Sudan University of Science and Technology

College of Graduate Studies

A Study of Eyes Diseases in Diabetic Patients using Ultrasonography

دراسة أمراض العيون في مرضى السكري باستخدام الموجات فوق الصوتية

A Thesis submitted for the Award of PhD in Medical diagnostic Ultrasound

By:

Safaa Alameen Hassan Bashir

Supervisor

Dr. Mohamed Mohamed Omer Mohamed Yousef

Associate Professor

Co- Supervisor Dr. Mona Ahmed Mohamed

Associate Professor

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بسم الله الرحمن الرحيم

الايـــــة

قـــال الله تعالى:

(أَفَلَمْ يَسِيرُوا فِي الأَرْضِ فَتَكُونَ لَهُمْ قُلُوبٌ يَعْقِلُونَ بِهَا أَوْ آذَانٌ يَسْمَعُونَ بِهَا فَإِنَّهَا لا تَعْمَى الأَبْصَارُ وَلَكِن تَعْمَى الْقُلُوبُ الَّتِي فِي الصُّدُورِ)

صدق الله العظيم

{ الحج 46 }

Dedication

I dedicate this work to my father who encourages me to joint PhD of ultrasound.

For his patience, encouragement

And continues support

To my lovely mother

To my sisters

Who helped me a lot

To my best friends who always support and helped me all the time.

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Abstract

Ultrasound has become an increasingly important role in the diagnosis and early detection of most widespread diseases. It is characterized by availability, ease and cheapness. The study evaluated diabetic eyes using ultrasound. Diabetes is a very common disease in the world population. It not only causes fatigue but also affects the economy of countries.

The aim of the present study is to study the role of B-scan. Ultrasonography in the eye for diabetic patients. A descriptive analytical study was conducted between June 2016 to June 2019 on 300 patients (141Female and 159 Male) their age range between 35-77, years old presenting to Makkah Ophthalmology Hospital in Khartoum. B-scan Ultrasound (with A-scan overlay) was performed with a 10 Mhz probe.

The current study revealed that the most affected age group was (60-69), (50-59) years (61%) & (18.3%) respectively then (70-77) (13%) the last group is the (35-49) which was (7.7%), most of them from Khartoum,.According to the duration of disease groups (10-19) years 209 (69.7%), (20-29) years 86 (28.7%) and (30-35) years were the most affected patients ,most of the patients with Diabetes (type II) (91%) and (type I) (9%), According to the associated diseases, patients with diabetes and hypertension (163 (54.3%), diabetes and trauma 57 (19%), trauma and hypertension 60 (20%), the right eye was more affected 155 (51.7%), the most ultrasound finding was retinal detachment 64 (21.3 %), vitreous hemorrhage 38 (12.7%), hyper mature catract 36 (12%), vitreous change 32 (10.7%), vitreous detachment 27 (9%), retinal detachment + vitreous hemorrhage 24 (8%), mature catract 21 (7%), retinal detachment + mature catract 8 (2.7 %), vitreous detachment + vitreous

change 5 (1.7%) . male were more affected p. value (0.01)). A Correlation done between duration of disease and final diagnose , it was found that there was no significant relation between them p. value (0.452). There was no significant correlation between type 2 and ultrasound finding p.value (0.204), there was 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,

It concluded that B- scan ultrasonography was the initial imaging modality opted in most of the cases as it was readily available, simple, cost effective, non-ionizing, noninvasive and reliable modality. It has a higher spatial and temporal resolution for the diagnosis of eye for diabetic patients pathologies, ultrasound must be uses routinely in the evaluation of the eyes of diabetics and also this research could form a database for further research in this area in the future.

المستخلص

أصبح للموجات فوق الصوتية دورا متزايد الأهمية في التشـــخيص والاكتشــاف المبكــر لأكثــر الأمراض انتشارا. إنها تتميز بالتوافر والســهولة والــرخص. قامــت الدراســة بدراســة عيــون السكري باستخدام الموجات فوق الصوتية. مرض السكري هو مــرض شــائع جــدا فــي ســكان العالم. ليس فقط يسبب الاعياء ولكن يؤثر أيضا على اقتصاد البلدان.

يتم إجراء دراسة الموجات فوق الصوتية للعين والمحجــر فــي وضــع الاســتلقاء او الجلــوس ، حيث يكون المسبار فوق الملتحمة او القرنية مباشرة او يوضع فــوق الجفــن المغلــق ، إلا انــه يتطلب تعقيم المسبار بين الإجراءات ، يستخدم محلول الاقتــران لتجنــب التــوهين النــاجم عــن الهواء .

الهدف من هذه الدراســة هــو دراســة دور الموجــات فــوق الصــوتية B-scan فــي العــين لمرضى السكري. تم إجراء دراســة وصــفية تحليليــة بــين يونيــو 2016 إلــى يونيــو 2019 على 300 مريض 141 أنثى و 159 ذكر يتــراوح اعمــارهم مــا بــين 35–77، عامًــا تــم تحويلهم إلى مستشفى مكة لطب العيون فــي الخرطــوم. لاجــراء فحــص الموجــات الصــوتية للعيون باستخدام مسبار تردده 10 ميغاهيرتز.

اوضحت نتائج الدراسة الحالية أن أكثــر الفئــات العمريــة تضــررا كانــت (60–69) ، (50–59) ســنة (61 ٪) و (18.3 ٪) علــى التــوالي ثــم (70–77) (13 ٪) المجموعــة الأخيــرة هي (35 –49) الذي كان (7.7٪) ، معظم المرضى مــن الخرطــوم. وفقًــا لمــدة المجموعــات المرضــــية (10–19) ســـنة 209 (69.7٪) ، (20–29) ســـنة 86 (28.7٪) و (30) – 35 سنة كانت أكثر المرضى تضررا ، معظم المرضــى يعــانون مــن مرضــى الســكري (النــوع الثاني) (91 ٪) و (النوع الأول) (9 ٪) ، وفقا للأمــراض المرتبطــة بهــا ، مرضــى الســكري وارتفــاع ضــغط الــدم (163 (54.3 ٪) ، ومــرض الســكري والصــدمات 57 (19 ٪) ، والصدمات وارتفاع ضــغط الــدم 60 (20 ٪) ، وكانــت العــين اليمنــى أكثــر تضــررا 155 (51.7 ٪)، وكانت النتيجة الأكثر بالموجــات فــوق الصــوتية انفصــال الشــبكية 64 (21.3 ٪) والنزيــف الزجــاجي 38 (12.7٪) ،عتمــة عدســة العــين(cataract) ناضــجة للغايــة 36

(12٪) ، تغيير زجــاجي 32 (10.7٪) ، انفصـــال زجــاجي 27 (9٪) ، انفصـــال الشـــبكية + نزيـــف زجــاجي 24 (8٪) ، cataract ناضـــجة 21 (7٪) ، انفصـــال الشـــبكية + cataract ناضجة 8 (2.7 ٪) ، مفرزة الزجاجية + تغيير الزجــاجي 5 (1.7 ٪) ، وكـــان الـــذكور أكثـــر تضررا ص. القيمة (0.01)). تم الارتباط بين مدة المرض والتشـــخيص النهـــائي ، وقـــد وجـــد أنه لا توجد علاقة كبيرة بينهما ص. القيمة (0.452). لـــم يكـــن هنـــاك ارتبـــاط معنـــوي بـــين النوع 2 والاكتشاف بالموجـــات فـــوق الصـــوتية (p. Value (0.204) ، كانـــت هنـــاك علاقـــة بين تاريخ المريض وقيمة التشخيص النهائيـــة (p0.000) ، مقارنـــة بـــين المصـــابين بالســـكرى والعلاج، لـــم يكـــن هنـــاك ارتبـــاط كبيـــر0.224 (p. Value) ، و(77.3 ٪) مـــن المرضـــى يعالجون بالأنسولين .

وخلصت إلى أن التصوير بالموجات فوق الصوتية B- هـــو طريقـــة التصـــوير الأوليـــة التـــي تم اختيارها في معظم الحالات لأنها كانت متوفرة وبسيطة وفعالـــة مـــن حيـــث التكلفـــة وغيـــر المؤينة وغير الغازية والموثوقة. ايضا الموجات فـــوق الصـــوتية لـــديها دقـــة مكانيـــة وزمنيـــة أعلى لتشخيص العين لأمراض مرضى السكري ، ويجـــب اســـتخدام الموجـــات فـــوق الصـــوتية بشكل روتيني في تقييم عيون مرضى السكري ويمكن أن يشـــكل هـــذا البحـــث قاعـــدة بيانـــات لمزيد من البحث في هذا المجال في المستقبل.

Table of Content

List of Tables

List of Figures

Table of Abbreviations

U/S	Ultrasound
DM	Diabetes Mellitus
HTN	Hyper Tension
VH	Vitreous Hemorrhage
RD	Retinal Detachment
IOFB	Intra Orbital Foregin Body
DL	Dislocated Lens
FD	Final Diagnose
IO	Intraocular
CT	Computed Tomography
OR	Orbital Region
OB	Orbital Bone
OW	Orbital Wall
OF	Orbital Fat
OND	Optic Nerve Disc
PSO	Posterior Segment Eye
ONL	Outer Nuclear Layer
OPL	Outer Plexiform Layer
INL	Inner Nuclear Layer
IPL	Inner Plexiform Layer
GCL	Ganglion Cell Layer
NFL	Nerve Fiber Layer
BS	Blood Supply
CFD	Color Flow Doppler
SD	Spectral Doppler
IL	Intra Lesional
PVD	Posterior Vitreous Detachment
BS	B Scan
A H	Asteroid Hyalosis
VF	Vitreous Floaters
DLM	Dislocated Lens Matter

Chapter one

Introduction

Chapter one

1.1 Introduction

Eye is fluid filled structure. It is situated in the anterior part of the orbit and embedded in the fat. The Tenon's capsule separates it from the orbital wall. The anterior segment forms 1/6th of eyeball and posterior segment forms 5/6th of eyeball. Normal axial length of eye is 22 mm. (Srivastava 2007).

1.2 Diabetes mellitus: (DM) is a condition that impairs the body's ability to process blood glucose, otherwise known as blood sugar There are three major diabetes types can develop Type 1 diabetes Also known as juvenile diabetes , this type occur when the body fails to produce insulin , people with type one diabetes are insulin dependent , which means they must take artificial insulin daily to stay alive ,Type 2 diabetes the way the body uses insulin. while the body still makes insulin unlike in type one , the cells in the body do not respond to it as effectively as they once did this the most common type of diabetes , according to the national institute of diabetes and digestive and kidney diseases and it has strong links with obesity , Gestational diabetes. This type occurs in women during pregnancy when the body can become less sensitive to insulin gestational diabetes does not occur in all women and usually resolves after giving birth.

(https://www.medical newstoday.com/article /323627.php)

1.3Ultrasonic appearance of the eye : Ultrasonic appearance of eye and orbit closely resemble the normal anatomical structures. Eye is the easiest structure to visualize within the orbit as its fluid content and superficial position makes it ideal for ultrasonography (USG) examination. Ultrasound is only practical method of obtaining images of the posterior segment of eye when the light conducting media are opaque and is the most useful investigation prior to vitrectomy. Ultrasound contributes more to tissue diagnosis than computed tomography. The characteristics of motion and topography of pathological intraocular structures enable differentiation between retinal detachment and vitreous membrane or tumor and hemorrhage. The 2D ultrasound image displays ocular and orbital structures much more than a CT scan. (Srivastava 2007).

The aim of this study was to study the diabetic eyes disease using ultrasonography

1.4 problem of the study: Diabetes is one of the common causes of retinopathy which can lead to glaucoma and later on may lead to blindness; these conditions need optimal care and management

1.5.1 The main objective:

The main purpose was to study diabetic eyes disease using ultrasonography

1.5.2 The specific objectives:

To compare between the effectiveness and types of DM.

To differentiate between types of diabetic retinopathy.

To compare between the diabetic retinopathy and the duration of DM.

To compare the effect of diabetes according to gender.

To find out the effect of diabetic according to residence .

To find out the historical diseases that associate with DM.

To find the effect of diabetes on eash eye.

1.6 Significance of the study:

This study was highlighted the issue of early diagnosis of possible problems of diabetic eyes where it will help in early detection of abnormalities so complication can be avoided.

Chapter two

Literature Reviews

Chapter Two

2.1 Literature Reviews

2.1.1 Ocular anatomy: The Orbital Region the orbits are a pair of bony cavities that contain the eyeballs; their associated muscles, nerves, vessels, fat and most of the lacrimal apparatus. The orbital opening is guarded by two thin, movable folds eyelid. (snell 2012)

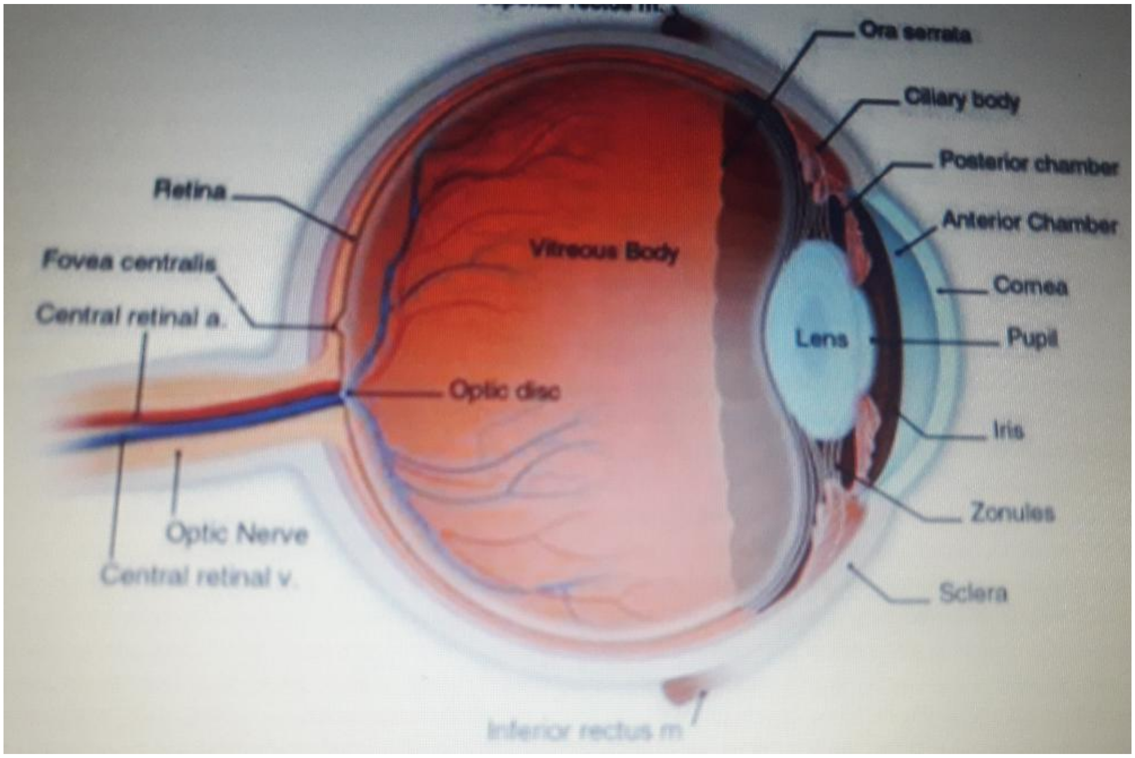

Figure (2.1) human eye anatomy (Lioyd 2017)

2.1.2. Orbital Bone: The orbital bones surround the globe and appear hyperechoic with posterior acoustic shadowing on ultrasound, similar to other bony structures that impede the ultrasound beam and create an artifact posteriorly. The orbital bones should have a smooth, sharp edge and any disruption may suggest an orbital fracture. (Ofeida Awad Mohamed 2019)**.**

2.1.3. The Orbital Walls: Seven different bones form the orbital walls. Don't be intimidated by this complexity,however, as these bones are not that confusing when you break them down Forexample, the roof of the orbit is a continuation of the frontal. bone, the zygomatic bone forms the strong lateral wall, while the maxillary bone creates the orbital floor. This makes sense, and you could probably guess these bones from the surrounding anatomy. The medial wall is a little more complex, however, but is mainly formed by the lacrimal bone (the lacrimal sac drains tears through this bone into the nose) and the ethmoid bone. The thinnest area in the orbit is a part of the ethmoid bone called the lamina papyracea. Sinus infections can erode through this "paper-thin wall" into the orbital cavity and create a dangerous orbital cellulitis. Despite the fragility of the medial wall, it is well buttressed by surrounding bones and rarely fractures. The orbital floor, however, breaks most often during blunt trauma. The maxillary bone fractures downward and the orbital contents can herniate down into the underlying maxillary sinus. This is called a "blowout fracture" and problems with eye movements from entrapment of the inferior rectus muscle. (Ofeida Awad Mohamed 2019)

2.1.4 Muscles of the Eyeball: Extrinsic Muscles of the eye, There are six voluntary muscles that run from the posterior wall of the orbital cavity to the eyeball ,These are the superior rectus the inferior rectus, the medial rectus, the lateral rectus and the superior and inferior oblique muscles. Intrinsic Muscles of Eyeball Smooth Muscle Sphincter papillae of iris, Dilator papillae of iris and Ciliary muscle. (snell 2012)

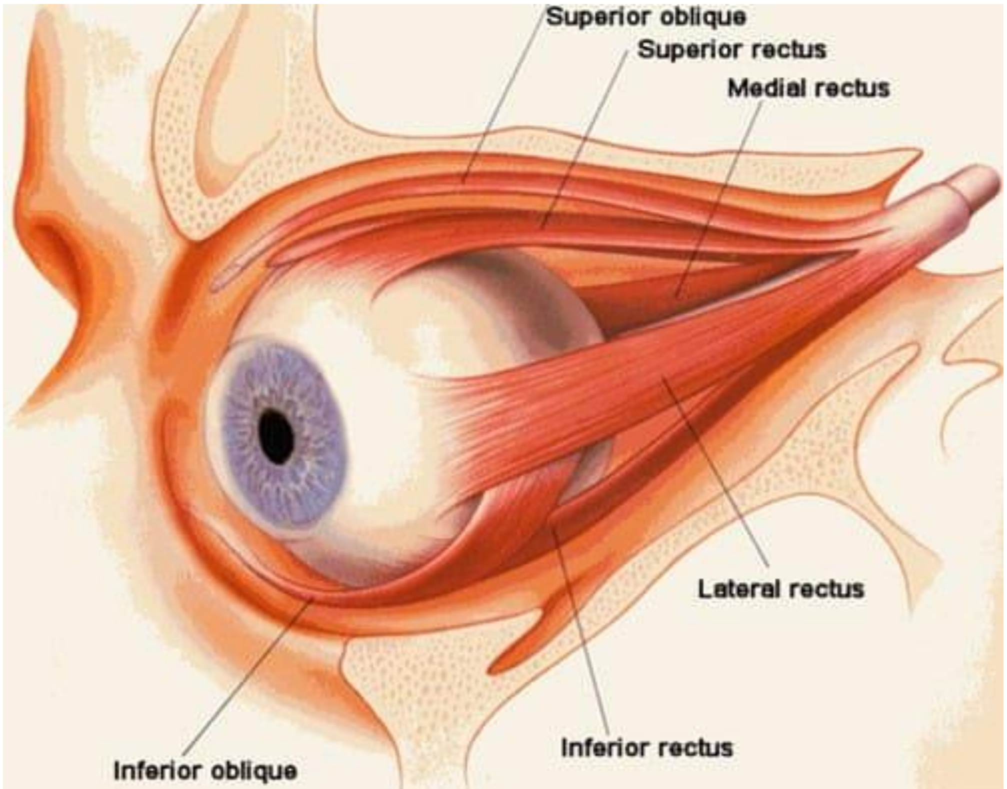

Figure (2.2): muscles of the eye (Saunders 2014)

2.1.5 Eyelid: The eyelids protect the eye from injury and excessive light by their closure the upper eyelid is larger and more mobile than the lower, and they meet each other at the medial and lateral angles. The palpebral fissure is the elliptical opening between the eyelids and is the entrance into the conjunctival sac. When the eye is closed, the upper eyelid completely covers the cornea of the eye. When the eye is open and looking straight ahead, the upper lid just covers the upper margin of the cornea. The lower lid lies just below the cornea when the eye is open and rises only slightly when the eye is closed. (Snell 2012).

