreous change 5 ( 1.7% ) table (4), this agree with finding of the study done by Mohaned *et al.* [19].

B-mode biometry has a learning curve, but once mastered it can be used for axial length measurement in every clinical situation, with proof of reliability, in particular when optical biometry is not available. The other advantage of B-mode biometry is that it provides an anatomical overview of the posterior segment of the eye, enabling assessment of the vitreoretinal interface, anatomical analysis of the macular region and visualization of peripheral lesions, which can be hidden by dense cataracts during slit-lamp examination.

## CONCLUSION

The study concluded that ocular B-mode ultrasonography is an effective method of diagnosing diabetic eye diseases by detecting a wide range of diabetic eye disorders.

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