

## Prevalence of Vitreous & Retinal Disorders among Sudanese Diabetic Patients: A B-Scan Ultrasonography Study

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### ABSTRACT

Retina and vitreous abnormalities represent the most common eye disorders in diabetic patients; they may be associated with severe complications. Therefore, this study aimed to study the prevalence of vitreous and retinal pathologies in diabetic patients using B-Scan ultrasound (U/S). A total of two hundred and three Sudanese diabetic patients with long diabetic disease duration (mean  $16.28 \pm 4.830$ ) years were enrolled in a descriptive-analytical study. 55% (n = 112) were males and 45% (n = 91) were females. The mean age of the participants was  $62.28 \pm 8.041$  (range between 30-79 years -old).

The study was conducted in a Sudanese ophthalmologic hospital in Khartoum, during the period from 2016–2019. A Nidek (Echoscan US–4000) - B-scan ultrasound unit with 10 MHZ transducer was used. A high-frequency direct contact technique was applied. The inclusion criteria included adult diabetic patients. The vitreous and retina disorders were more prevalent in diabetic hypertensive participants 55 % (n = 112). The high frequency of the disorders was observed in age groups: 60–69 and 50–59 years-old. The most common disorder was

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retinal detachment which was detected in 30.5% (n = 62) followed by vitreous changes in 16.3% (n = 33). Posterior vitreous was observed in 15.8% (n = 32), vitreous hemorrhage seen in 15.3% (n = 31), both retinal detachment with vitreous hemorrhage were detected in 11.3% (n = 23), retinal detachment with cataract were reported in 3.4% (n = 7), retinal detachment with Vitreous changes were seen in 3% (n = 6), and other changes were noted in 4.4% (n = 9) of the participants. There is no significant a statistical association between gender/diabetic duration and age with the disorders (P = 0.2, 0.43, and 0.5) respectively. Vitreous & Retinal disorders were more prevalent in diabetic hypertensive patients. The high frequency of the disorders was observed in the age group (50–70). The ultrasound is a useful method in diagnosing Vitreous & Retinal disorders among the diabetics.

*Keywords:* B-scan, diabetes, retina, ultrasonography, vitreous

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## INTRODUCTION

Retina and vitreous abnormalities represent the most common eye disorders in diabetic patients; they may be associated with severe complications. Diabetic eye disease and its complications are a leading cause of blindness and visual dysfunction in adults (Moss et al., 1988). The eye is a fluid-filled structure located in the anterior part of the orbit and embedded in the fat, and the tendon's capsule separates it from the orbital wall. The anterior segment forms 1/6th of the eyeball and the posterior segment forms 5/6th of the eyeball. The normal axial length of the eye is 22 mm (Srivastava, 2007). The vitreous body is bounded anteriorly by the lens zonular fibers and posterior lens capsule, anterolaterally by the non-pigmented epithelium of the ciliary body, and posterolaterally by the internal limiting membrane of the retina. The retroental space of Erggelet and the canal of Petit are potential spaces (Phillpotts, 2018). Diabetes mellitus (DM) is a chronic metabolic disorder characterized by increasing blood glucose over a long period.

There are three main diabetes types; Type 1 diabetes once known as juvenile diabetes or insulin-dependent diabetes, Type 1 diabetes occurs when the body fails to produce insulin, Type 2 diabetes is the most common type of diabetes, in which the body cells do not respond to the effect of insulin, this type of DM has a direct relation with obesity. The third is Gestational Diabetes Mellitus (GDM), which happens during the pregnancy when the body can become less sensitive to insulin. GDM generally does not continue after delivery and it does not occur for all women (Falck, 2020).

Ocular abnormalities represent approximately 2% to 3% of all visits to the emergency department (ED) (Tintinalli et al., 2020). These abnormalities can result in permanent vision loss or can be simple. The common eye disorders and diseases that are diagnosed in the ED are vitreous hemorrhage (VH), vitreous detachment (VD), and retinal detachment

(RD). RD is considered to be a true ophthalmologic emergency that requires immediate diagnosis and treatment (Haimann et al., 1982).