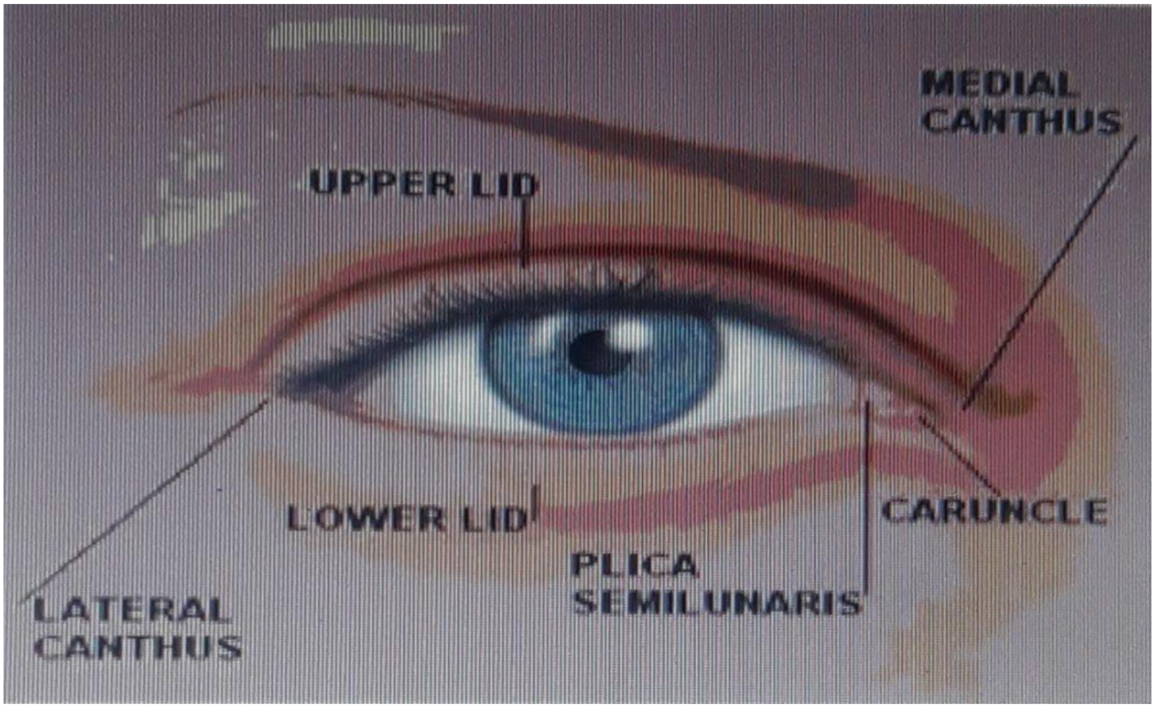

Figure (2.3).frontal view of eyelid (carolyn 2012)

The superficial surface of the eyelids is covered by skin and the deep surface is covered by a mucous membrane called the conjunctiva. The eyelashes are short, curved hair on the free edges of the eyelids. They are arranged in double or triple rows at the mucocutaneous junction. The sebaceous glands of Zeis open directly into the eyelash follicles. The ciliary glands glands of moll are modified sweat glands that open separately between adjacent lashes , the tarsal glands are long ,modified sebaceous glands that pour their oily secretion onto the margin of the lid , their openings lie behind the eyelashes , this oily material prevents the over flow of tears and helps make the closed eyelids air tight (Snell 2012) The more rounded medial angle is separated from the eyeball by a small space, the lacus lacrimalis in the center of which is a small, reddish yellow elevation, the caruncula lacrimalis. A reddish semilunar fold called the plica semilunaris lies on the lateral side of the caruncle. Near the medial angle of the eye a small elevation, the papilla lacrimalis is present. On the summit of the papilla is a small hole , the punctum lacrimalem which leads into the canaliculus lacrimalis, the papilla lacrimalis projects into the lacus and the punctum and canaliculus carry tears down into the nose (snell 2012). The conjunctiva is a thin mucous membrane that lines the eyelids and is reflected at the superior and inferior fornices onto the anterior surface of the eyeball Its epithelium is continuous with that of the cornea. The upper lateral part of the superior fornix is pierced by the ducts of the lacrimal gland. The conjunctiva thus forms a potential space, the conjunctival sac which is open at the palpebral fissure . Beneath the eyelid is groove the subtarsal sulcus, which runs close to and parallel with the margin of the lid The sulcus tends to trap small foreign particles introduced into the conjunctival sac and is thus clinically important. The framework of the eyelids is formed by a fibrous sheet the orbital septum. This is attached to the periosteum at the orbital margins. The orbital septum is thickened at the margins of the lids to form the superior and inferior tarsal plates. The lateral ends of the plates are attached by a band, the lateral palpebral ligament to ends of the plates are attached by a band, the medial palpebral ligament to the crest of the lacrimal bone. The tarsal glands are embedded in the posterior surface of the tarsal plates The superficial surface of the tarsal plates and the orbital septum are covered by the palpebral fibers of the orbicularis oculi muscle .The aponeurosis of insertion of the levator palpebrae superior is muscle pierces the orbital septum to reach the anterior surface of the superior tarsal plate and the skin. (Snell 2012).

2.1.6 Movements of the Eyelids: The position of the eyelids at rest depends on the tone of the orbicularis oculi and the levator palpebrae superioris muscles and the position of the eyeball. The eyelids are closed by the contraction of the orbicularis oculi and the relaxation of the levator palpebrae superioris muscles.the eye is opened by the levator palpebrae superioris raising the upper lid. On looking upward, the levator palpebrae superioris contracts, and the upper lid moves with the eyeball .On looking downward, both lids move, the upper lid continues to cover the upper part of the cornea, and the lower lid is pulled downward slightly by the conjunctiva, which is attached to the sclera and the lower lid. (Snell 2012)

2.1.7 Lacrimal Apparatus:

2.1.7.1 Lacrimal Gland: The lacrimal gland consists of a large orbital part and a small palpebral part which are continuous with each other around the lateral edge of the aponeurosis of the levator. palpebrae superioris. It is situated above the eyeball in the anterior and upper part of the orbit posterior to the orbital septum. The gland opens into the lateral part of the superior fornix of the conjunctiva by 12 ducts. The parasympathetic secretomotor nerve supply is derived from the lacrimal nucleus of the facial nerve the preganglionic fibers reach the pterygopalatine ganglion. sphenopalatine ganglion via the nervus intermedius and its great petrosal branch and via the nerve of the pterygoid canal. The postganglionic fibers leave the ganglion and join the maxillary nerve. They then pass into its zygomatic branch and the zygomaticotemporal nerve. They reach the lacrimal gland within the lacrimal nerve The sympathetic postganglionic nerve supply is from the internal carotid plexus and travels in the deep petrosal nerve, the nerve of the pterygoid canal, the maxillary nerve. The zygomatic nerve, the zygomaticotemporal nerve, and finally the lacrimal nerve (Snell 2012)

2.1.7.2 Lacrimal Ducts: The tears circulate across the cornea and accumulate in the lacus lacrimalis. From here, the tears enter the canaliculi lacrimales through the puncta lacrimalis. The lacrimales pass medially and open into the lacrimal sac which lies in the lacrimal groove behind the medial palpebral ligament and is the upper blind end of the nasolacrimal duct. The nasolacrimal duct is about 0.5 in (1.3 cm) long and emerges from the lower end of the lacrimal sac. The duct descends downward, backward and laterally in abony canal and opens into the inferior meatus of the nose. The opening is guarded by a fold of mucous membrane known as the lacrimal fold. This prevents air from being forced up the duct into the lacrimal sac on blowing the nose (Snell 2012)

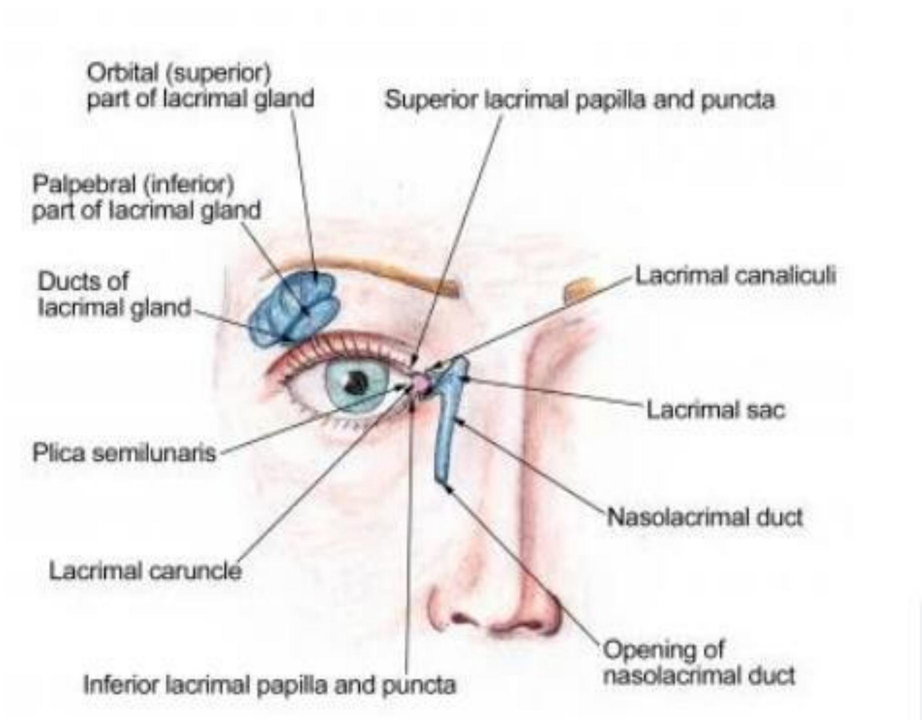

Figure (2.4) nasolacrimal system anatomy (Bobbie 2016)

2.1.8 The Orbit: The orbit is a pyramidal cavity with its base anterior and its apex posterior. The orbital margin is formed above by the frontal bone, the lateral margin is formed by the processes of the frontal and zygomatic, the inferior margin is formed by the zygomatic bone and the maxilla and the medial margin is formed by the processes of the maxilla and the frontal bone .(Snell 2012).

2.1.8.1 Roof: Formed by the orbital plate of the frontal bone which separates the orbital cavity from the anterior cranial fossa and the frontal lobe of the cerebral hemisphere.

2.1.8.2 Lateral wall: Formed by the zygomatic bone and the greater wing of the sphenoid.

2.1.8.3 Floor: Formed by the orbital plate of the maxilla, this separates the orbital cavity from the maxillary sinus.

2.1.8.4 Medial wall: Formed from before backward by the frontal process of the maxilla, the lacrimal bone, the orbital plate of the ethmoid which separates the orbital cavity from the ethmoid sinuses and the body of the sphenoid .(Snell 2012)

2.1.8.5 Openings into the Orbital Cavity: Orbital opening lies anteriorly about one sixth of the eye is exposed; the remainder is protected by the walls of the orbit. Supraorbital notch (Foramen). The supraorbital notch is situated on the superior orbital margin .it transmits the supraorbital nerve and blood vessels Infraorbital groove and canal. Situated on the floor of the orbit in the orbital plate of the maxilla , they transmit the infraorbital nerve (acontinuation of the maxillary nerve) and blood vessels . Nasolacrimal canal located anteriorly on the medial wall it communicates with the inferior meatus of the noseiIt transmits the nasolacrimal duct.

Inferior orbital fissure: Located posteriorly between the maxilla and the greater wing of the sphenoid it communicates with the pterygopalatine fossa. It transmits the maxillary nerve and its Superio orbital zygomatic branch, the inferior ophthalmic vein and sympathetic nerve fissure: Located posteriorly between the greater and lesser wings of the sphenoid ,it communicates with the middle cranial fossa. It transmits the lacrimal nerve, the frontal nerve. , the trochlear nerve the oculomotor nerve (upper and lower divisions), the abducent nerve, the nasociliary nerve and the superior ophthalmic vein. Optic canal: Located posteriorly in the lesser wing of the sphenoid it communicates with the middle cranial fossa. It transmits the optic nerve and the ophthalmic artery. (Snell 2012)

2.1.8.6 Orbital Fascia: The orbital fascia is the periosteum of the bones that form the walls of the orbit. It is loosely attached to the bone and is continuous through the foramina and fissures with the periosteum covering the outer surfaces of the bomes. The muscle of Müller or orbitalis muscle is a thin layer of smooth muscle that bridges the inferior orbital fissure It is supplied by sympathetic nerves and its function is Unknown. (Snell 2012)

2.1.9 Nerves of the Orbit:

2.1.9.1 Optic Nerve: The optic nerve enters the orbit from the middle cranial fossa by passing through the optic canal. It is accompanied by the ophthalmic artery, which lies on its lower lateral side. The nerve is surrounded by sheaths of pia mater, arachnoid mater and dura mater. It runs forward and laterally within the cone of the recti muscles and pierces the sclera at a point medial to the posterior pole of the eyeball. Here, the meninges fuse with the sclera so that the subarachnoid space with its contained cerebrospinal fluid extends forward from the middle cranial from around the optic nerve and through the optic canal as far as the eyeball. A rise in pressure of the cerebrospinal fluid fossa within the cranial cavity therefore is transmitted to the back of the eyeball. (Snell 2012)

2.1.9.2 Lacrimal Nerve: The lacrimal nerve arises from the ophthalmic division of the trigeminal nerve. It enters the orbit through the upper part of the superior orbital .fissure and passes forward along the upper border of the lateral rectus muscle It is joined by a branch of the zygomaticotemporal nerve, which later leaves it to enter the lacrimal gland (parasympathetic secretomotor fibers). The lacrimal nerve ends by supplying the skin of the lateral part of the upper lid. (Snell 2012)

2.1.9.3 Frontal Nerve: The frontal nerve arises from the ophthalmic division of the trigeminal nerve. It enters the orbit through the upper part of the superior orbital fissure and passes forward on the upper surface of the levator palpebrae superioris beneath the roof of the orbit. It divides into the supratrochlear and supraorbital nerves that wind around the upper margin of the orbital cavity to supply the skin of the forehead; the supraorbital nerve also supplies the mucous membrane of the frontal air sinus. (Snell.2012)

2.1.9.4 Trochlear Nerve: The trochlear nerve enters the orbit through the upper part of the superior orbital fissure. It runs forward and supplies the superior oblique muscle. (Snell 2012).

2.1.9.5 Oculomotor Nerve: The superior ramus of the oculomotor nerve enters the orbit through the lower part of the superior orbital fissure It supplies the superior rectus. muscle, then pierces it, and supplies the levator palpebrae superioris muscle. The inferior ramus of the oculomotor nerve enters the orbit in a similar manner and. supplies the inferior rectus the medial rectus, and the inferior oblique muscles.The nerve to the inferior oblique gives off a branch that passes to the ciliary ganglion and carries parasympathetic fibers to the sphincter pupillae and the ciliary muscle. (Snell 2012)

2.1.9.6 Nasociliary Nerve: The nasociliary nerve arises from the ophthalmic division of the trigeminal nerve. It enters the orbit through the lower part of the superior orbital fissure. It crosses above the optic nerve, runs forward along the upper margin of the medial rectus muscle, and ends by dividing into the anterior ethmoidal and infratrochlear nerves. (Snell 2012)

2.1.9.7 Branches of the Nasociliary Nerve: The communicating branch to the ciliary ganglion is a sensory nerve. The sensory fibers from the eyeball pass to the ciliary ganglion via the short ciliary nerves, pass through the ganglion without interruption and then join the nasociliary nerve by means of the communicating branch. The long ciliary nerves two or three in number, arise from the nasociliary nerve as it crosses the optic nerve they contain sympathetic fiber for the dilator pupillae muscle.The nerves pass forward with the short ciliary nerves and pierce the sclera of the eyeball. They continue forward between the sclera and the choroid to reach the iris. The posterior ethmoidal nerve supplies the ethmoidal and sphenoidal air sinuses .(Snell 2012)

2.1.9.8 The infratrochlear nerve: Passes forward below the pulley of the superior oblique muscle and supplies the skin of the medial part of the upper eyelid and the adjacent part of the nose . (Snell 2012)

2.1.9.9The anterior ethmoidal nerve: Passes through the anterior ethmoidal foramen and enters the anterior cranial fossa on the upper surface of the cribriform plate of the.ethmoid. It enters the nasal cavity through a slitlike opening alongside the crista galli. After supplying an area of mucous membrane, it appears on the face as the external nasal branchat the lower border of the nasal bone, and supplies the skin of the nose down as far as the tip. (Snell 2012)

2.1.9.10 Abducent Nerve: The abducent nerve enters the orbit through the lower Part of the superior orbital fissure. It supplies the lateral rectus muscle. (Snell 2012)

2.1.9.11 Ciliary Ganglion: The ciliary ganglion is a parasympathetic ganglion about the size of a pinhead and situated in the posterior part of the orbit. It receives its preganglionic parasympathetic fibers from the oculomotor nerve via the nerve to the inferior oblique. The postganglionic fibers leave the ganglion in the short ciliary nerves,which enter the back of the eyeball and supply the sphincter pupillae and the ciliary muscle. number of sympathetic fibers pass from the internal carotid plexus into the orbit and run through the ganglion without interruption. (Snell 2012). **2.1.10 Blood Vessels and Lymph Vessels of the orbit:** **2.1.10.1Ophthalmic Artery :** The ophthalmic artery is a branch of the internal carotid artery after that vessel emerges from the cavernous sinus It enters the orbit through the optic canal with the optic nerve. It runs forward and crosses the optic nerve to reach the medial wall of the orbit. It gives off numerous branches, which accompany the nerves in the orbital cavity. (Snell 2012)

2.1.10.2 Branches of the Ophthalmic Artery : The central artery of the retina is a small branch that pierces the meningeal sheaths of the optic nerve to gain entrance to the nerve. It runs in the substance of the optic nerve and enters the eyeball at the center of the optic disc.Here it divides into branches which may be studied in a patient through an ophthalmoscope. The branches are end arteries the muscular branches The ciliary arteries can be divided into anterior and posterior groups. The former group enters the eyeball near the comeoscleral junction the latter group enters near the optic nerve the lacrimal artery to the lacrimal gland.The supratrochlear and supraorbital arteries are distributed to the skin of the forehead. (Snell 2012)

2.1.10.3 Ophthalmic Veins: The superior ophthalmic vein communicates in front with the facial vein .The inferior ophthalmic vein.communicates through the inferior orbital fissure with the pterygoid venous plexus. Both veins pass backward through the superior orbital fissure and drain into the cavernous sinus.(Snell 2012). Lymph Vessels: No lymph vessels or nodes are present in the orbital cavity. (Snell 2012)

2.1.11 Movements of the Eyeball Terms Used in Describing Eye Movements, the center of the cornea or the center of the pupil is used as the anatomic "anterior pole" of the eye. All movements of the eye are then related to the direction of the movement of the anterior pole as it rotates on any one of the three axes horizontal, vertical, and sagittal). The terminology then becomes as follows: Elevation is the rotation of the eye upward, depression is the rotation of the eye downward abduction is the rotation of the eye laterally and adduction. is the rotation of the eye medially. Rotatory movements of the eyeball use..the upper rim of the cornea (or pupil) as the marker. The eye rotates either medially or laterally Extrinsic Muscles Producing Movement of the eye There are six voluntary muscles that run from the posterior wall of the orbital cavity to the eyeball .These are the superior rectus,the inferior rectus,the medial rectus,the lateral rectus and the superior and inferior oblique muscles , because the superior and the inferior recti are inserted on the medial side of the vertical axis of the eyeball they not only raise and depress the cornea, respectively but also rotate it medially. For the superior rectus muscle to raise the cornea directly upward, the inferior oblique muscle must assist for the inferior rectus to depress the cornea directly downward, the superior oblique muscle must assist. Note that the tendon of the superior oblique muscle passes through a fibrocartilaginous pulley (trochlea) attached to the frontal bone. The tendon now turns backward and laterally and is inserted into the sclera beneath the superior rectus muscle.(Snell 2012) .Oblique Muscles Because the actions of the superior and inferior recti and the superior and inferior oblique muscles are complicated when a patient is asked to look vertically upward or vertically downward. The origins of the superior and inferior recti are situated about 23° medial to their insertions and therefore, when the patient is asked to turn the cornea laterally these muscles are placed in the optimum position to raise (superior rectus) or lower.(inferior rectus) the cornea using the same rationale, the superior and inferior oblique muscles can be tested. The pulley of the superior oblique and the origin of the inferior oblique muscles lie medial and anterior to their insertions. The physician tests the action of these muscles by asking the patient first to look medially, thus placing these muscles the cornea. In other words, when you ask a patient to look medially and downward at the tip of his or her nose, you are testing the superior oblique at its best position Conversely, by asking the patient to look medially and upward you are testing the inferior oblique at its best position.(Snell 2012) Intrinsic Muscles: The involuntary intrinsic muscles are the ciliary muscle and the constrictor and the dilator pupillae of the iris take no part in the movement of the eyeball. (Snell 2012). Fascial Sheath of the Eyeball: The fascial sheath surrounds the eyeball from the optic nerve to the corneoscleral junction. It separates the eyeball from the orbital fat and provides it with asocket for free movement. It is perforated by the tendons of the orbital muscles and is reflected onto each of them as a tubular sheath. The sheaths for the tendons of the medial and lateral recti are attached to the medial and lateral walls of the orbit by triangular ligaments called the medial and lateral check ligaments The lower part of the fascial sheath which passes beneath the eyeball and connects the check ligaments is thickened and serves to suspend the eyeball it is called the suspensory ligament of the eye By this means, the eye is suspended from the medial and lateral walls of the orbit, as if in a hammock. (Snell 2012)

2.1.12 Structure of the Eye: The eyeball is embedded in orbital fat but is separated from it by the fascial sheath of the eyeball. The eyeball consists of three coats, which from without inward are the fibrous coat, the vascular pigmented coat and nervous coat. (Snell 2012)

2.1.12.1Coats of the Eyeball Fibrous Coat : The fibrous coat is made up of a posterior opaque part, the sclera, and an anterior transparent part, the cornea. (Snell 2012)

2.1.12.2 The Sclera: The opaque sclera is composed of dense fibrous tissue and is white. Posteriorly it is pierced by the optic nerve and is fused with the dural sheath of that nerve. Lamina cribrosa is the area of the sclera that is pierced by the nerve fibers of the optic nerve. The sclera is also pierced by the ciliary arteries and nerves and their associated veins, the venae vorticosae. The sclera is directly continuous in front with the cornea at the corneoscleral junction, or limbus. (Snell 2012)

2.1.12.3 The Cornea : is the most densely innervated structure in the human body. The nerve branches supplying the cornea are derived from the long posterior ciliary nerves, which are from the ophthalmic and maxillary division of the trigeminal nerve. At the peripheral cornea, the nerves from the conjunctiva episclera and sclera penetrate the cornea at various depths The nerve fibers become unmyelinated when they penetrate the cornea and run parallel to its surface. The corneal nerves turn abruptly 90 degreesand proceed towards the corneal surface where they branch into the dense subepithelial plexus.Unsheathed nerve endings arisefrom the subepithelial plexus and continue superficially into the wing and squamous cell layers of the epithelium.(Herranz&Herran 2013)

2.1.12.4 The Choroid: The choroid is composed of an outer pigmented layer and an inner, highly vascular layer . (Snell 2012)

2.1.12.5 The Ciliary Body : The ciliary bodyis continuous posteriorly with the choroid, and anteriorly it lies behind the peripheral margin of the iris.It is composed of the ciliary ring,the ciliary processes, and the ciliary muscle.The ciliary ringis the posterior part of the body and its surface has shallow grooves, the ciliary striae. The ciliary processes are radially arranged folds, or ridges to the posterior surfaces of which are connected the suspensory ligaments of the lens .The ciliary muscle is composed of meridianal and circular fibers of smooth muscle. The meridianal .fibers run backward from the region of the corneoscleral junction to the ciliary processes. The circular fibers are fewer in number and lie internal to the meridianal fibers Nerve supply: The ciliary muscleis supplied by the parasympathetic fibers from the oculomotor nerve. After synapsing in the ciliary ganglion, the postganglionic fibers pass forward to the eyeball in the short ciliary nerves. Action:contraction of the ciliary muscle, especially the meridianal fibers, pulls the ciliary body forward. This relieves the tension in the suspensory ligament, and the elastic lens becomes more convex. This increases the refractive power of the lens (Snell 2012)

2.1.12.6 The Iris : The iris is a thin, circular structure located anterior to the lens, often compared with a diaphragm of an optical system. The center aperture, the pupil,actually is located slightly nasal and inferior to the iris center. Pupil size regulates retinal illumination. The diameter can vary from 1mm to 9 mm depending on lighting conditions. The pupil is very small (miotic) in brightly lit conditions and fairly large (mydriatic) in dim illumination. The average diameter of the iris is 12 mm, and its thickness varies. It is thickest in the region of the collarette, a circular ridge approximately 1.5 mm from the pupillary margin .This slightly raised jagged ridge was the attachment site for the fetal pupillary membrane during embryologic development. The collarette divides the iris into the papillary zone,which encircles the pupil, and the ciliary zone which extends from the collarette to the iris root The color of these two zones often differs. The pupillary margin of the iris rests on the anteriorsurface of the lens and, in profile, the iris has a truncatedcone shape such that the pupillary margin lies anterior toits peripheral termination, the iris root.Theroot approximately 0.5 mm thick, is the thinnest part ofthe iris and joins the iris to the anterior aspect of the ciliary body.The iris divides the anterior segment of the globe into anterior and posterior chambersand the pupil allows the aqueous humor to flow from theposterior into the anterior chamber with no resistance. (Remington 2012)

2.1.12.7 the pupil : It is suspended in the aqueous humor between the cornea and the lens. The periphery of the iris is attached to the anterior surface of the ciliary body. It divides the space between the lens and the cornea into an anterior and a posterior chamber The muscle fibers of the iris are involuntary and consist of circural and radiating fibers. The circular fibers form the sphincter papillae and are arranged around the margin of the pupil. The radial fibers form the dilator papillae and consist of a thin sheet of radial fibers that lie close to the posterior surface. (Snell 2012) Nerve supply:The sphincter papillae is supplied by parasympathetic fibers from the oculomotor nerve. After synapsing in the ciliary ganglion, the postganglionic fibers pass forward to the eyeball in the short ciliary nerves. The dilator papillae is supplied by sympathetic fibers, which pass forward to the eyeball in the long ciliary nerves. Action:The sphincter pupillae constricts the pupil in the presence of bright light and during accommodation The dilator pupillae dilates the pupil in the presence of light of low intensity or in the presence of excessive sympathetic activity such as occurs in fright. (Snell 2012).

2.1.12.8 Nervous Coat:

The Retina: Is the highly specialized nervous tissue ,in reality apart of brain that has become exteriorized , it has the equivalent of both white matter

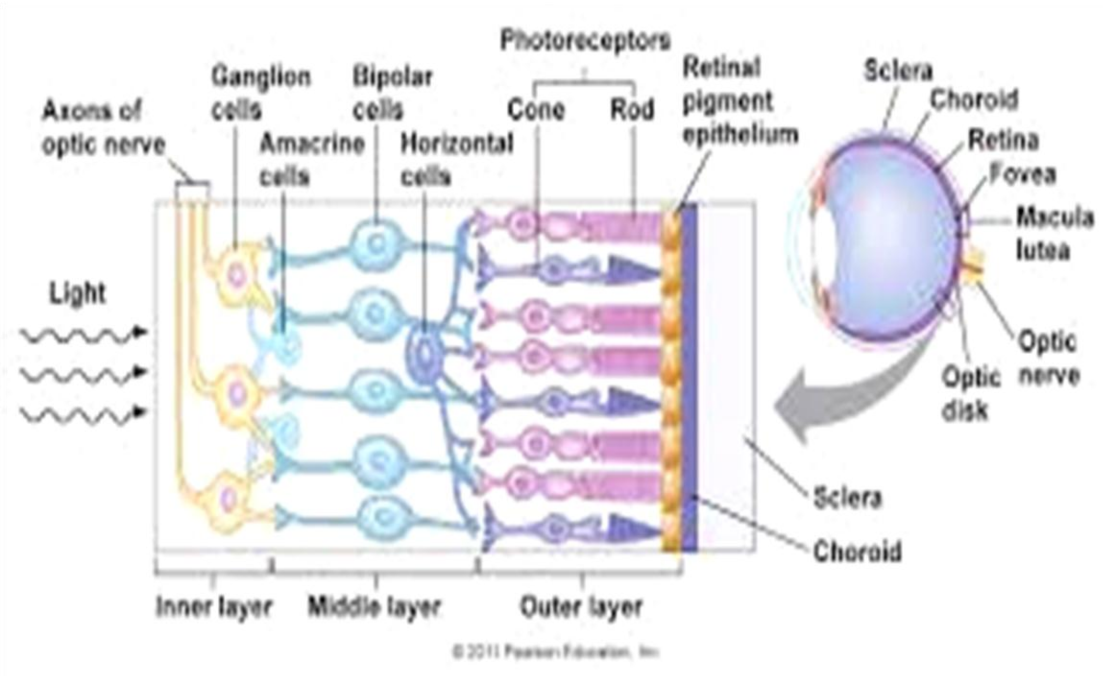

Figure (2.5) retina different cell and synaptic layers (Bruce et al., 1996).

(retinal plexiform and nerve fiber layer) and gray matter (retinal nuclear and ganglion cell layer) the glial cells are represented mostly by large all pervasive specialized muller cells and less noticeably by smaller astrocytes of the inner retinal cells , as in the brain a vasculature is present in which the endothelial cells possess tight junctions producing a blood retinal barrier. (Yanoff_ Fine)

2.1.12.9 Aqueous Humor : The aqueous humor is a clear fluid that fills the anterior and posterior chambers of the eyeball. It is believed to be a secretion from the ciliary processes, from which it enters the posterior chamber. It then flows into the anterior chamber through the pupil and is drained away through the spaces at the iridocorneal angle into the canal of Schlemm. Obstruction to the draining of the aqueous humor results in a rise in intraocular pressure called glaucoma. This can produce degenerative changes in the retina, with consequent blindness. The function of the aqueous humor is to support the wall of the eyeball by exerting internal pressure and thus maintaining its optical shape. It also nourishes the cornea and the lens and removes the products of metabolism these functions are important because the cornea and the lens do not possess a blood supply. (Snell 2012)

2.1.12.10 Vitreous Body: The vitreous body fills the eyeball behind the lens and is a transparent gel the hyaloid canal is a narrow channel that runs through the vitreous body from the optic disc to the posterior surface of the lens; in the fetus, it is filled by the hyaloid artery, which disappears before birth. The function of the vitreous body is to contribute slightly to the magnifying power of the eye. It supports the posterior surface of the lens and assists in holding the neural part of the retina against the pigmented part of the retina. (Snell 2012)

2.1.12.11The Lens : The lens is a transparent, biconvex structure enclosed in a transparent capsule. It is situated behind the iris and in front of the vitreous body and is encircled by the ciliary processes. The lens consists of an elastic capsule, which envelops the structure; a cuboidal epithelium, which is confined to the anterior surface of the lens and lens fibers, which are formed from the cuboidal epithelium at the equator of the lens .the lens fiber make up the bulk of the lens. The elastic lens capsule is under tension, causing the lens constantly to endeavor to assume a globular rather than a disc shape. The equatorial region or circumference of the lens is attached to the ciliary processes of the ciliary body by the suspensory ligament. The pull of the radiating fibers of the suspensory ligament tends to keep the elastic lens flattened so that the eye can be focused on distant objects. (Snell 2012)

2.1.13 Accommodation of the Eye: To accommodate the eye for close objects, the ciliary muscle contracts and pulls the ciliary body forward and inward so that the radiating fibers of the suspensory ligament are relaxed. This allows the elastic lens to assume a more globular shape.With advancing age, the lens becomes denser and less elastic and as a result, the ability to accommodate is lessened (presbyopia). This disability can be overcome by the use of an additional lens in the form of glasses to assist the eye in focusing on nearby objects. (Snell 2012)

2.1.14Constriction of the Pupil during Accommodation of the Eye: To ensure that the light rays pass through the central part of the lens so spherical aberration is diminished during accommodation for near objects, the sphincter papillae muscle contracts so the pupil becomes smaller. (Snell 2012)

2.1.15 Convergence of the Eyes during Accommodation of the lens: In humans, the retinae of both eyes focus on only one set of objects (single binocular vision). When an object moves from a distance toward an individual the eyes converge so that a single object not two is seen. Convergence of the eyes results from the coordinated contraction of the medial rectus muscles. (Snell 2012)

2.2 Sonographic Anatomy:

Examination of a normal globe at high system sensitivity reveals two echographic areas, separated by an echo free area. The echographic area at the beginning of the scan represents vibrations at the tip of the probe and has no clinical significance. When the scan resolution is good one could see the posterior convex structure of the crystalline lens. The large echo free area represents the vitreous cavity. The echogenic area after the vitreous represents the retina, choroid, sclera, and the orbital tissue behind it. The retina is seen as a concave surface proximally. The optic nerve shadow is seen as a triangular shadow within the orbital fat. The first few mm comprising the cornea, anterior chamber and anterior lens capsule are not easily visualized without adequate standoff or an immersion technique Lens. The entire lens can be seen with the standoff technique or an immersion scan. It is seen as an oval high reflective structure with intralesional echoes varying from none to highly reflective depending on the amount of cataract. This is acoustically clear but can show low reflective echoes depending on the amount of syneresis in older people. A senile posterior vitreous detachment can be seen in the elderly as a smooth, mobile low reflective membrane having no posterior pole attachments. Retina, Choroid and Sclera All three are seen as a single high reflective structure. The layers are seen distinctly only in pathological conditions such as retinal detachment, choroidal effusion, scleritis, etc. Optic Nerve this is seen as a wedge shaped acoustic void in the retrobulbar region on an axial scan. This view however gives limited information. The vertical transverse approach at low gain settings is the ideal view for imaging the optic nerve. Extraocular Muscles these are seen as echolucent to low reflective fusiform structures within the orbit, extending posteriorly from their tendinous insertions towards the orbital apex. The superior rectus- LPS complex is the thickest and the inferior rectus is the thinnest of the muscles. The inferior oblique is usually not imaged except in pathological conditions. (Nethralaya 2006)

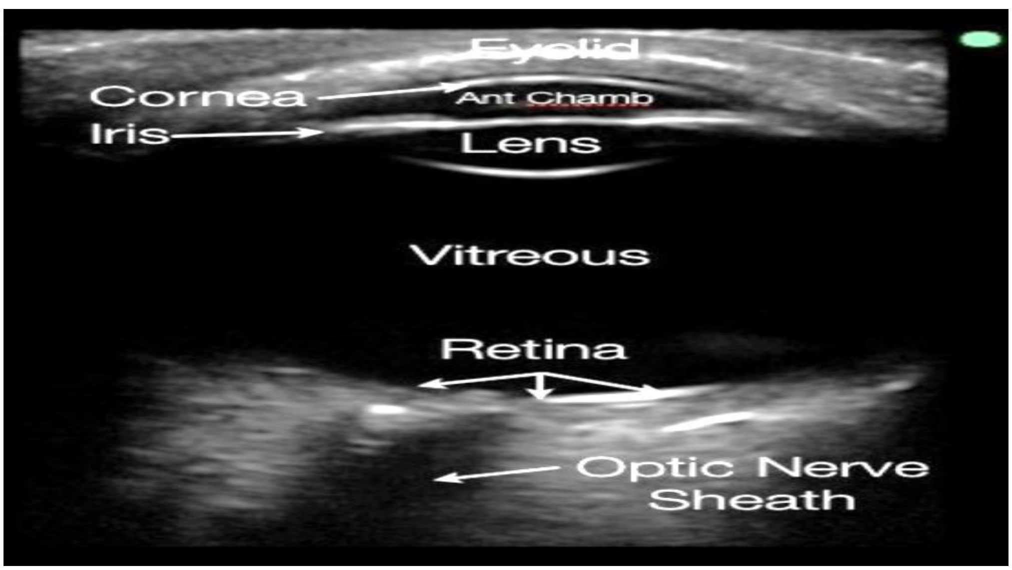

Figure (2.6): normal Ultrasongraphyvitreous cavity, concave retinochoroidal layer and the optic nerve show (Nethralaya 2006)

2.3 Ocular physiology:

Sight begins when light rays from an object enter the eye through the cornea the clear front window of the eyeball's light ray bending capability the cornea's refractive power bends the light ray in such a way that they pass freely through the pupil , the size changing hole in the iris . The iris is the structure that gives the eyes color works like a shutter in a camera. It has the ability to enlarge and shrink depending on how much light the environment is sending into the pupil . After passing through the iris the light rays strike the eye's crystalline lens .this clear flexible structure works much like the lens in a camera shortening and lengthening its width in order to focus light rays properly . In a normal eyeball after exiting the back of the lens.the light rays pass through the vitreous , the vitreous humor helps the eye hold its spherical shape . finally the light rays land and come to sharp focusing point on the retina . The retina is much like the film in a camera , it is responsible for capturing all the light rays , processing them into light impulses through millions of tiny nerve endings then sending these light impulses through over a million nerve fibers to the optic nerve . The optic nerve is sort of like an extension of the brain .it is a bundled cord of more than a million nerve fibers .the light impulses travel through this nerve fiber to the brain , where they are interpreted as an image .(https://www.nkcf.org)

2.4 The Visual System Pathways to the Brain:

The neural signals initially processed by the retina travel via the axons of the ganglion cells through the optic nerves, dividing and partially crossing over into the optic chiasm and then travelling via the optic tracts to the lateral geniculate nucleus (LGN). From the LGN, the signals continue to the primary visual cortex, where further visual processing takes place.The optic nerve of each eye consists of a bundle of approximately 1 million retinal ganglion cell axons. The nerve connects to the posterior aspect of the eye in a position that is about 15° nasal to the macula. The connection is referred to as the optic nerve head and is visible when looking into the eye using an ophthalmoscope. The optic nerve head is approximately 1.8 mm (0.07 in) in diameter. Since there are no photoreceptors (rods or cones) overlying the optic nerve head, there is a small blind spot or "scotoma" of approximately 5° in size about 15° temporal to fixation in the visual field of each eye. When both eyes are open, the blind spot of each eye is "filled in" by the visual field of the other eye. The optic nerves of each eye continue posterior and then meet at the optic chiasm. It is here that axons of neurons from the nasal retina (temporal visual field) cross to the opposite or "contra lateral" optic tract (e.g. axons from the right eye temporal visual field cross to the optic tract on the left side of the brain). Axons of neurons from the temporal retina (nasal visual field) continue along the same side optic tract (same side of side of the visual field are traveling to the brain via the left optic tract and signals from the left visual field are traveling via the right optic tract the brain). This means that visual signals from the right. Each optic tract terminates at its LGN. If a stroke, aneurism or tumor causes damage along the visual pathway, it is often possible to diagnose the exact location of the insult by measuring the visual field. For instance, a pituitary tumor would appear near the optic chiasm and the impact on the visual field would be on the fibers that are crossing to the other side of the brain. Since these fibers are from the nasal retina of each eye, the loss of vision would be in both temporal visual fields defect. whereas an insult to one of the optic tracts would result in a loss of vision to the opposite or contra lateral side of the visual field. For instance, a defect to the right optic tract would cause a loss of the left visual field of both eye The visual cortex in the occipital lobe of the brain is where the final processing of the neural signals from the retina takes place and “vision” occurs. The occipital lobe is at the most posterior portion of the brain. There are a total of six separate areas in the visual cortex, known as the V1, V2, V3, V3a, V4 and V5. The primary visual cortex or V1 is the first structure in the visual cortex where the neurons from the LGN synapse. In V1, the neural signals are interpreted in terms of visual space, including the form, color and orientation of objects. (Mohamed2019)

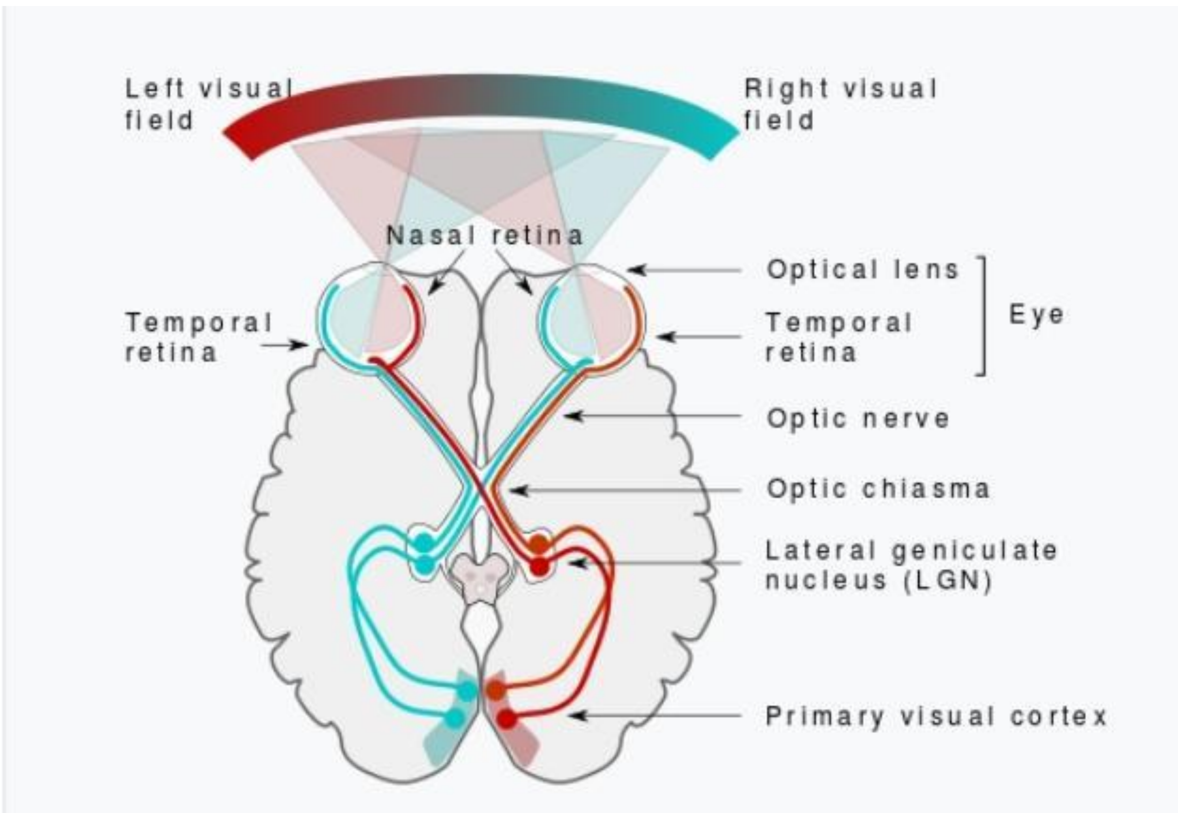

Figure (2.7) The central visual system (Zar Sky 2016)

2.5 Ultrasound Physical

The effective use of ophthalmic ultrasound requires a basic knowledge of its physical nature and the phenomena associated with its propagation and scattering. This understanding is important for proper interpretation of clinical results and avoidance of misleading artifacts that can arise in ocular examinations. It is also important for evaluating emerging techniques that promise to extend the scope of ultrasonic examinations in the future as well as to best use other techniques for complementary diagnostic value. Ultrasound is a high-frequency acoustic wave using frequencies outside the normal hearing range (20 Hz to 20 kHz). Most ophthalmic equipment is set at (8MHz) or higher. This contrasts with ultrasound equipment used for general surgery or obstetrics that works at (5–6 MHz) allowing a greater depth of tissue penetration but reduced resolution. Probes generating frequencies up to(20 MHz) and, in the case of (UBM), up to (50 MHz) are now also used in ophthalmology. These allow resolution of very small structures. The probe contains quartz or ceramic crystals (usually lead zirconate titanate) that vibrate when a voltage is applied, generating a sound wave of constant frequency and amplitude. This is known as the piezoelectric effect. The higher the frequency, the shallower is the depth of tissue penetration. Increasing the energy of the wave will increase penetration but will increase heat generation. (Dibernardo … et al 2007)

2.6 Pathology:

2.6.1 Cataract: is the name given to any light-scattering. Opacity within the lens. When it lies on the visual axis or is extensive, it gives rise to visual loss; when It lies outside the papillary zone, it may have little effect on vision. cataract is the commonest cause of treatable blindness in the world .The majority of cataracts occur in older subjects and are referred to as age related. They result from accumulative exposure of the lens to environmental and other influences, such. As diabetes, UV and ionizing radiation, corticosteroids and smoking, age of onset is lower in countries with the highest prevalence of cataract reflecting the influence of special cataract genic factors such as high

UV. Exposure, poor diet and chronic disease . A smaller number of cataracts are associated with specific ocular or systemic diseases or defined physicochemical. mechanisms.Some congenital, infantile and even . adult cataracts maybe inherited.