Patients with RD may have sudden, painless, monocular vision loss as well as flashes and floaters in the visual field. Similar to VH, and VD, symptoms. Distinguishing these conditions is clinically important for patients' management.

Patients with ophthalmologic abnormality undergo all of these examinations, including ophthalmoscopy, slit-lamp, tonometry, and visual acuity (Hollands et al., 2009). However, the criterion standard for ocular disease diagnosis establishment, such as RD is an ophthalmologic evaluation that includes several procedures such as ultrasound, optical coherence tomography, and dilated ophthalmoscopy (Corbett, 2003; Restori, 2008). These procedures are conducted to visualize the layers of the retina by scanning the posterior chamber of the eye.

Ultrasound has been used by ophthalmologists to evaluate ocular abnormality but has been used commonly by emergency medicine practitioners (Lizzi & Coleman, 2004). Many studies recommended that the physicians could use ocular point-of-care ultrasonography (POCUS) to identify RD in the ED (Baker et al., 2018; Blaivas et al., 2002; Shinar et al., 2011; Yoonessi et al., 2010). Ocular U/S is a modality that can be used to diagnose and identify ocular diseases (Jacobsen et al., 2016). Ultrasound is suitable because it is less expensive, simpler, and safer than other diagnostic imaging modalities. Utilization of ultrasound for ocular disorders evaluation is preferable not only due to eye location but also its fluid-filled structure. The emergency medicine practitioners confirm that ocular anomalies can be identified by using POCUS (Moore et al., 2004). In addition, permanent blindness can be avoided by the early diagnosis and treatment of ocular disorders processes, B-scan ultrasound can help in early detection of ocular diseases.

This study aimed to study the prevalence and types of the vitreous and retina pathologies detected by ultrasound examination in diabetic patients. Also, to compare the U/S findings with study gender and/or age groups.

## **MATERIALS AND METHODS**

A descriptive-analytical study, the study took place in a Sudanese ophthalmologic hospital - in Khartoum, during the period from 2016 –2019.203 Sudanese diabetic patients were included. The inclusion criteria were included; all diabetic patients with a long duration of the disease (more than 10 years). The children and adults with the short duration of the disease were excluded. A Nidek (Echoscan US – 4000) B- Scan ultrasound machine with a frequency 10 MHZ transducer was used. A direct contact technique was applied. Initial examinations were done utilizing high gain ranged from 80 dB to 100 dB and low gain ranged from 60 dB to 70 dB.

## **Ultrasound Examination 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 gel was used to provide standoff and avoid attenuation caused by air.

## **Ethics Consideration**

This study was done after receiving the ethical approval from the local ethics committee of the medical radiological sciences college, Sudan University of Science and Technology, Khartoum, Sudan, and informed consent was also taken from the participants.

## **Statistical Analysis**

The data collected during the study were stored in a compact disk in a personal computer. The statistical software SPSS Inc. Version 16.0. Chicago, USA, was utilized to interpret the data. Data were presented as percentages and frequency. A chi-square test was used to evaluate the association between age and gender with sonographic findings of the posterior segment of the eye. The statistical association considered significant when  $P < 0.05$ .

## **RESULTS**

The study included 203 patients with Diabetic Mellitus (DM). A hundred and twelve of the participants (55%) were male and 45% ( $n = 91$ ) were females. The mean age of the participants was  $62.28 \pm 8.041$  (ranging between 30-79 years -old). Table 1 summarizes the common U/S findings; the most common disorders was retinal detachment which was detected in 30.5% ( $n = 62$ ) followed by vitreous changes in 16.3% ( $n = 33$ ), posterior vitreous detachment seen in 15.8% ( $n = 32$ ), vitreous hemorrhage was seen in 15.3% ( $n = 31$ ), retinal detachment with vitreous hemorrhage were detected in 11.3% ( $n = 23$ ), retinal detachment with cataract were reported in 3.4% ( $n = 7$ ), retinal detachment with Vitreous changes were seen in 3% ( $n = 6$ ), and other changes were noted in 4.4% ( $n = 9$ ) of the participants. The detail of other changes includes (other pathology including hyper mature cataract with vitreous change (5 patients), posterior vitreous detachment with vitreous change (1 patient), retinal cyst (1 patient), vitreous change with axial length defect (1 patient) and high myopia with vitreous change (1 patient).