Some ocular causes of cataract:

Ocular trauma–such as apenetrating injury, but also blunt trauma to the globe. Uveitis–unilateral if the uveitis affects one eye only. High myopia. Topical medications (such asteroid eye drops). Intraocular tumour–ciliary body tumours may impinge physically on the lens.

Some systemic causes of cataract:

Diabete Other metabolic disorders (including galactosaemia and hypocalcaemia Systemic drugs (particularly steroids, also chlorpromazine). X-radiation. Infection (congenital rubella). Atopy (accompanying atopic dermatitis) Inherited (congenital cataracts and some adult cataracts as in myotonic dystrophy Syndromes (Down syndrome, Lowe syndrome)

Symptoms of cataract:

Pain less loss of vision glare–due to light scattering. a change in refraction In neonates and infants , cataract causes amblyopia. A failure of visual maturation (which may be profound) which occurs when the retina is deprived of a formed image atacritical stage of visual development. (Bron 2017)

2.6.2 Glaucoma : Glaucoma is generic name for group diseases in which for a variety of reasons, the intraocular pressure increases to a level which impairs the vascular perfusion of the neurological disease and causes blindness. The rise in pressure is due to obstruction so the outflow of aqueous, which occurs either as the result of closure of the chamber angle or as the result of an abnormality within the outflow system. (Mohamed 2019)

2.6.3 TRACHOMA It is a chronic keratoconjunctivitis caused by infection with Chlamydia trachomatisand is characterized by inflammatory changes in the conjunctiva in children with subsequent scarring, corneal opacity and blindness in adults . Etiology: Endemic trachoma is caused by the four ocular serotypes of C. trachomatis. C trachomatisis probably transmitted between individuals by a variety of mechanisms, including: (a direct spread from eye to eye during close. contact such as during play or sleep, b) spread of infected ocular or nasal secretions on fingers, c) indirect spread by fomites such as infected facecloths, d) transmission by eye-seeking flies. No non-human reservoir of infection has been found, with flies only acting as passive vectors. Epidemiology Trachoma is a major cause of blindness in many less-developed countries especially in poor rural areas .Blinding trachoma is believed to be endemic in over 50 countries, with the highest prevalence of active disease and trichiasis in Africa. Risk factors for trachoma are recognized associated to inadequate conditions of hygiene and poverty as water scarcity, limited access to latrines and crowded living conditions Ocular Surface Active trachoma is predominantly seen in young children with equal prevalence in male and female, becoming less frequent and shorter in duration with increasing age. Conjunctival scarring accumulates with age, usually becoming evident in the second or third clinical features active disease is characterized by recurrent episodes of chronic, follicular conjunctivitis. (Herranz-Corrales 2013)

2. 6.4 Vitreous Hemorrhage:

Vitreous hemorrhage spreads diffusely in the gelatinous vitreous, obscuring the optic disk, and does not form a fluid meniscus unless the bleeding is in the space around the vitreous. The causes of vitreous hemorrhage include vitreous detachment, diabetic retinopathy, retinal microaneurysm, trauma, and vascular tumors. The patient complains of black rain” and has reduced visual acuity.

The hemorrhage is absorbed slowly and the clinical course depends on the exact cause. If choroid tumors are large or near the optic disk, enucleation of the eye is sometimes necessary. However, brachytherapy that is, radiation plaques placed outside the sclera adjacent to the tumor is the preferred mode of treatment. **(**Srivastava …et al 2007)

Figure (2.8) Vitreous hemorrhage (Coleman2008)

2. 6.6 Asteroid Hyalosis:

is a unilateral condition characterized by formation of calcium soaps within the vitreous cavity, appears as bright round signals on B-scan, and medium amplitude spikes in A-scan, with an echo free space just in front of the retina that represents the echo free vitreous gel. This is in contrast to an eye with emulsified silicone oil, where there is no echo-free space. Generally these opacities exhibit distinct movement on movement of the eye.(Mohamed 2019)

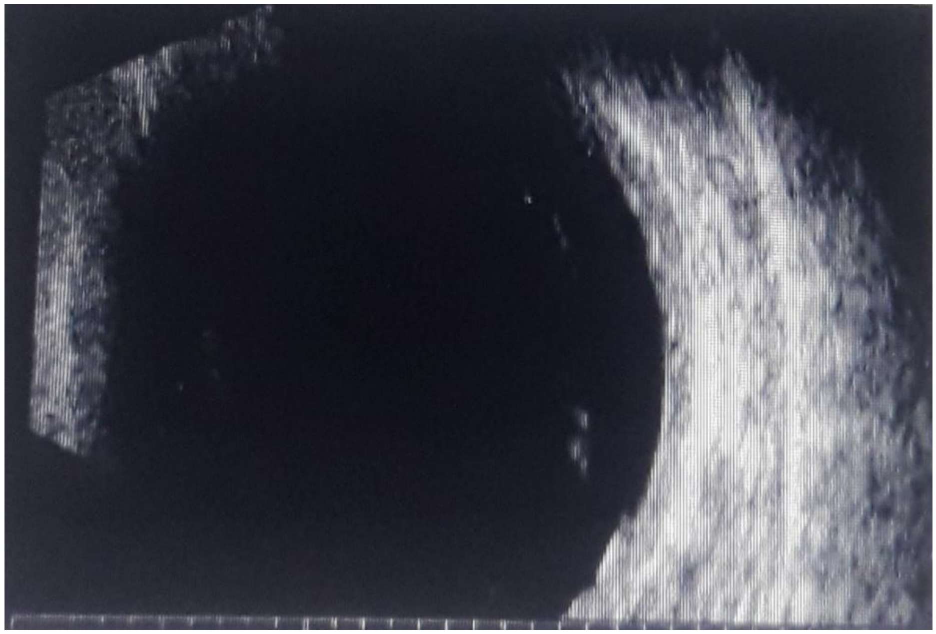

Figure (2.9) sterid hylosis (Murray 2014)

2.6.7 Vitreous floaters:

Appear as one or more echo dots of less brightness in the mid posterior vitreous cavity which show mobility with after movement display on Bscan. These may be associated with enlarged globe size. (Dibernardo … et al2007)

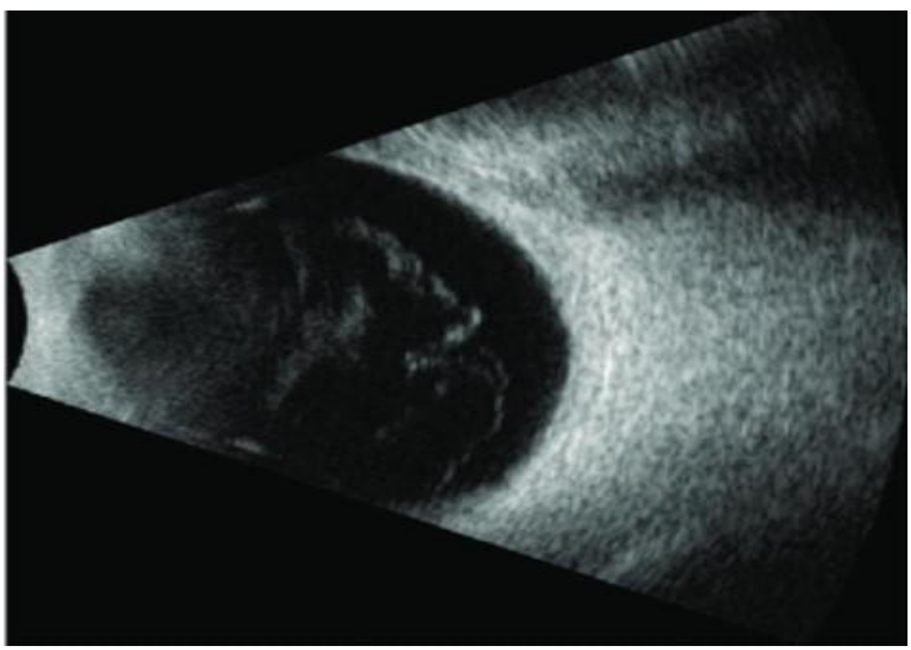

Figure (2.10) vitreous flotars (Marnoy)

2. 6.8 Posterior Vitreous Detachment:

A Posterior vitreous detachment (PVD) appears as an undulating membrane in front of the retinochoroidal layer that moves with movement of the eye. It may separate completely from the posterior pole or may remain attached to the optic disk. PVD may be complete or incomplete. It is incomplete in most of the vascular retinopathies associated with vitreous hemorrhage, particularly proliferative diabetic retinopathy (PDR). (Dibernardo 2007)

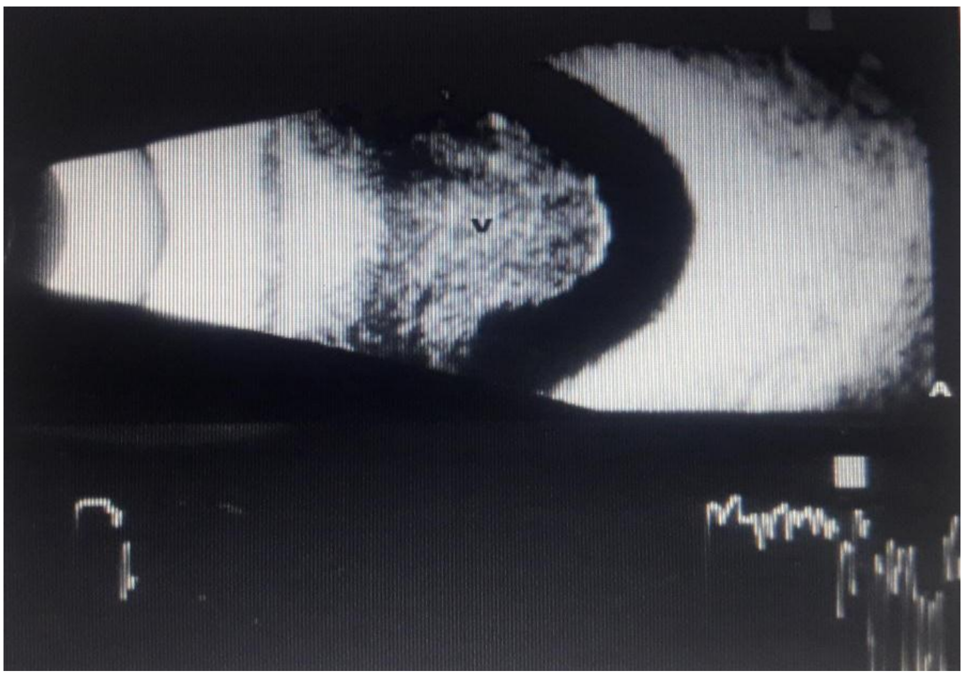

Figure (2.11) posterior vitreous detachment (Dibernardo 2007)

2. 6.9Retinal Detachment : Retinal detachment means separation of neurosensory retina from the pigmentary retina. It may be total/subtotal ‘ local ized/ peripheral or fresh/ old with proliferative vitreoretinopathy (PVR) changes. On Bscan, it appears as echogenic dense membrane, biconvex or biconcave .

Figure (2.12) Axial scan showing total retinal detachment. (dibernardo 2007)

2. 6.10 Diabetic retinopathy:

Diabetes can damage the small blood vessels in the retina. Blood vessels of retina can break down, leak, or become blocked affecting oxygen and nutrient delivery to the retina impairing vision over time. More damage to the retina can occur when abnormal new blood vessels grow on the surface of the retina and leak fluid or bleed. This can result in blurring of vision initially and in late stages; retinal detachment and/or glaucoma may develop. Untreated diabetic retinopathy progresses through four stages mild non-proliferative, diabetic retinopathy, moderate non-proliferative diabetic retinopathy and severe non pro- liferative diabetic retinopathy, non-proliferative diabetic retinopathy (NPDR): is the early stage of this disease. Small blood vessels bulge in mild NPDR, followed by blood vessel blockage in moderate NPDR, and greater vessel blockage and loss of blood supply in severe NPDR. Proliferative diabetic retinopathy (PDR): The most advanced stage of diabetic retinopathy is (PDR). It is marked by the growth of new, fragile, abnormal blood vessels on the retina or optic nerve. These blood vessels can leak blood into the eye and lead to severely blurred vision. This bleeding may cause dark spots (floaters), strands that look like cobwebs, or clouded vision. The abnormal blood vessels can scar and contract, sometimes pulling the retina away from the back of the eye, causing a retinal detachment. This may result in loss of vision or even blindness if it is not treated in a timely manner If abnormal new blood vessels block the normal flow of fluid out of the eye, pressure may build up in the eye. This can damage the nerve that carries information from the eye to the brain (optic nerve), resulting in glaucoma and possible vision loss. (Dibernardo2007)

2.6.11 Intraocular Foreign Body:

Ultrasonography can detect both metallic and non-metallic foreign bodies. Metallic foreign bodies produce very bright signals on B-scan that persist on lowering the gain When the sound beam is focused on the metallic foreign body, much of the sound waves are absorbed by the foreign body, thus creating a shadowing artifact on the adjacent orbit. Round metallic foreign bodies classically produce reverberation artifact just behind the foreign body and the sound signals gradually reduce as it progresses to the orbit. On A-scan metallic foreign bodies produce high (100%) reflective echoes, and reduplication echoes are seen as progressively decreasing amplitude spikes behind the round metallic foreign body. Glass and vegetative matter (radiolucent) are more challenging, but they also produce bright signals on B-scan, and tall reflective echo on A-scan. (Mohamed 2019)

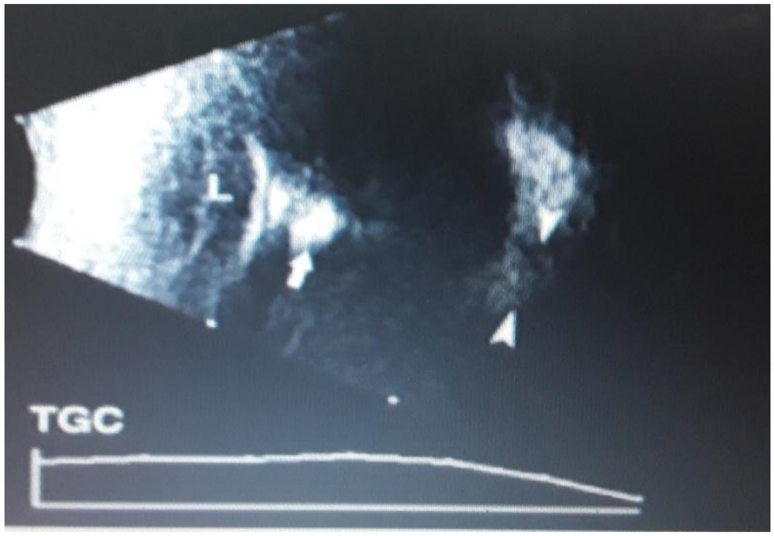

Figure (2.13) B Scan image of an intral-ocular foreign body (Nethralaya 2006)

2.6.12 Dislocated Lens Matter:

Usually occurs during cataract surgery .Can be a spontaneous occurrence due to preexisting zonular dehiscence or following trauma. Either the entire lens, nucleus, or parts of it can be dislocated into the vitreous Presence of retained lens fragments can cause severe postoperative inflammation Ultrasonography is indicated in cases of significant media opacity (Nethralaya … et al 2006).

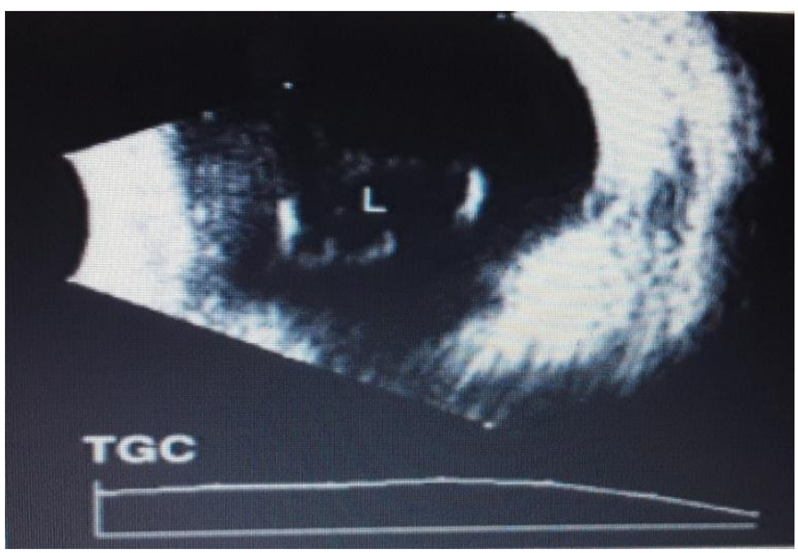

Figure (2.14) B scan image showing a mobile dislocated lens (Nethralaya 2006)

2.6.13 OPTIC DISC DRUSEN:

Cause disc swelling that is commonly misdiagnosed as papilloedema usually bilateral Present from birth but are usually buried and not clinically visible until later in life .Ultrasound is indicated to confirm pseudo opapilloedema. (Nethralaya 2006)

2.6.14 CHALAZION (MEIBOMIAN CYST):

This is a chronic inflammatory granuloma of the tarsal glands caused by infection of the retained sebaceous material inside the gland. Clinically, it starts slowly and symptomlessly In the beginning it is small and hard,free from the overlying skin. It is much more common in upper lid and is seen more frequently in adults. Patients with chronic inflammatory conditions of lid margin can have multiple lesions in the same lid. Mostly the lesions remain stationary after growing to a certain size, but sometimes spontaneous regression or secondary infection can take place. Rarely, the chalazion develops in the duct of the gland and then sprouts out on the lid.(Wortsman 2018).

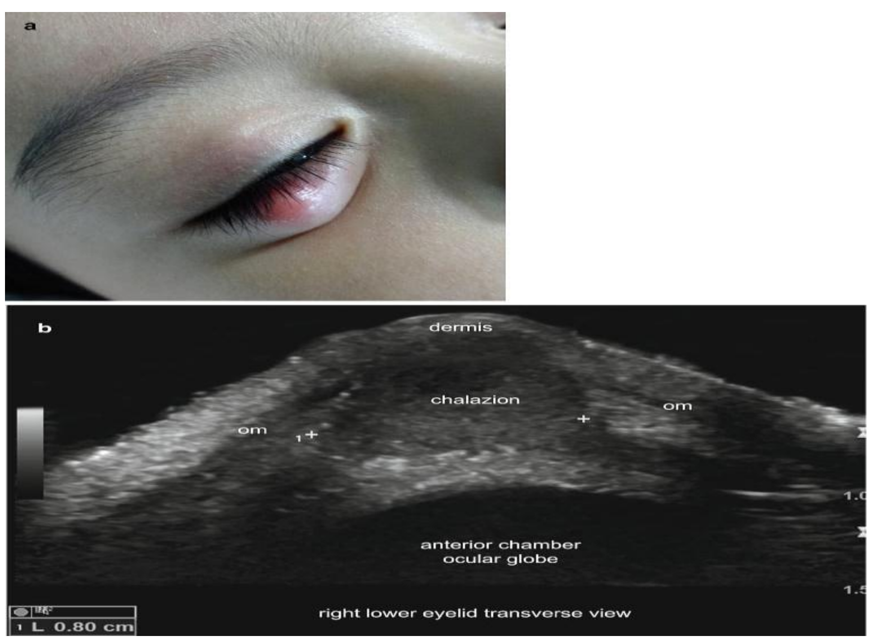

Figure (2.15) Chalazion (Wortsman 2018)

2.6.15 Tumor:

2.6.15.1Choroidal Hemangioma:

Can occur as a circumscribed tumor or a diffuse lesion. The latter is seen in patients with the Sturge Weber syndrome ultrasonographic appearance dome shaped mass at the posterior pole , regular internal structure , no demonstrable internal blood flow and secondary retinal detachment can be quite extensive and may even become total High reflective plaques on the surface may indicate fibrous or osseous metaplasia . (Nethralaya 2006)

2.6.15.2 Choroidal Osteoma: Benign tumor of the choroid that is composed of mature bone Seen in healthy young females in the second or third decade Unilateral in 75-80% of cases. The patient may be asymptomatic or have varying degrees of visual impairment. (Nethralaya 2006)

2.6.15.3 Retinoblastoma (RB): is a rapidly developing intraocular cancer arising from immature retinal cells .95% of cases are in children under 5 years, the most common sign of RB is leukocoria also known as amaurotic cats eye reflex or white eye , maybe unilateral or bilateral .(Midyett – Mukherji 2015).

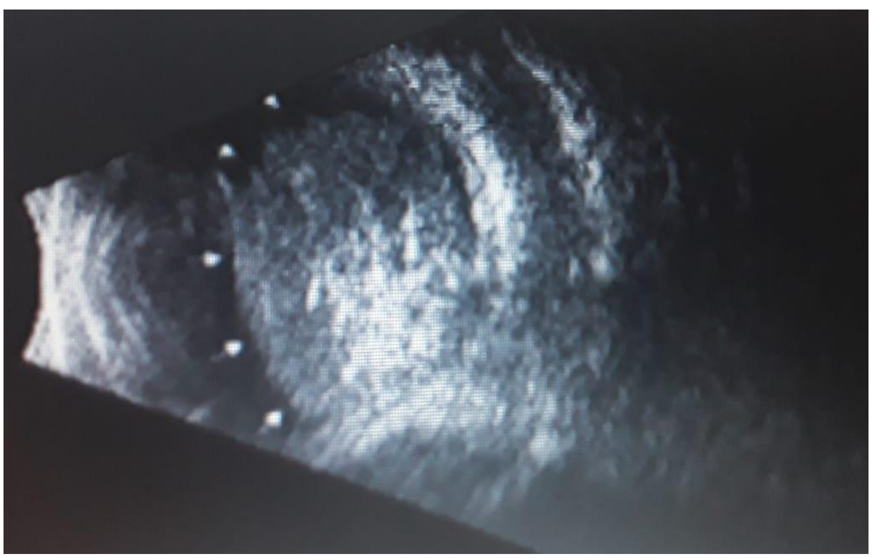

Figure (2.16) Low gain showing internal calcification causing shadowing of the orbit (retinoblastoma) (Singh-Hayden 2008)

2.7 Previous study:

Bengt Jerneld, Deep Algvere ,Gur Singh Acta ophthalmologica 58(2),193-201,1980 , An ultrasonographic study of diabetic vitreo-retinal disease with low visual acuity ninety –three diabetics (168 eyes) with opaque ocular media and low visual acuity (range amaurosis to 0.1) were examined by ultrasonography (A and B –scan) using a coleman ophthalmoscan 100 dense vitreous membranes were found in 112(67%) eyes , 100(60%) of which showed posterior membranes . preretinal or prepapillary proliferations (extraretinal stalks) were demonstrated in 71 (42%) eyes . fifty four (32%) eyes had retinal detachments (40 localized , 14 total) these were present in 10 (50%) of the 20 amaurotic eyes . the ultrasonic accuracy was checked in 49 eyes at vitrectomy . it was 78% for retinal detachments and 67% for prepapillary and preretinal proliferations , the stalks circumscribed within 2 mm or less were the hardest to detect . ultrasonography thus aids to predict the prognosis after vitrectomy, the visual prognosis appears to be much more optimistic in eyes with vitreous membrane and prepapillary proliferations than in those with vitreous membrane associated with preretinal proliferation .

Mashair Abolgasim Abdellateef , Evaluation of Ultrasonography Efficiency in Diagnosing Traumatized Eyes in Sudan , This a prospective study conducted to evaluate the effects of trauma on eye where 53 traumatized eye patients visited trauma clinic in makkah hospital for eye in khartoum and all undergone , Ultrasound imaging by B-Scan machine with high frequency sector transducer (10MHrz) ,the result of this study showed that the right eye is sustained to trauma more than the left but in closely ratio is (54.7%to 45.3%) , also the ratio is close between the blunt (50.9%) and penetrating trauma (47.2%) ,but there is a big difference between these two types and postsurgical trauma (1.9%), this big difference might be due to lack of data as a result of poor management . In relation to gender the study found that males are sustained penetrating trauma (51.1%) , whereas females experience blunt trauma (60%) . Causative factors varied from sharp objects to solid objects, which lead to variations in the effect: retinal detachment, catract , corneal opacity , detach , vitreous hemorrhage and endophthalmitis . The effects result from eye trauma diagnosed easily and perfectly by B-Scan Ultrasonography and all patients undergone their investigation with closed eyes , which emphasized that B-Scan is effective in diagnosis of traumatized eyes.

Another study by Ofeida Awad Mohamed , this was cross sectional descriptive study for eyes of diabetic patient for of ultrasound in makaah hospital eye Omdurman, in this which was carried out during the period from October 2016 to may 2018 , this study include 150 patients age between (25 above 45) years old. Study to determine the causes of vision defect of eye in diabetic patient used using a Nidek (Echoscan US-4000) ultrasonic unit with a high frequency direct contact 1o MHz .transverse probe position before apply ultrasound gel in the probe . the study found that the females were more affected (60%) than the male (40%) ,the most affected age groups were elderly patient more than 45 years .the study found that the ultrasound could be able to image the anterior ocular structure and therefore can diagnose any pathological change for diabetic patient and U/S findings shows that catract 21(14%) , the patient with retinal detachment (10%) , patient with vitreous hemorrhage (6%) ,the study found that there was significant correlation between duration of disease and U/S finding p.value (0.01)

The study done by Eman Ahmed Osman National Ribat University 2017Assessment of Eye in Diabetic patient using Ultrasound study done by 100 diabetic patients the females were more affected 63 (63%) than the male 37(37%) .US finding showed that most of the patients (25%) were diagnosed as vitreous detachment and (19%) with retinal detachment which, also found vitreous hemorrhage (5%) posterior vitreous detachment (5%) and vitreous change + cataract (10%).

Michele Bertolotto , G Serafini , LM Sconfienza , F Lacelli , M Cavallaro , A Coslovich , Daniele Tagnetto , MARIA ASSUNTA Cova , Ultraschall in der Medizin –European Journal of Ultrasound 35 (02), 173-180, 2014 , The use of CEUS in the diagnosis of retinal /choroidal detachment and associated intraocular masses preliminary investigation in patients with equivocal findings at conventional . Purpose : To investigate whether contrast enhanced ultrasound (CEUS) may help to diagnose retinal/choroidal detachment and may help to differentiate intraocular lumps in cases with equivocal features on conventional grayscale and doppler modes . Result : a total of 31patients (18 men , 13 women) according to the reference standard ,13 patients had retinal detachment , 4 had choroidal detachment and 3 hadboth retinal and choroidal detachment there were 8 associated intraocular lumps (4 subretinal hemorrhage , 3 malignant melanomas , 1 metastasis) . The inter reader agreement was good (K=0.644) and very good (K=0.833) for conventional modes and CEUS , respectively . The diagnostic performance of CEUS was high for both reader (area ± standard error under the ROC curve : 0.966 ± 0.031 and 0.900 ± 0.055 for readers 1 and 2 , respectively) . There were 2 false –positive results and 1 false –negative result in patients with proliferative diabetic retinopathy .CEUS was effective in differentiating sub retinal hypovascular tumors.

Christopher R Forrest , Andrew C Lata , Daniel W Marcuzzi , M Hugh Bailey, Plastic and reconstructive surgery 92(1), 28-34, 1993, The role of orbital ultrasound in the diagnosis of orbital fractures ,the objectives of this study were to define the role of orbital ultrasound in the assessment of the traumatized orbit and to provide correlation of pathology with CT imaging . eighteen patients (16 males , 2 females) having sustained trauma to the orbitozygomatic region the results of the study revealed a positive correlation between ultrasound and CT findings in 17 (94 percent) and specificity (100 percent) and positive predictive value (100 percent) when compared with CT scanning .soft tissue herniation , orbital emphysema and muscle entrapment were well visualized by means of real time ultrasound .

Another study done by Jasmin Zvornicanin Vahid Jusufovic , Emir Cabric , Zlatko Musanovic , Edita Zvornicanin , Allen Popovic –Beganovic , Medical Archives 66(5),318, 2012 ,Significance of ultrasonography in evaluation of vitreoretinal pathologies ,This prospective study, To assess the diagnostic value of ultrasonography in the detection of vitreoretinal pathologies . The result :Study included 146 eyes from 122 patients . 58 (39,7%) eyes had poor posterior segment visualization , 21 (14,4%) eyes due to dense cataracts and 37 (25, 3%) eyes due to different vitreous opacities . 88(60,3%) eyes had good or partial posterior eye segment visualization , where 67(45,9%) eyes had proliferative vitreoretinopathy and 55(37,7%) eyes had tractional retinal detachment . Most common causes for referral to vitreoretinal surgeon were ocular complications of diabetes mellitus 94(64,4%) , ocular trauma 18(12,3%) rhegmatogenous retinal detachment 16(10,9%) and intraocular inflammation 9(6,9%).

Chapter three

Materials and Methods

Chapter Three

3.1Material

3.1.1 Type of the study

Descriptive, analytical study.

3.1.2 Population of the study

All patients who presented with diabetes, were investigated by U/S

3.1. 3 Study area and duration:

The study was conducted in Sudan-Khartoum in ultrasound department in makaah hospital, during the period from 2016 – 2019.

3.1.4 Sample size

The sample size consist of 300 Sudanese patients were selected randomly.

3.1.5 Inclusion criteria

All diabetic Patients.

3.1.6 Exclusion criteria

Children Patients.

3.1.7 Study variables

- Patient age, gender, residence, duration of illness and symptoms.

3.2 Method:

3.2.1 Ultrasound technique:

Patient Positioning

Ultrasound evaluation of the eye and orbit is performed in the supine or sitting position. The probe is 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 is used to provide standoff and avoid attenuation caused by air.

Figure (3.1) ocular ultrasound (LIoyd 2017)

3.2.2 Method of data collection

1- Data collection sheet which was designed to include all variables to satisfy the study.

2. Ultrasound scanning finding each patient was scanned by experience Sonographer to get accurate result using an international scan guidelines and protocols.

3.2.3 Equipments used

Using a Nidek (Echoscan US – 4000) ultrasonic unit, equipped wih a high frequeny direct contact 10 MHZ transducer, display on the 110×20 cm graphics sony thermal printer. Initial examination was performed under high gain (80 dB to 100 dB) and low gain (60 dB to 70 dB) sensitivity for more detailed inspection during ultrasonography.

3.2.4 Ethical consideration: To ensure combined validity and reliability the ultrasound results was verified by experience sonographer who had expertise in performing ultrasound scanning. To ensure generalizability all patients were scanned by the same ultrasound machine using the same international guidelines and protocol for performing ultrasound and with using the same room preparation, then it is assumed that patients offered the same level performing ultrasound.

Justice and human dignity was observed by treating selected patients equally when telling them to participate in the research as sample of this Study. The patients were free to decide whether to participate or not.

3.2.5 Data analysis:

It carried out by statically pockage for social sciences SPSS program version 16 and the result were presented in form of graph and table .

3.2.6 Data storage:

Patient's data sheets kept in locked cabinet, and all data stored on personal computer.

Chapter four

Results

Chapter four

4. Results

Table (4.1) frequency distribution of age \years

Age \years	Frequency	Percent	Valid Percent	Cumulative Percent
35-49	23	7.7	7.7	7.7
50-59	55	18.3	18.3	26.0
60-69	183	61.0	61.0	87.0
70-77	39	13.0	13.0	100.0
Total	300	100.0	100.0	
Minimum= 35, maximum=77, mean = 62.28±8.041				

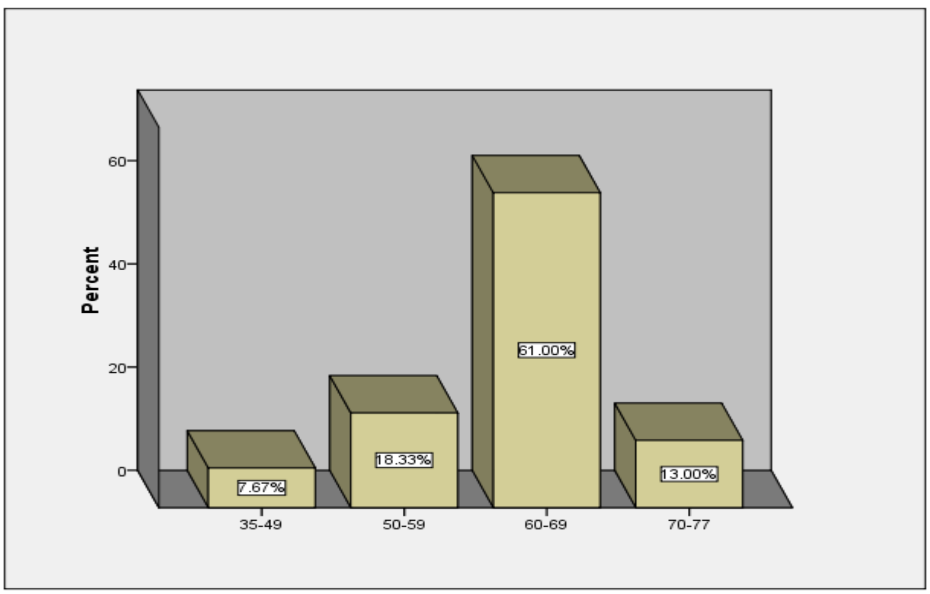

Figure (4.1) frequency distribution of age \years

Table (4.2) frequency distribution of gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Female	141	47.0	47.0	47.0
Male	159	53.0	53.0	100.0
Total	300	100.0	100.0	

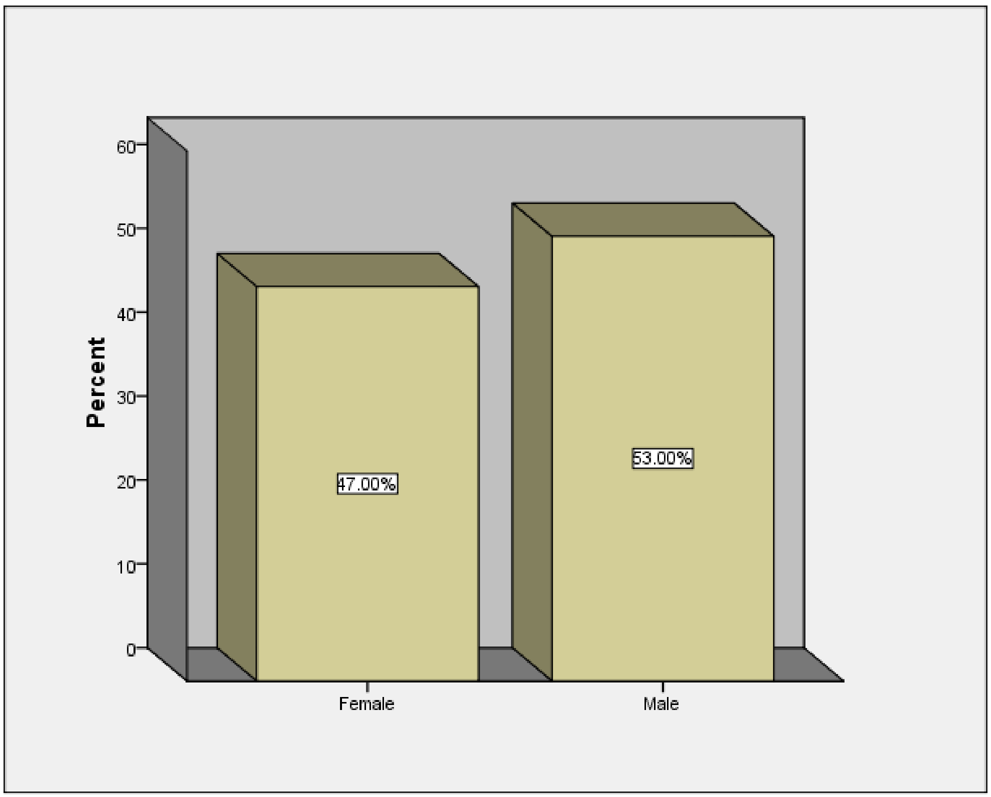

Figure (4.2) frequency distribution of gender

Table (4.3) 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	

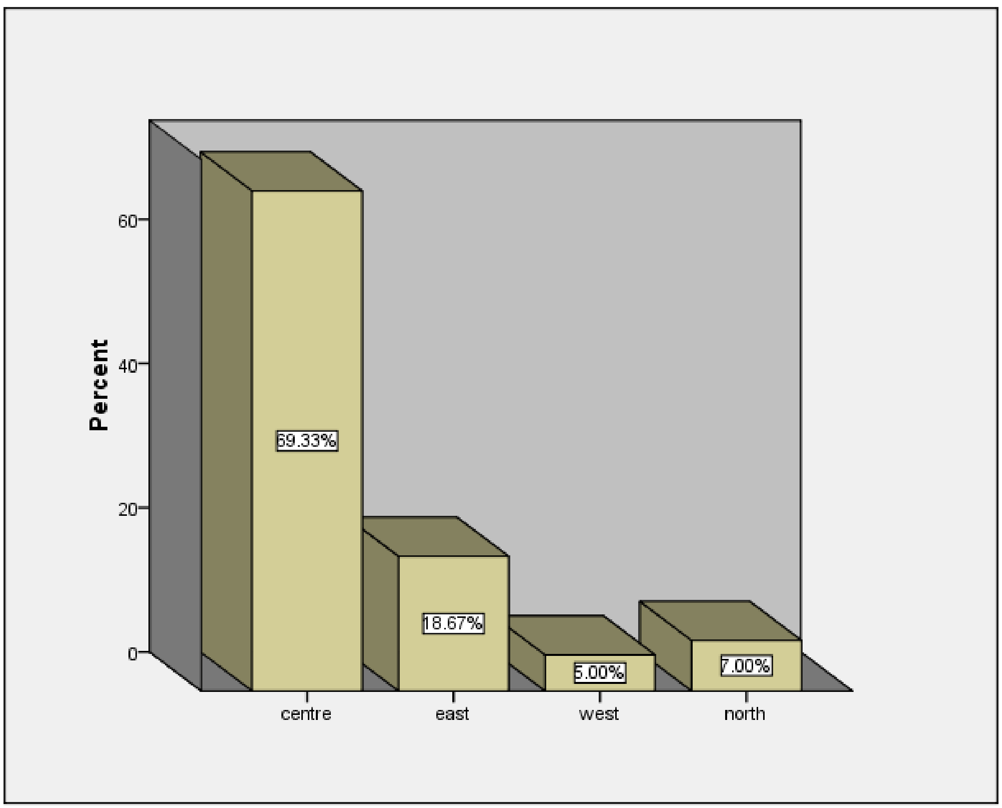

Figure (4.3) frequency distribution of residence

Table (4.4) frequency distribution of duration\years

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				

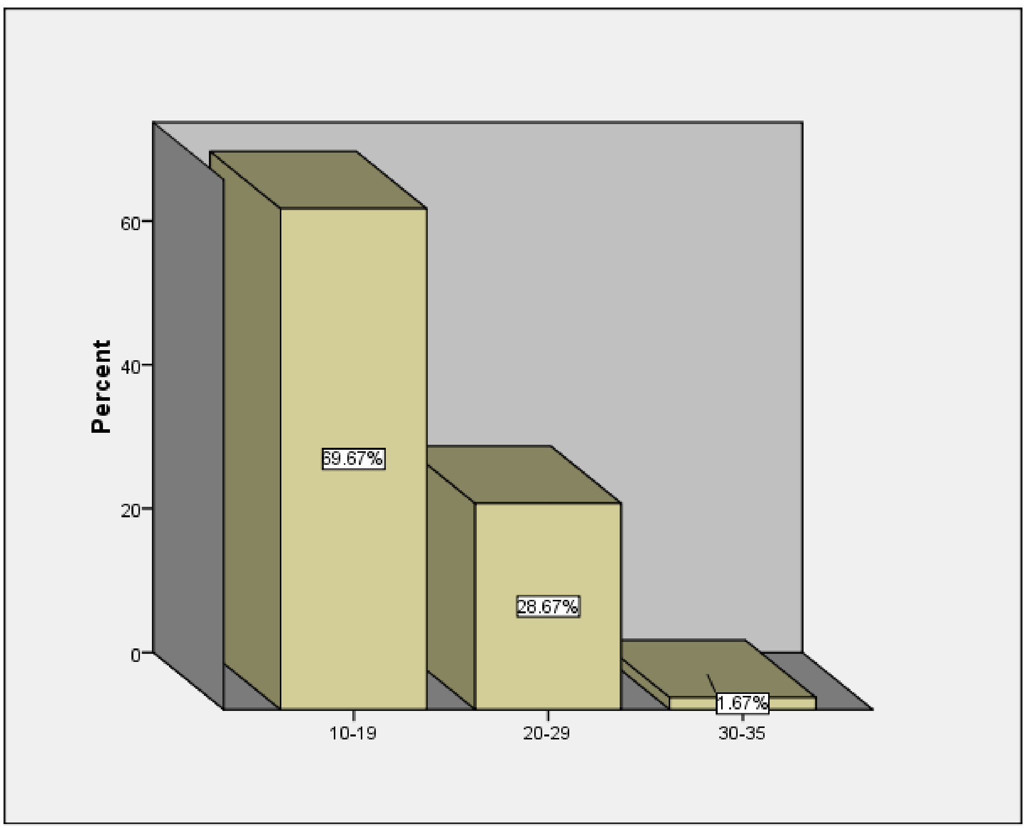

Figure (4.4) frequency distribution of duration\years

Table (4.5) 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	

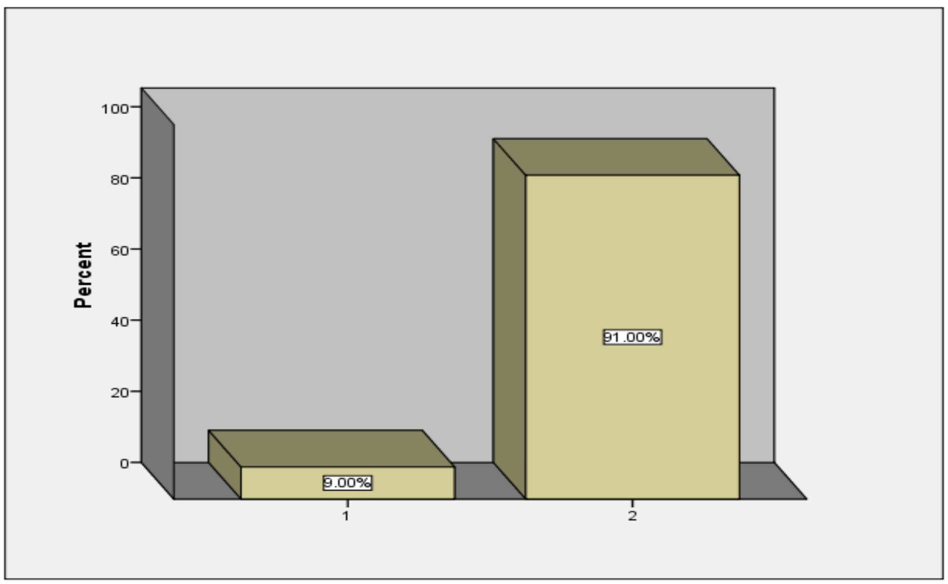

Figure (4.5) frequency distribution of type of DM

Table (4.6) frequency distribution of history

History	Frequency	Percent	Valid Percent	Cumulative Percent
Hypertensive	163	54.3	54.3	54.3
Trauma	57	19.0	19.0	73.3
Thyroid disorder	4	1.3	1.3	74.7
No	46	15.3	15.3	90.0
Renal disorder	4	1.3	1.3	91.3
Trauma + hypertension	20	6.7	6.7	98.0
Heart diseases	3	1.0	1.0	99.0
HIV	2	.7	.7	99.7
Nemophilia	1	.3	.3	100.0
Total	300	100.0	100.0	