A cross-tabulation represented in Table 2 presents the associated clinical history of the participants with the U/S findings revealed that the vitreous and retina disorders were more prevalent in diabetic hypertensive participants 55 % (out of 203). Table 3 shows a

cross-tabulation of the U/S findings with the gender of participants, the high frequencies of vitreous and retina disorders were noted in the male gender. No significant statistical association was observed between gender and disorders ( $P = 0.2$ ). Table 4 summarizes a cross-tabulation between age groups and ultrasound findings, the high frequency of the disorders was observed in age groups 60–69, and 18.7 % of the retinal detachments were noted in this age group. Statistical analysis revealed, no significant statistical association between the participants' age and the disorders ( $P = 0.5$ ) Table 5 and 6 demonstrate a cross-tabulation between duration of DM and the U/S findings, regarding Pearson Chi-Square test there is no significant association between sonographic findings and DM duration ( $P = 0.4$ ).

The associated clinical history of the participants besides diabetes shown in Figure 1 which presents 55% of them were diabetic hypertensive. Figure 2 to 5 shows sample images of the B-scan U/S findings, a retinal detachment seen in Figure 2, a posterior vitreous detachment observed in Figure 3, a retinal detachment associated with vitreous hemorrhage noted in Figure 4, and vitreous changes presented in Figure 5.

Table 1

*Frequency of ultrasound findings of the study*

U/S findings	(n)	(%)
Retinal Detachment	62	30.5
Vitreous Changes	33	16.3
Vitreous Hemorrhage	31	15.3
Vitreous changes & Retinal detachment	6	3.0
Posterior Vitreous Detachment	32	15.8
Retinal Detachment & Vitreous Hemorrhage	23	11.3
Retinal Detachment & Cataract	7	3.4
Others	9	4.4
Total	203	100.0

Table 2  
Associated clinical history of the participants \*ultrasound findings cross-tabulation

Clinical Disorders	Ultrasound findings							Total	
	Retinal Detachment	Vitreous Changes	Vitreous Hemorrhage	Retinal detachment & Vitreous changes	Posterior Vitreous Detachment	Vitreous Hemorrhage & Retinal Detachment	Retinal Detachment & Cataract		Other
No	8	3	1	3	3	1	0	1	20
Hypertension (HTN)	46	19	5	1	21	8	7	5	112
Trauma	3	8	20	1	4	6	0	1	43
HTN+ Trauma	0	2	3	1	0	8	0	1	15
Thyroid disease	2	0	0	0	1	0	0	0	3
Heart Disease	2	0	0	0	1	0	0	0	3
Renal Disease	0	1	0	0	2	0	0	1	4
Others	1	0	2	0	0	0	0	0	3
Total	62	33	31	6	32	23	7	9	203

Table 3  
Study gender \* ultrasound findings cross-tabulation

Gender	Ultrasound Findings							Total
	Retinal Detachment	Vitreous Changes	Vitreous Hemorrhage	Retinal detachment & Vitreous changes	Posterior Vitreous Detachment	Retinal Detachment & Vitreous Hemorrhage	Retinal Detachment & Cataract	
Male	32	18	14	1	20	17	4	112
Female	30	15	17	5	12	6	3	91
Total	62	33	31	6	32	23	7	203

Table 4  
Age groups \* ultrasound findings cross-tabulation

Age Groups (years)	Ultrasound Findings							Total
	Retinal Detachment	Vitreous Changes	Vitreous Hemorrhage	Retinal detachment & Vitreous changes	Posterior Vitreous Detachment	Retinal Detachment & Vitreous Hemorrhage	Retinal Detachment & Cataract	
30-39	0	2	1	1	0	0	0	4
40-49	5	2	2	0	3	0	0	12
50-59	10	5	8	0	5	3	1	36
60-69	38	19	17	5	20	16	5	123
70-79	9	5	3	0	4	4	1	28
Total	62	33	31	6	32	23	7	203