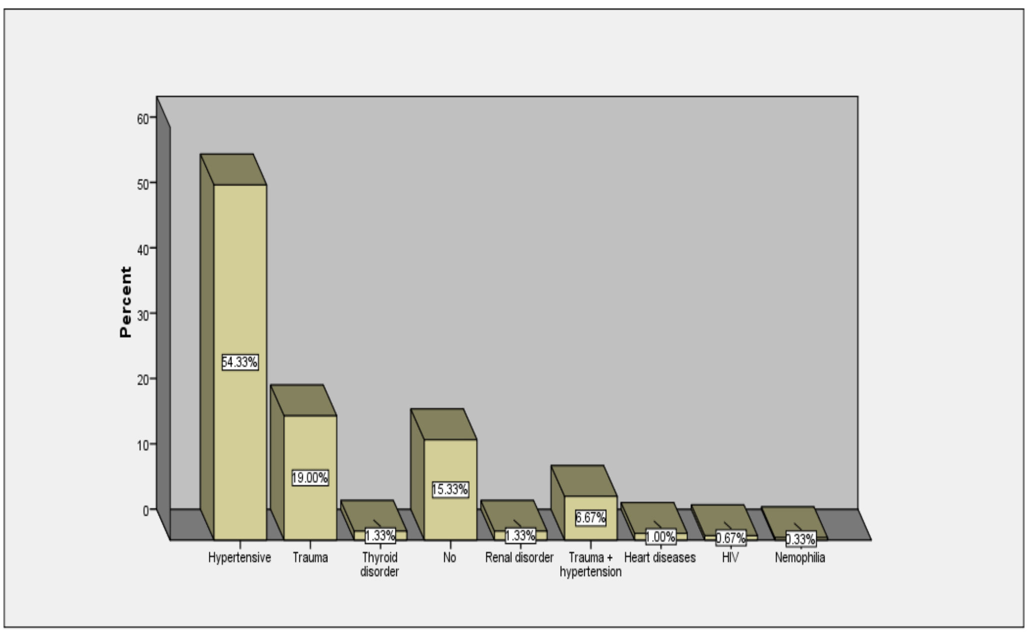

Figure (4.6) frequency distribution of history

Table (4.7) frequency distribution of control of DM (insulin usage)

Control	Frequency	Percent	Valid Percent	Cumulative Percent
No	68	22.7	22.7	22.7
Yes	232	77.3	77.3	100.0
Total	300	100.0	100.0	

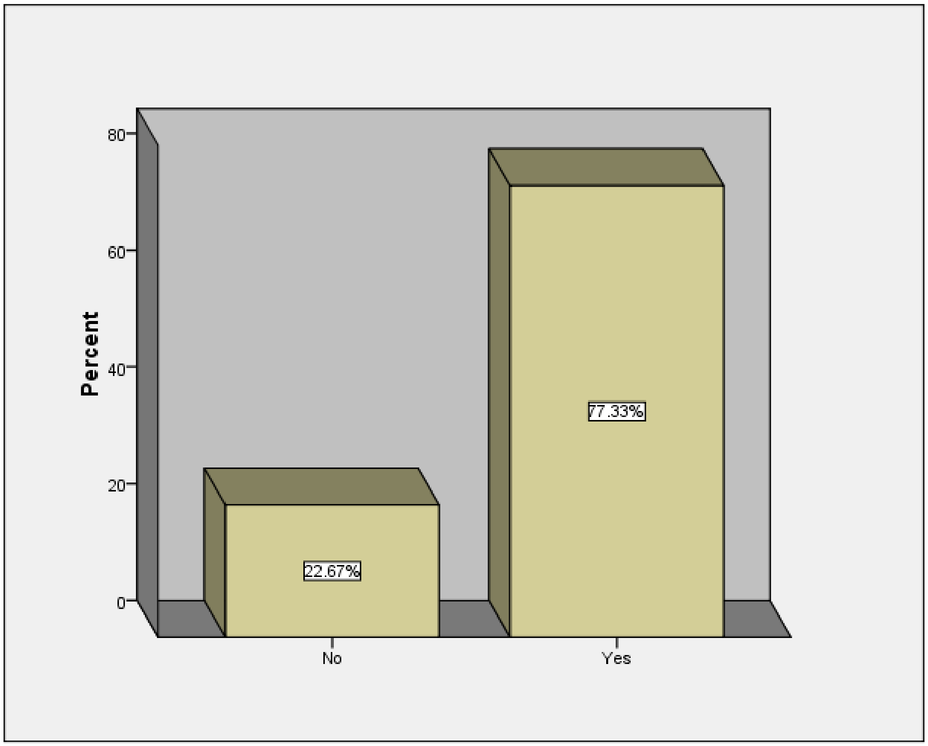

Figure (4.7) frequency distribution of control of DM (insulin usage)

Table (4.8) frequency distribution of affected eye

Side	Frequency	Percent	Valid Percent	Cumulative Percent
Left	144	48	48	48
Right	135	45	45	45
Total	279	100.0	100.0	

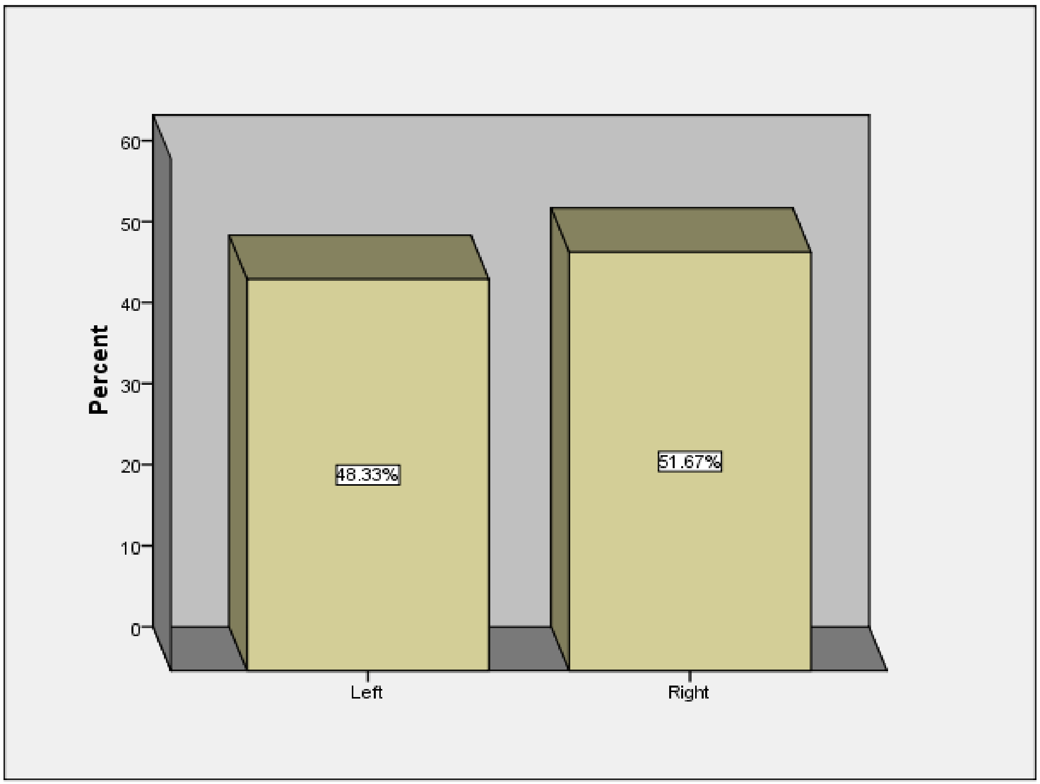

Figure (4.8) frequency distribution of affected eye

Table (4.9) frequency distribution of final diagnosed (ultrasound 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	

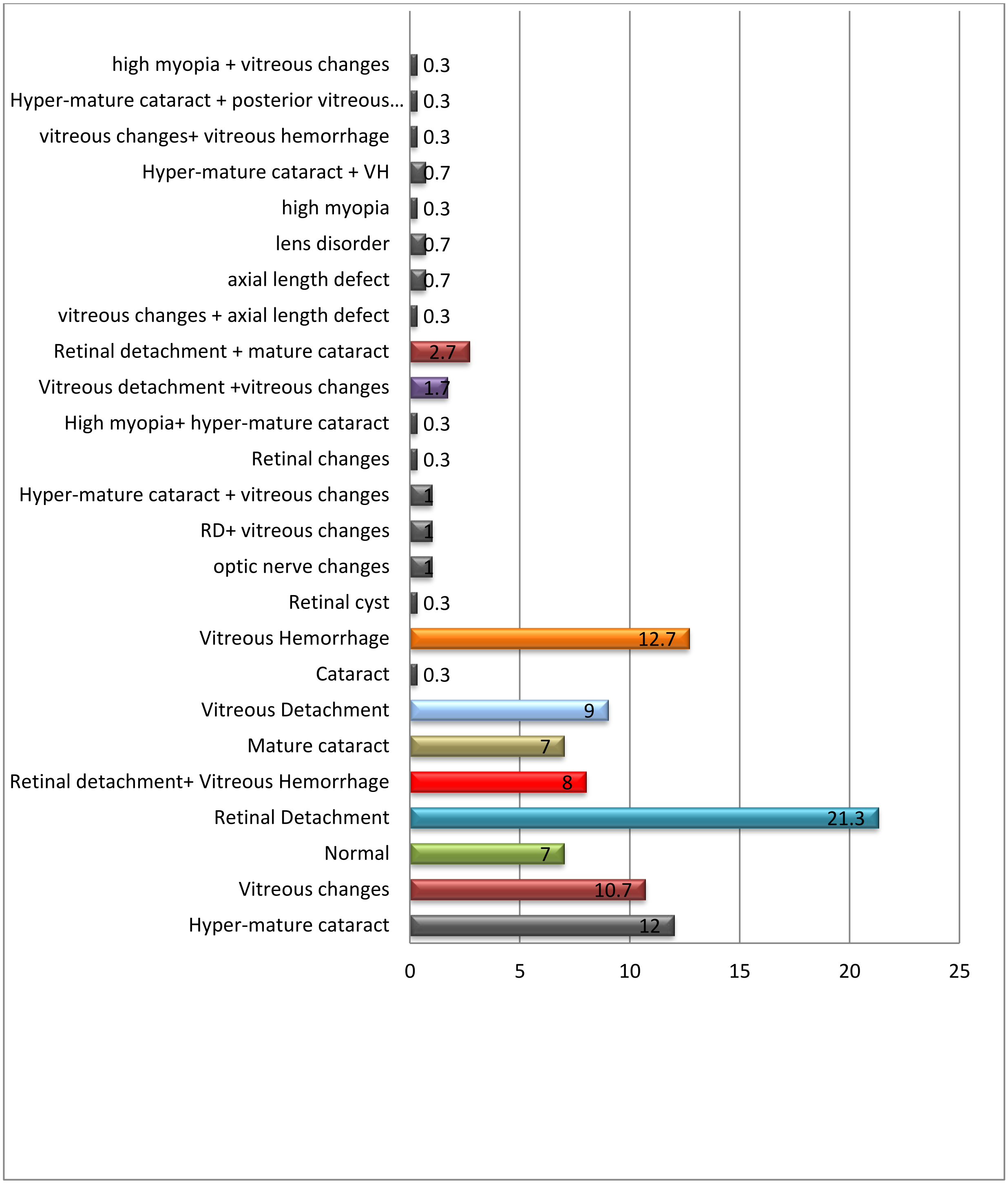

Figure (4.9) frequency distribution of final diagnosed (ultrasound findings)

Table (4.10) cross tabulation age and final diagnosed (ultrasound findings)

Final diagnosed	Age years				Total
	35-49	50-59	60-69	70-77	
Hyper-mature cataract	2	4	23	7	36
Vitreous changes	5	4	18	5	32
Normal	1	8	12	0	21
Retinal Detachment	6	9	40	9	64
Retinal detachment+ Vitreous Hemorrhage	0	3	17	4	24
Mature cataract	3	4	14	0	21
Vitreous Detachment	3	5	17	2	27
Cataract	0	1	0	0	1
Vitreous Hemorrhage	2	11	21	4	38
Retinal cyst	0	1	0	0	1
optic nerve changes	0	0	1	2	3
RD+ vitreous changes	0	1	2	0	3
Hyper-mature cataract + vitreous changes	0	0	1	2	3
Retinal changes	0	1	0	0	1
High myopia+ hyper-mature cataract	1	0	0	0	1
Vitreous detachment+vitreous changes	0	0	4	1	5
Retinal detachment + mature cataract	0	1	5	2	8
vitreous changes + axial length defect	0	1	0	0	1
axial length defect	0	0	2	0	2
lens disorder	0	0	2	0	2
high myopia	0	0	1	0	1
Hyper-mature cataract + VH	0	0	1	1	2
vitreous changes+ vitreous hemorrhage	0	0	1	0	1
Hyper-mature cataract + posterior vitreous detachment	0	0	1	0	1
high myopia + vitreous changes	0	1	0	0	1
Total	23	55	183	39	300
P value =0.110					

Table (4.11) cross tabulation gender and final diagnosed (ultrasound findings)

Final diagnosed	sex		Total
	Female	Male	
Hyper-mature cataract	15	21	36
Vitreous changes	14	18	32
Normal	11	10	21
Retinal Detachment	32	32	64
Retinal detachment+ Vitreous Hemorrhage	6	18	24
Mature cataract	13	8	21
Vitreous Detachment	13	14	27
Cataract	1	0	1
Vitreous Hemorrhage	18	20	38
Retinal cyst	1	0	1
optic nerve changes	1	2	3
RD+ vitreous changes	2	1	3
Hyper-mature cataract + vitreous changes	1	2	3
Retinal changes	1	0	1
High myopia+ hyper-mature cataract	1	0	1
Vitreous detachment+vitreous changes	2	3	5
Retinal detachment + mature cataract	3	5	8
vitreous changes + axial length defect	1	0	1
axial length defect	2	0	2
lens disorder	1	1	2
high myopia	1	0	1
Hyper-mature cataract + VH	0	2	2
vitreous changes+ vitreous hemorrhage	0	1	1
Hyper-mature cataract + posterior vitreous detachment	1	0	1
high myopia + vitreous changes	0	1	1
Total	141	159	300
P value =0.545			

Table (4.12) cross tabulation duration and final diagnosed (ultrasound findings)

Final diagnosed	**Duration\ years**			**Total**
	10-19	**20-29**	**30-35**	
Hyper-mature cataract	26	8	2	36
Vitreous changes	21	11	0	32
Normal	20	1	0	21
Retinal Detachment	41	21	2	64
Retinal detachment+ Vitreous Hemorrhage	14	9	1	24
Mature cataract	18	3	0	21
Vitreous Detachment	19	8	0	27
Cataract	0	1	0	1
Vitreous Hemorrhage	28	10	0	38
Retinal cyst	1	0	0	1
optic nerve changes	1	2	0	3
RD+ vitreous changes	3	0	0	3
Hyper-mature cataract + vitreous changes	0	3	0	3
Retinal changes	1	0	0	1
High myopia+ hyper-mature cataract	1	0	0	1
Vitreous detachment+vitreous changes	4	1	0	5
Retinal detachment + mature cataract	4	4	0	8
vitreous changes + axial length defect	0	1	0	1
axial length defect	2	0	0	2
lens disorder	2	0	0	2
high myopia	1	0	0	1
Hyper-mature cataract + VH	0	2	0	2
vitreous changes+ vitreous hemorrhage	1	0	0	1
Hyper-mature cataract + posterior vitreous detachment	0	1	0	1
high myopia + vitreous changes	1	0	0	1
Total	209	86	5	300
P =0452				

Table (4.13) cross tabulation type of DM and final diagnosed (ultrasound findings)

Final diagnosed	Type of disease		Total
	1	2	
Hyper-mature cataract	3	33	36
Vitreous changes	5	27	32
Normal	1	20	21
Retinal Detachment	7	57	64
Retinal detachment+ Vitreous Hemorrhage	0	24	24
Mature cataract	3	18	21
Vitreous Detachment	2	25	27
Cataract	1	0	1
Vitreous Hemorrhage	4	34	38
Retinal cyst	0	1	1
optic nerve changes	0	3	3
RD+ vitreous changes	0	3	3
Hyper-mature cataract + vitreous changes	0	3	3
Retinal changes	0	1	1
High myopia+ hyper-mature cataract	0	1	1
Vitreous detachment+vitreous changes	0	5	5
Retinal detachment + mature cataract	0	8	8
vitreous changes + axial length defect	1	0	1
axial length defect	0	2	2
lens disorder	0	2	2
high myopia	0	1	1
Hyper-mature cataract + VH	0	2	2
vitreous changes+ vitreous hemorrhage	0	1	1
Hyper-mature cataract + posterior vitreous detachment	0	1	1
high myopia + vitreous changes	0	1	1
Total	27	273	300
P=0.204			

Table (4.14) cross tabulation type of history and final diagnosed (ultrasound findings

	History									Total
	HT	Trauma	Thyroid disorder	No	Renal disorder	Trauma + hypertension	Heart diseases	HIV	Nemophilia	
Hyper-mature cataract	23	7	1	2	0	3	0	0	0	36
Vitreous changes	19	6	0	4	1	2	0	0	0	32
Normal	4	0	0	17	0	0	0	0	0	21
Retinal Detachment	46	3	2	10	0	0	2	1	0	64
Retinal detachment+ Vitreous Hemorrhage	9	6	0	1	0	8	0	0	0	24
Mature cataract	12	5	0	3	0	1	0	0	0	21
Vitreous Detachment	18	1	1	4	2	0	1	0	0	27
Cataract	1	0	0	0	0	0	0	0	0	1
Vitreous Hemorrhage	8	24	0	0	0	4	0	1	1	38
Retinal cyst	0	0	0	0	1	0	0	0	0	1
optic nerve changes	3	0	0	0	0	0	0	0	0	3
RD+ vitreous changes	1	1	0	0	0	1	0	0	0	3
Hyper-mature cataract + vitreous changes	2	0	0	1	0	0	0	0	0	3
Retinal changes	1	0	0	0	0	0	0	0	0	1
High myopia+ hyper-mature cataract	1	0	0	0	0	0	0	0	0	1
Vitreous detachment +vitreous changes	2	2	0	1	0	0	0	0	0	5
Retinal detachment + mature cataract	8	0	0	0	0	0	0	0	0	8
vitreous changes + axial length defect	1	0	0	0	0	0	0	0	0	1
axial length defect	1	0	0	1	0	0	0	0	0	2
lens disorder	2	0	0	0	0	0	0	0	0	2
high myopia	0	0	0	1	0	0	0	0	0	1
Hyper-mature cataract + VH	0	1	0	0	0	1	0	0	0	2
vitreous changes+ vitreous hemorrhage	0	1	0	0	0	0	0	0	0	1
Hyper-mature cataract + posterior vitreous detachment	1	0	0	0	0	0	0	0	0	1
high myopia + vitreous changes	0	0	0	1	0	0	0	0	0	1
Total	163	57	4	46	4	20	3	2	1	300
P value =0.000										

Table (4.15) cross tabulation control and final diagnosed (ultrasound findings)

Final diagnosed	Insulin		Total
	No	Yes	
Hyper-mature cataract	10	26	36
Vitreous changes	8	24	32
Normal	2	19	21
Retinal Detachment	11	53	64
Retinal detachment+ Vitreous Hemorrhage	6	18	24
Mature cataract	8	13	21
Vitreous Detachment	4	23	27
Cataract	0	1	1
Vitreous Hemorrhage	13	25	38
Retinal cyst	1	0	1
optic nerve changes	0	3	3
RD+ vitreous changes	1	2	3
Hyper-mature cataract + vitreous changes	0	3	3
Retinal changes	1	0	1
High myopia+ hyper-mature cataract	0	1	1
Vitreous detachment+vitreous changes	1	4	5
Retinal detachment + mature cataract	0	8	8
vitreous changes + axial length defect	0	1	1
axial length defect	0	2	2
lens disorder	0	2	2
high myopia	0	1	1
Hyper-mature cataract + VH	1	1	2
vitreous changes+ vitreous hemorrhage	1	0	1
Hyper-mature cataract + posterior vitreous detachment	0	1	1
high myopia + vitreous changes	0	1	1
Total	68	232	300
P= 0.224			

Table (4.16) cross tabulation side and final diagnosed (ultrasound findings)

Final diagnosed	side effect		Total
	Left	Right	
Hyper-mature cataract	21	15	36
Vitreous changes	16	16	32
Normal	7	14	21
Retinal Detachment	32	32	64
Retinal detachment+ Vitreous Hemorrhage	7	17	24
Mature cataract	13	8	21
VitreousDetachment	9	18	27
Cataract	1	0	1
VitreousHemorrhage	21	17	38
Retinal cyst	1	0	1
Optic nerve changes	2	1	3
RD+ vitreous changes	1	2	3
Hyper-mature cataract + vitreous changes	3	0	3
Retinal changes	0	1	1
High myopia+ hyper-mature cataract	1	0	1
Vitreousdetachment+vitreous changes	0	5	5
Retinal detachment + mature cataract	4	4	8
Vitreous changes + axial length defect	1	0	1
Axial length defect	0	2	2
Lens disorder	1	1	2
High myopia	0	1	1
Hyper-mature cataract + VH	2	0	2
Vitreous changes+ vitreoushemorrhage	1	0	1
Hyper - maturecataract + posterior vitreousdetachment	0	1	1
High myopia + vitreous changes	1	0	1
Total	145	155	300
P =0.094			

Chapter five

Discussion – Conclusion and Recommendation

Chapter five

5.1 Discussion:

B-scan ultrasound is reported in patients with diabetic eye disease , retinal detachment, vitreous haemorrhage, hypermature cataract , and vitreous change were frequently diagnose. Ultrasound has become an increasingly important role in the diagnosis and early detection of most widespread diseases. It is characterized by availability, ease and cheapness. The study was study diabetic eyes using ultrasound. Diabetes is a very common disease in the world population. It not only causes fatigue but also affects the economy of countries. ultrasonography (US) of the eye is a useful tool in diagnosing conditions of the ocular globe, especially when combined with ophthalmoscopy. Pathologic conditions of the ocular globe include several usual and unusual entities, most of which may be properly identified at US. For instance, the ocular globe may have an abnormal size or unusual morphologic characteristics. Lesions of the anterior chamber (eg, hyphema), lens (eg, cataract, luxation), and iris or ciliary bodies (eg, cysts) are usually seen at ophthalmoscopy but may also be depicted at US. Vitreous pathologic conditions may demonstrate echoes caused by various entities such as degeneration, asteroid hyalosis, hemorrhage, and infection, and lines are indicative of different types of detachment, including retinal, choroidal, and hyaloid detachment and retinoschisis. Posterior wall masses are usually tumors (eg, melanoma, metastasis, nevus, hemangioma) but may also result from subretinal hemorrhage or granulomas (from tuberculosis or histoplasmosis). Calcifications may be caused by drusen or be nonspecific. Foreign bodies may also be seen. Knowledge of ocular US techniques and protocols and familiarity with normal and pathologic imaging findings are critical in making a correct diagnosis.

The current study is descriptive analytical study included 300 diabetic patients complain of eye problems thier age ranged between (35-77) years old , they were divided to four groups , the most affected group was the (60-69) years (50-59) years which were (61%)&(18.3%) respectively then (70-77) years which was (13%) the last group is the (35-49)which was (7.7%) this was the same result as (Eman Ahmed Osman 2017) table (4-1) According to the gender we found that the male were more affected 159 (53%) than female 141(47%) this result is agree with the previous study (Michele Bertolotto 2014) table (4.2) The study showed that the most affected patients were lived in Khartoum this consigned with a result by (Eman Ahmed Osman 2017) table (4-3).According to the duration of disease the study reported that the groups (10-19) years 209 (69.7%) , (20-29) years 86 (28.7%) and (30-35) years were the most affected patients respectively this result is agree with the previous study which done by (Eman Ahmed Osman 2017) table (4-4). The study found that in Diabetic patients (type II) (91%) were high frequency than (type I) (9%) this result agree with the (Ofeida Awad Mohamed 2019) Table (4.5). According to the associated diseases the study revealed that some of patients came with other pathological conditions beside diabetes mellitus , patients with diabetes and hypertension were the bigger group (163 patients) (54.3%) , patients with diabetes and trauma represented 57patients (19%) , patients with trauma and hypertension (20%) , this result agree with(EmanAhmedOsman,2017) table (4-6) The study found that the right eye 155 (51.7%) was more affected than left 145 (48.3%) this result agree with (Mashair Abolgasim Abdellateef 2017) table (4-7). The study found a highly incidence of eye problems in ultrasound was retinal detachment 64 patients

(21.3 %) , followed by vitreous hemorrhage 38 pt (12.7%) , hyper mature catract 36 pt (12%) , vitreous change 32 pt (10.7%) , vitreous detachment 27 pt (9%) , retinal detachment + vitreous hemorrhage 24 pt (8%) , mature catract 21 pt (7%) , retinal detachment + mature catract 8 pt (2.7 %) , vitreous detachment + vitreous change 5 pt (1.7%) ,(optic nerve change, hyper mature catract + vitreous change , retinal detachment +vitreous change , axial length defect , catract , retinal cyst retinal change, high myopia +hyper mature catract vitreous change + axial length defect, high myopia , vitreous change + vitreous hemorrhage 1(, hyper mature catract +posterior vitreous detachment , high myopia +vitreous change had near incidence) this agree with (Michele Berta lotto 2014) table (4-8).On the Correlation of the affect of diabetes mellitus with gender it was found that the male were more affected than female .(the significance expressed by p. value (0.01)). Table (4.9) A Correlation done between duration of disease and final diagnose , it was found that there was no significant relation between them p. value (0.452). Table (4.10) A Correlation between type of diabetes and final diagnose , there was no significant correlation between type 2 and ultrasound finding p.value (0.204) table (4-11) The study found that there was relationship between patient history and final diagnose p value (0.000) table (4-12) Comparing between controlled and non-controlled DM , there was no significant correlation p.value (0.224) table (4-13)

Diabetic retinopathy is a common cause of blindness, visual loss resulting from retinal detachment, vitreous haemorrhage, vitreous detachment , rubeotic glaucoma, or major ocular vascular occlusion. Treatment of certain types of severe diabetic eye disease is now possible with the advent of new techniques of vitreous removal

The cystic nature of the eye, its superficial location, and high-frequency transducers make it possible to clearly show normal anatomy and pathology such as tumors, retinal detachment, vitreous hemorrhage, foreign bodies, and vascular malformations. Sonography is useful as a treatment follow-up technique because it has no adverse effects. it needs additional investigations (CT, MRI, histopathology) for confirming the diagnosis, ultrasound proves a useful imaging tool and correlates very well with the final diagnosis.

Ultrasound is an established diagnostic imaging modality. There are many systems which are relatively small with handheld probes. No ionizing radiation is used, but the image resolution can be limited compared to other visualization modalities. Advances have allowed high resolution imaging possible, especially of the anterior segment with the ability to create 3D reconstructions of ocular tissues and foreign bodies to aid in diagnosis and management of many disorders. Doppler flow can be an invaluable tool in the real time diagnosis of vasculopathies. However, 3D systems with rapid scan acquisition are not yet readily available.

5.2. Conclusion

Ocular ultrasonography is the effective method of diagnosing the diabetic eye diseases.

The study found that the females were more affected than males.

The older patients were the most affected. The stduy found that most of pathological condition occure in diapatic patient in dected by ultrasonography were retinal detachment, vitreous hemorrhage, hyper mature cataract, vitreous changes, and posterior vitreous detachment.

The long standing diabetis mellitus related strongly to the retinal detachment.

The study concluded that the ultrasonography can be able to image the interior of ocular structures and therefore can diagnose any pathological change occuring due to different disease.

There was a significat correlation between patients history and abnormalities dibatic by ultrasonography respectiulay.

Ocular ultrasonography in comparing with others medical imaging modalities such as , computed tomography (C T) or Magnetic Resonance Imaging (M R I) , is considered the modality of choice and first line of investigation , because of the Ultrasound is quick , accurate ,noninvasive , cheap and available tool

The ultrasonic findings are discussed in relation to the pathological changes in the diabetic eye diseases.

5.3. Recommendations:

Ocular ultrasonography should be the first investigation for ophthalmology

Folow up of the diabetic retinopathy shoud be perform by ocular ultrasonography for its safity and free from radiations

The long standing diabetis mellitus patients are awared to the retinal detachment.

Ocular ultrasonography in comparing with others medical imaging modalities is considered the modality of choice and first line of investigation

The further study well be inculde children patients.

Encourage the use of Doppler and 3D Ultrasound in case of there is no ophthalmoscopy view into the eye .

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Appendices

Appendix (1)

Data Collection Sheet (Questionnaire)

Evaluation of eye in diabetic patient using ultrasound

Date: …………. .

Age (yrs): ☐

Gender

a) Male ☐ b) Female ☐

Residence: ☐

Duration (yrs): ☐

Type of diabetes:

a)Type1 ☐ b)Type2 ☐

Patient history association: ………………………………………….. .

Control of DM (insulin usage) yes ☐ No ☐

Affected eye side: RT ☐ LT ☐ Both ☐

Ultrasound findings:

…………………………………………………………………………………

………………………………………………………………………….... .

12-**Final diagnosis**:

…………………………………………………………………………………

………………………………………………………………………….. .

Appendix (2) Cases

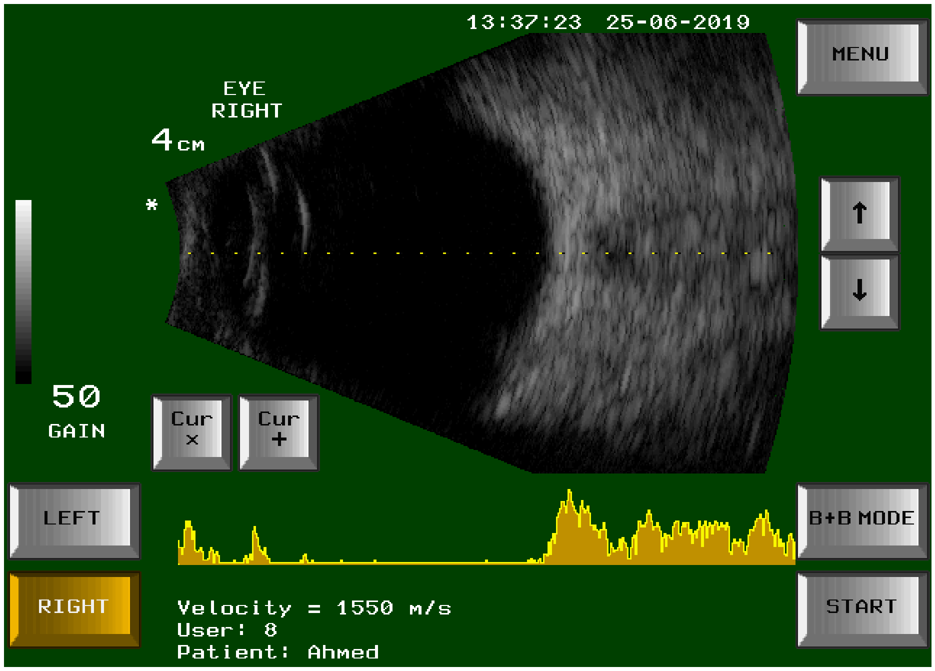

Fig (1): right B scan images examining the nasal globe transverse scanning (12 O'clock) Patient 63 year old female shows retinal detachment.

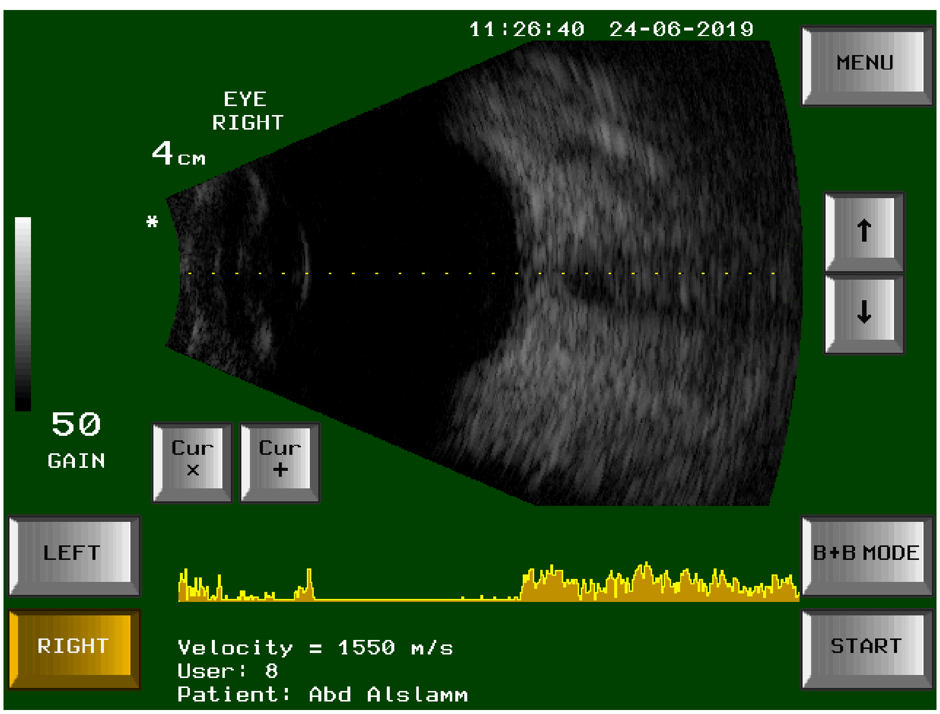

Fig (2): right B scan images transverse scanning Patient 65 year old female shows optic nerve change .

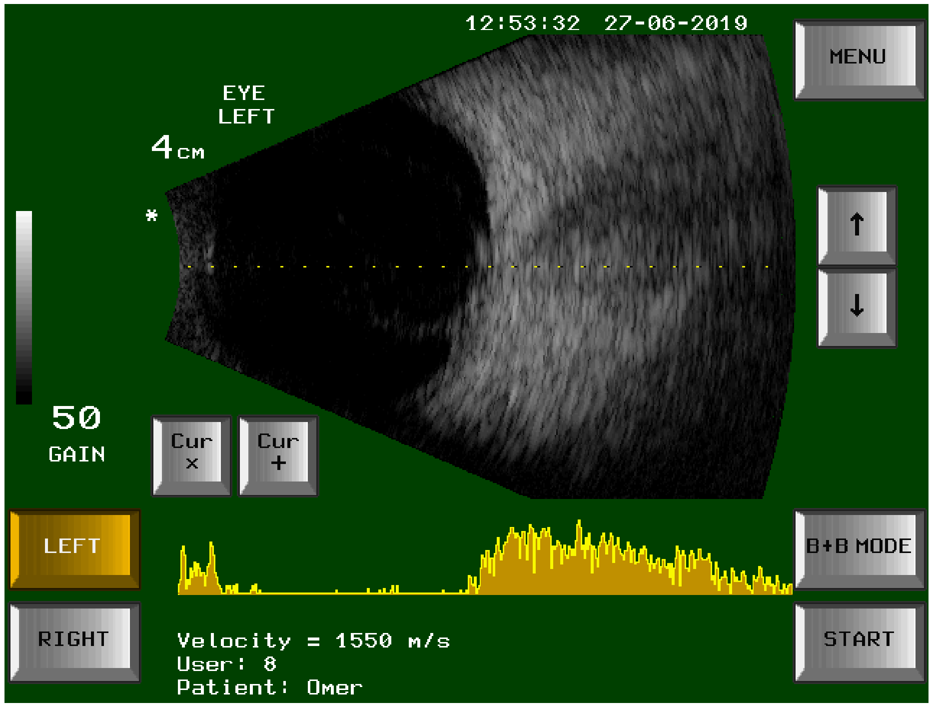

Fig (3): left B scan images transverse scanning Patient 67 year old male shows retinal detachment

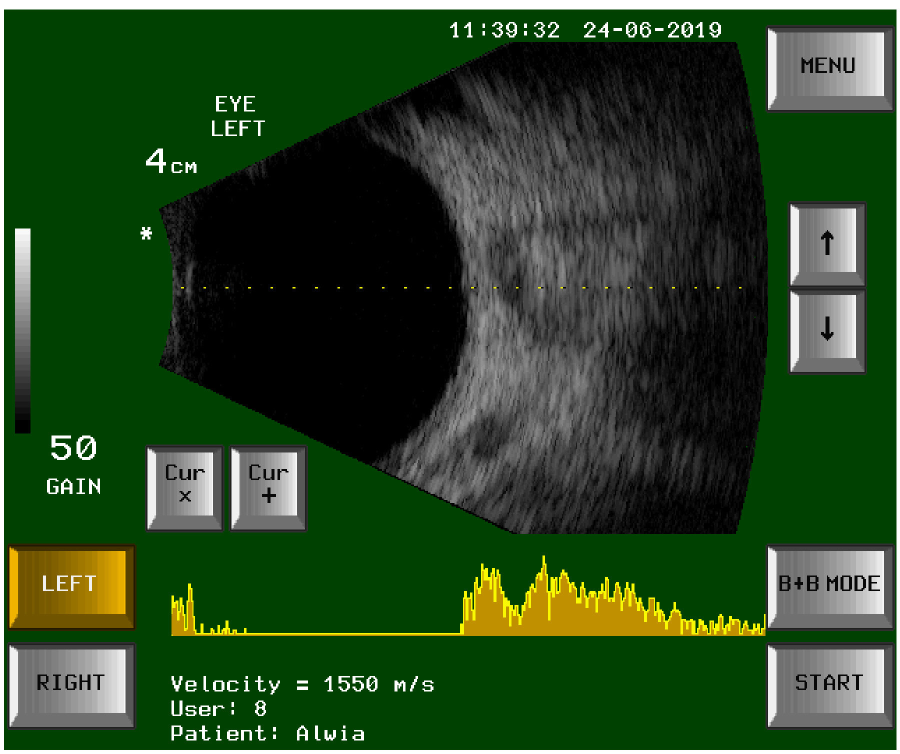

Fig (4): left B scan images transverse scanning Patient 45 year old female shows normal image .