Table 5  
*Duration of DM \* Ultrasound Findings Cross - tabulation*

Duration of the DM (years)	Ultrasound Findings							Total	
	Retinal Detachment	Vitreous Changes	Vitreous Hemorrhage	Retinal detachment + Vitreous changes	Posterior Vitreous Detachment	Retinal Detachment + Vitreous Hemorrhage	Retinal Detachment + Cataract		Others
10-14	27	11	12	6	17	7	3	4	87
15-19	12	10	10	0	6	6	0	1	45
20-24	20	12	7	0	7	7	4	4	61
25-29	1	0	2	0	2	2	0	0	7
30-34	2	0	0	0	0	1	0	0	3
Total	62	33	31	6	32	23	7	9	203



Table 6

*Chi-Square Test for the association of the diabetic duration with the ultrasound Findings.*

	Chi-Square Tests		
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	34.762 <sup>a</sup>	34	.431
Likelihood Ratio	44.397	34	.109
N of Valid Cases	203		

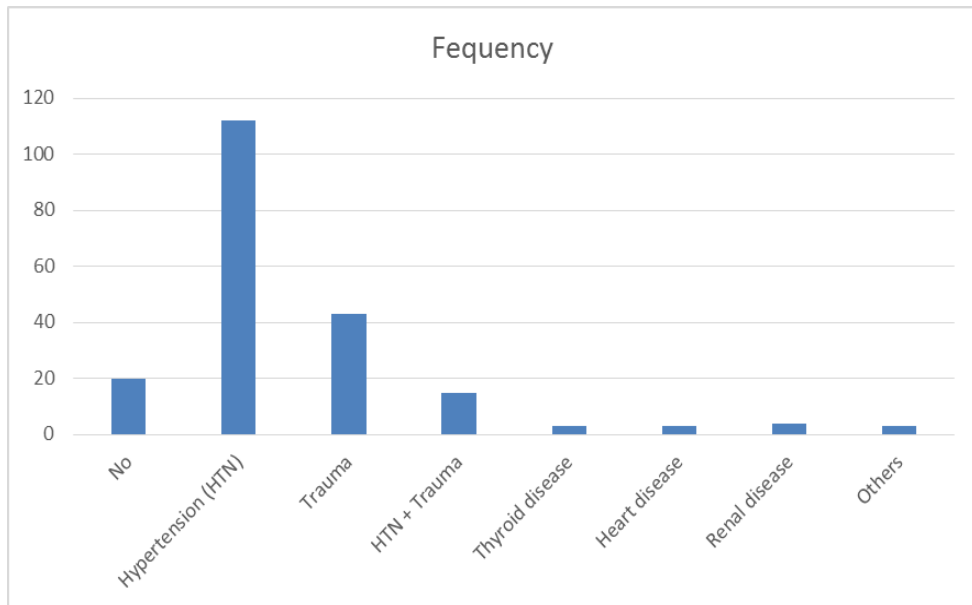


Figure 1. Clinical history of the participants

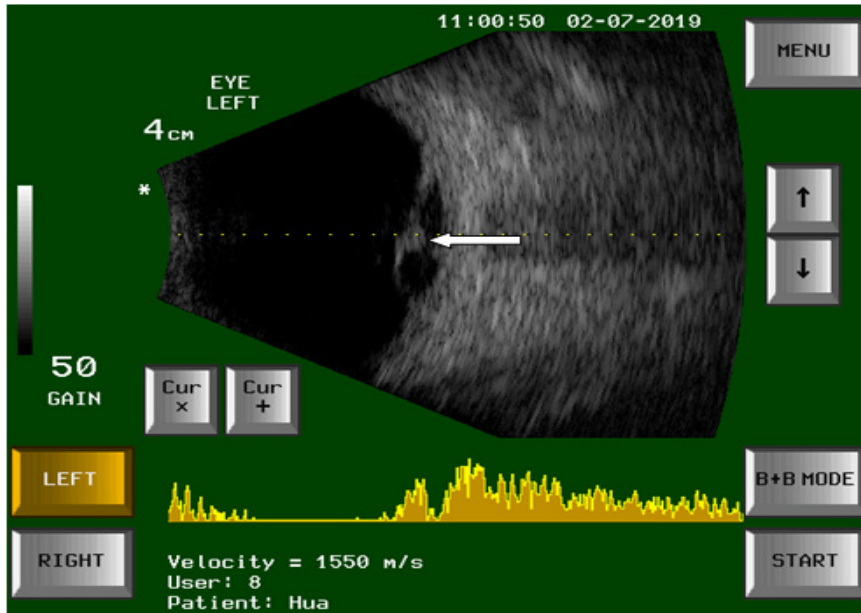


Figure 2. A transverse view of B-scan image showing a retinal detachment in 65 years- old female

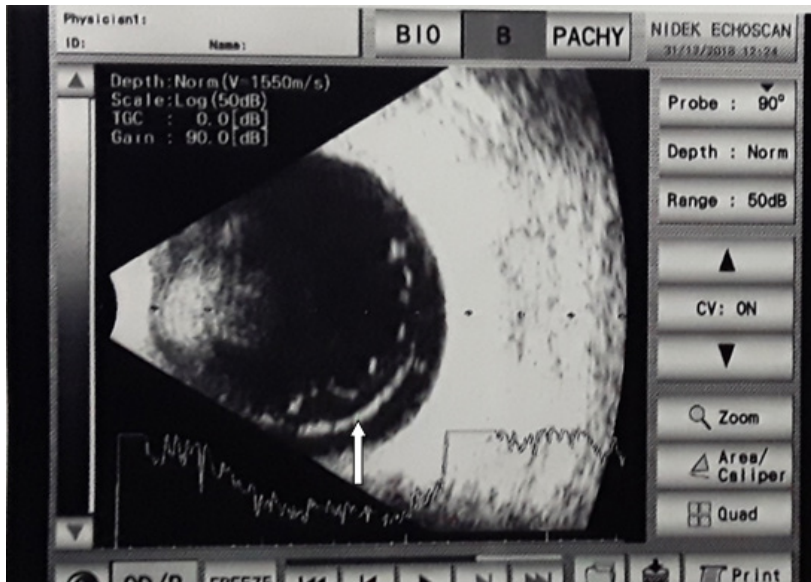


Figure 3. A transverse B-scan image for 61 years- old female showing a posterior vitreous detachment



Figure 4. A transverse B-Scan image for 59 years- old female showing a retinal detachment (white arrows) + vitreous hemorrhage (black arrows).

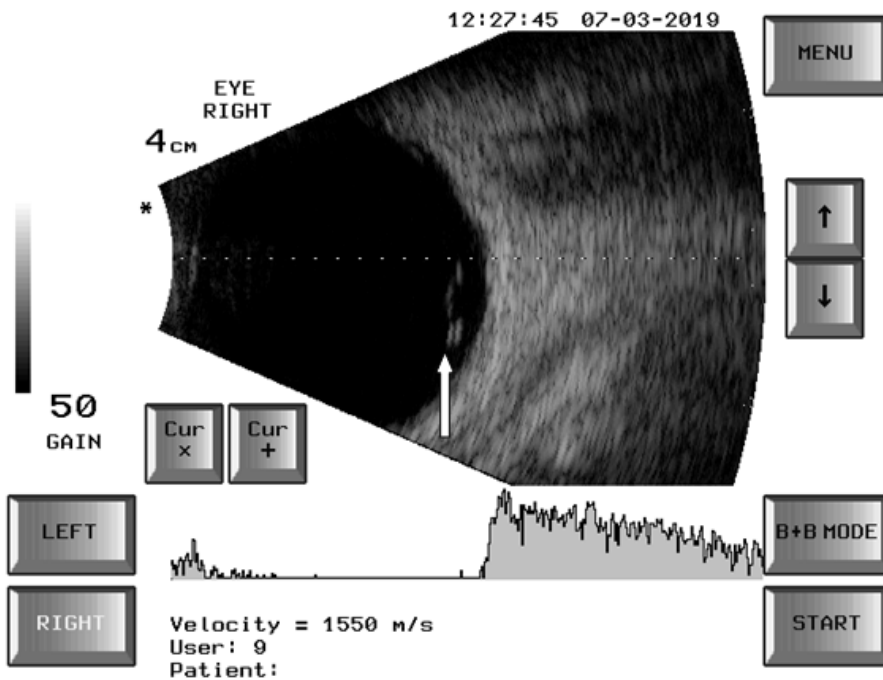


Figure 5. A transverse B-Scan image for 59 years- old female showing floaters (vitreous changes).

## DISCUSSION

Ophthalmic ultrasound (U/S) has become an indispensable diagnostic modality that has increased the chance of detecting and differentiating many orbital and ocular disorders. According to our aim, this study was created to study the prevalence of vitreous and retina disorders among diabetic patients using B-Scan ultrasonography. Regarding the age, the study by Moss et al. (1988) revealed that the most affected age groups were 60–69 years (n = 123) and 50–59 years-old (n = 36). The result agrees with the study done by Nanda et al. (2017). In a study by Qureshi and Laghari (2010), maximum number of patients was also present in the age group of 60-69 years.

The study showed that the most common disorders of vitreous and retina were retinal detachment which was detected in 30.5% (n = 62) followed by vitreous changes in 16.3% (n = 33). Posterior vitreous detachment was observed in 15.8% (n = 32), vitreous hemorrhage was seen in 15.3% (n = 31) (Table 1). Dawood et al. (2008) have proposed that ultrasound examination has greatly advanced and this has enabled us to study the orbits even in the presence of opaque media. Rabinowitz et al. (2004) indicated that the most common causes of vitreous hemorrhage continue to be proliferative diabetic retinopathy and ocular trauma. These two causes account for 35% and 33% of all vitreous hemorrhage.

Retinal detachment (including patients of RD combined with vitreous disorders) was seen in 30 (15%) cases. Sharma (2005) concluded that the common finding was retinal detachment 21.31 % (out of 122). Javed et al. (2007) reported that out of 463 patients, the patients of retinal detachment were 68 (14.70%). According to the patient history, the study highlighted that the patient with a history of hypertension was more affected (55.2 %, n=112) (Table 2). These results agree with Jitendrakumar and Ram (2018) who had reported on the main risk factor for other retinal disorders such as occlusion of a retinal artery or vein and diabetic retinopathy. Besides, diabetes with hypertension combined extremely increases the risk of vision loss.

The current study found that the male was more affected than the female, the frequency in males was 112, and in females were 91 (Table 3). The findings agree with studies done by Nanda et al. (2017) and Jitendrakumar and Ram (2018).

Qureshi and Laghari (2010) showed that the high frequency of vitreous & retinal disorders was found in the age group of 60-69 years old. These results support the present study, which showed that 74.4% of the detected vitreous and retinal disorders were observed in the age group  $\geq 60$  years- old (Table 4). This agrees with the finding of the study done by Jitendrakumar and Ram (2018).

The main limitation is this study was conducted in a single center, another comparative study is needed. The study was performed by more than one sonographer. The study sample size is not large enough to generalize the results.

## CONCLUSION

B-scan ultrasonography can be widely utilized in evaluating the prevalence of vitreoretinal diseases. It is a reliable, safe, cheap, rapid investigation, and a feasible option. Vitreous and retinal disorders were more prevalent in diabetic hypertensive participants 55%. The high frequencies of the disorders were observed in age groups 60–69 and 50–59 years-old. Further studies were recommended.

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