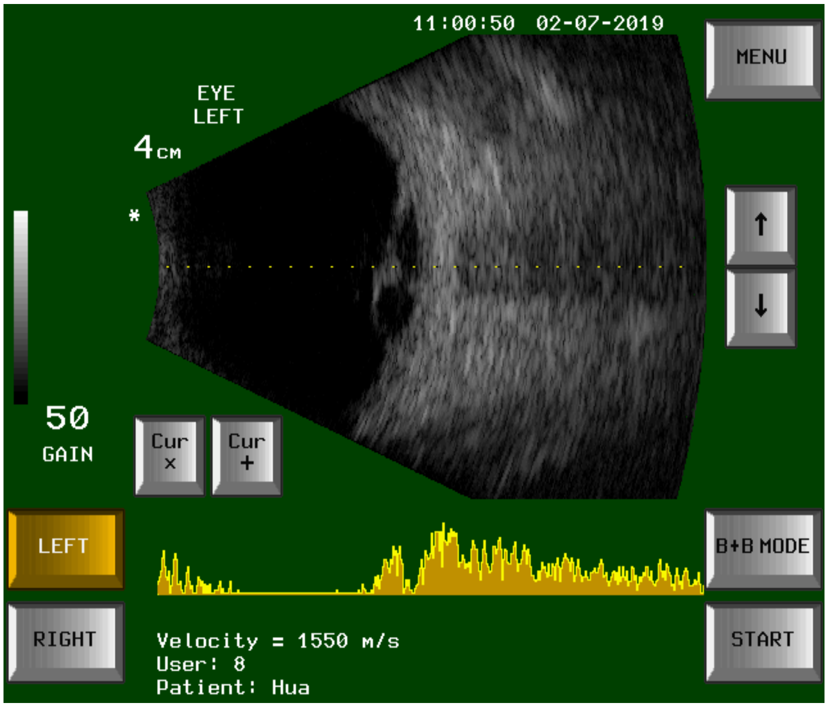

Fig (5): left B scan images transverse scanning Patient 65 year old female shows retinal detachment

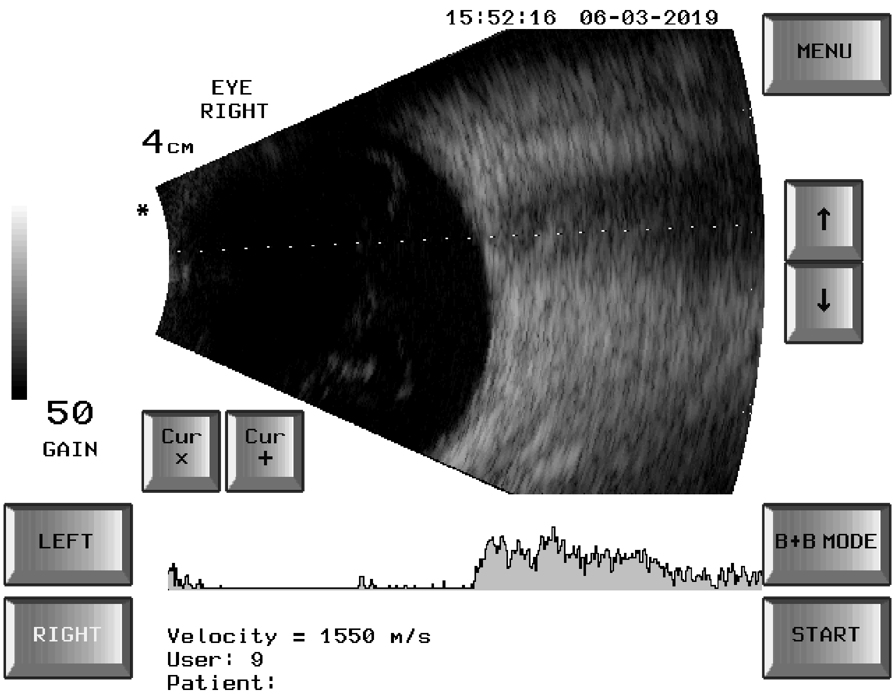

Fig (6): right B scan images transverse scanning Patient 59 year male shows vitreous change .

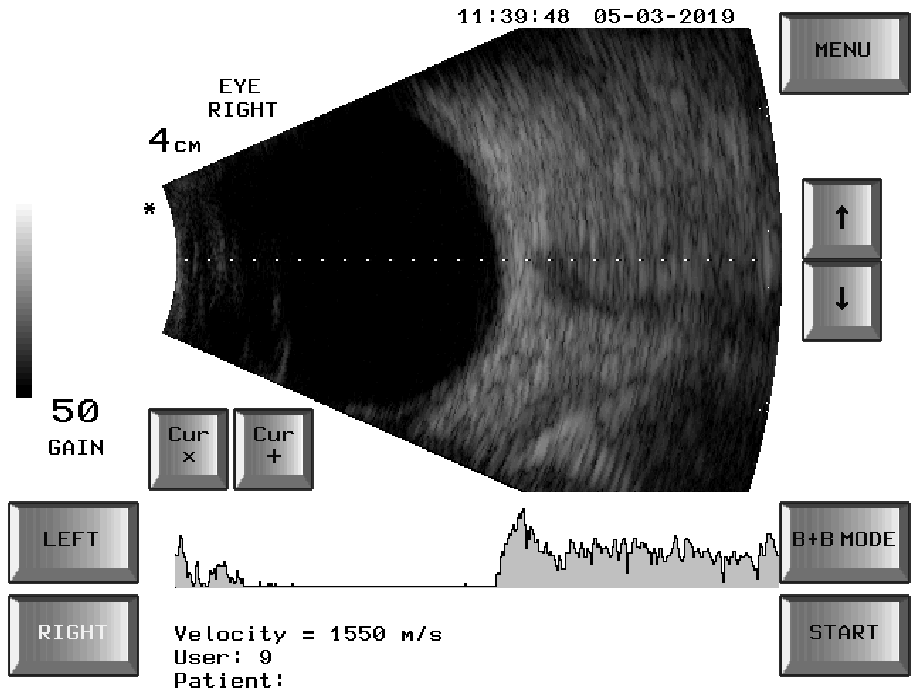

Fig (7): right B scan images Patient 55 year female shows mature cataract .

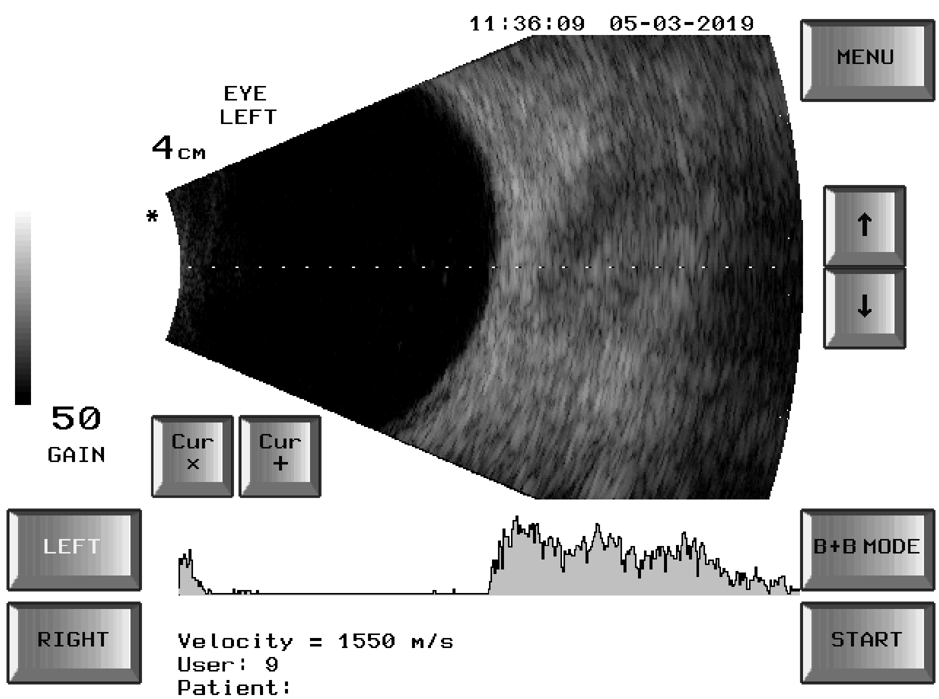

Fig (8):left B scan images Patient 45 year female shows normal image .

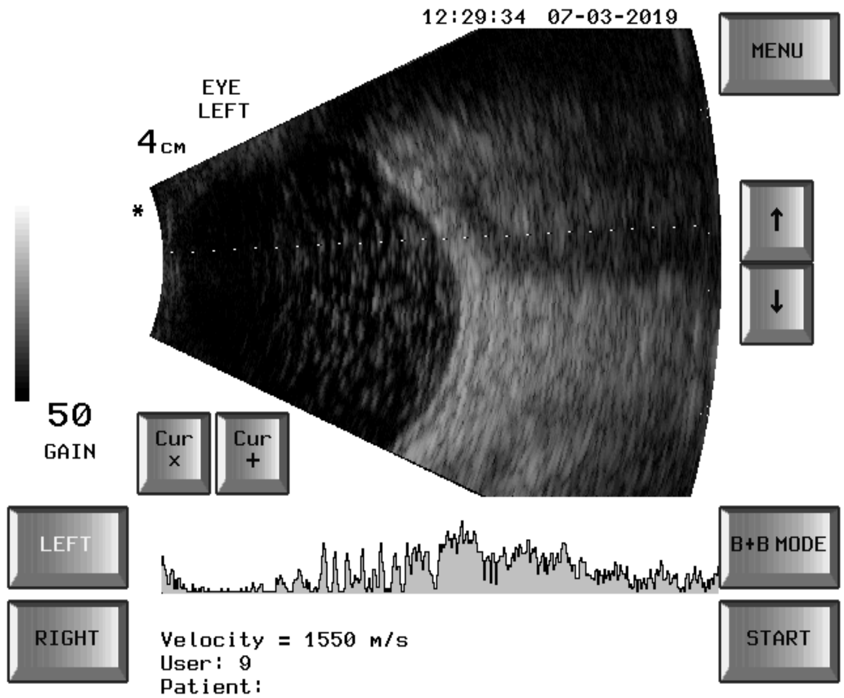

Fig (9):left B scan images transverse scanning (12 O'clock) Patient 64 year old female shows vitreous hemorrhage.

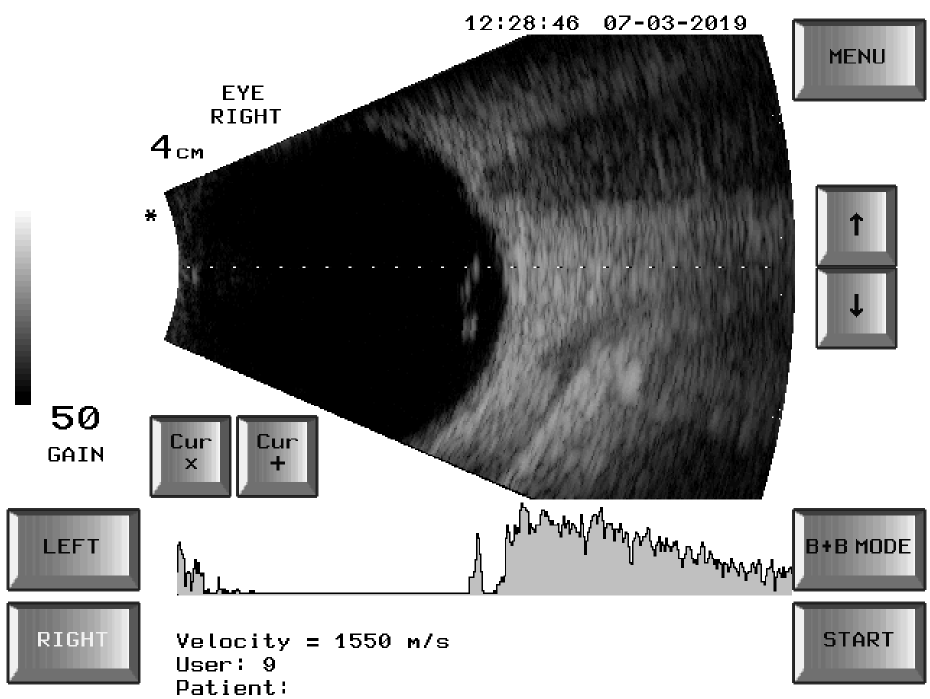

Fig (10): right B scan images transverse scanning Patient 62 year old male shows flotars (vitreous change)

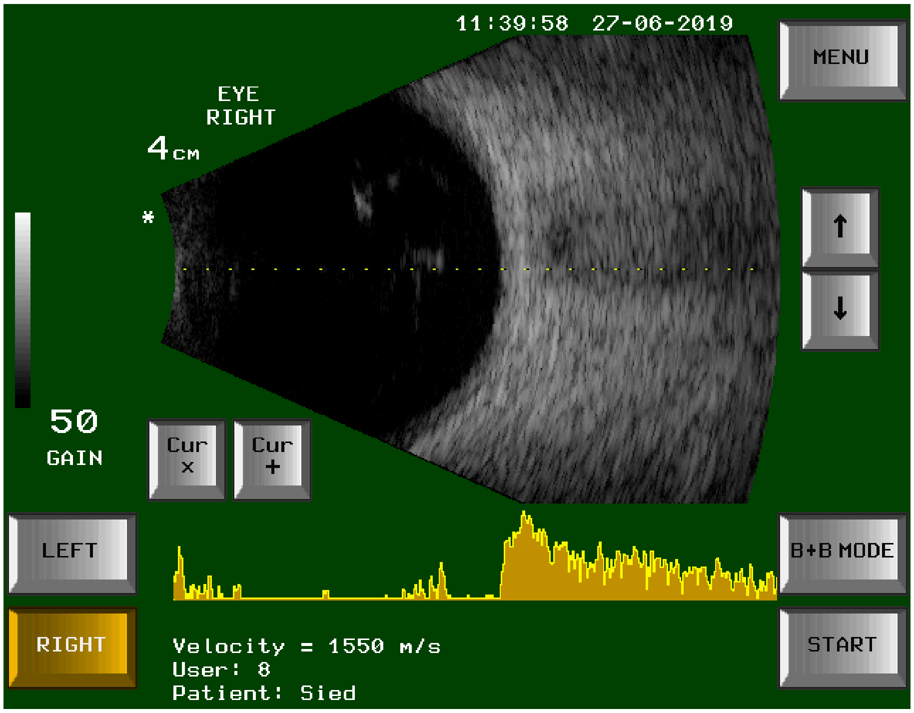

Fig (11): right B scan images transverse scanning Patient 65 year old female shows vitreous change .

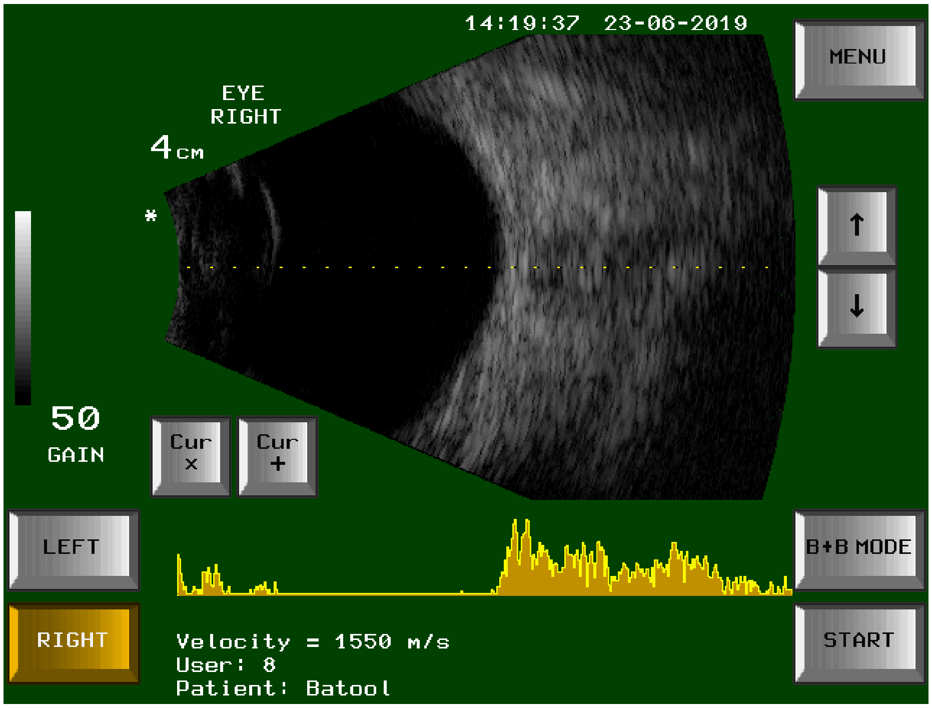

Fig (12): right B scan images transverse scanning Patient 61 year old male shows mature cataract.

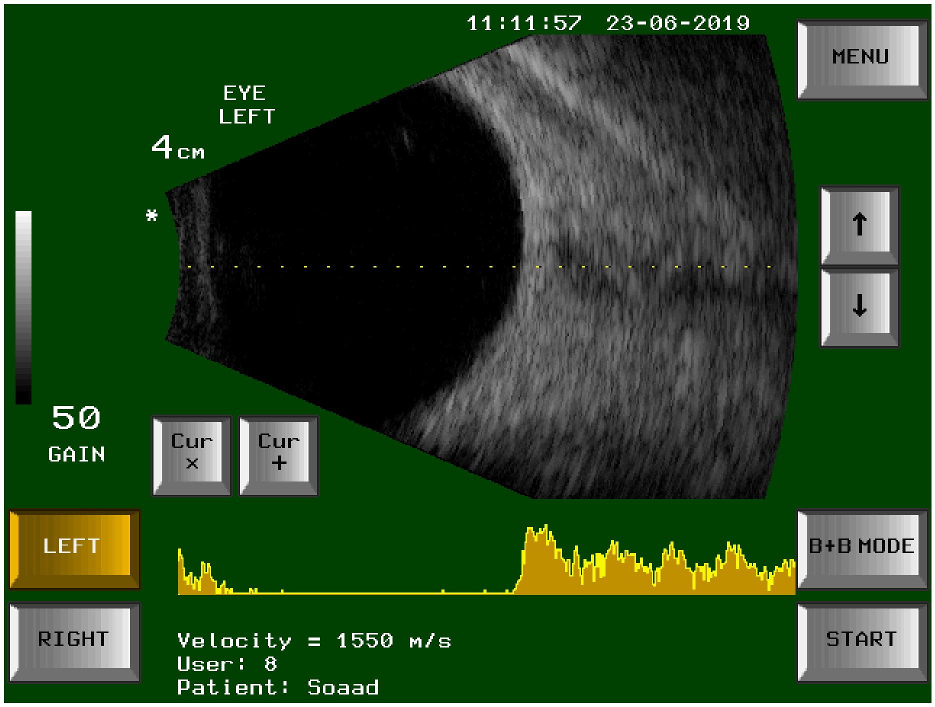

Fig (13): left B scan images transverse scanning Patient 45 year female shows vitreous change .

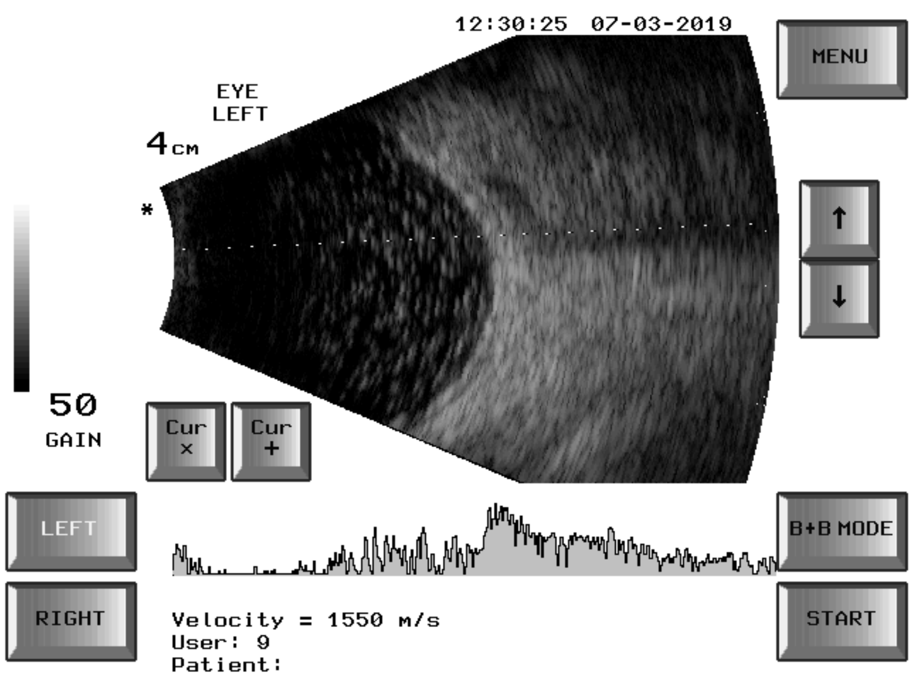

Fig (14): left B scan images transverse scanning Patient 65 year old male shows vitreous hemorrhage .

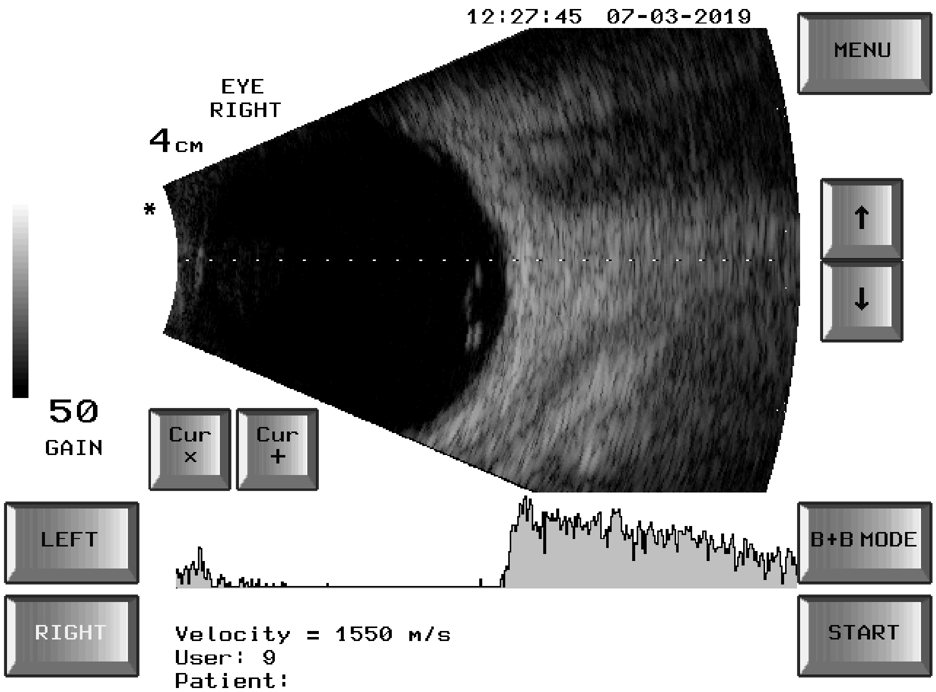

Fig (15): right B scan images transverse scanning Patient 63 year old female shows flotars (vitreous change) ,

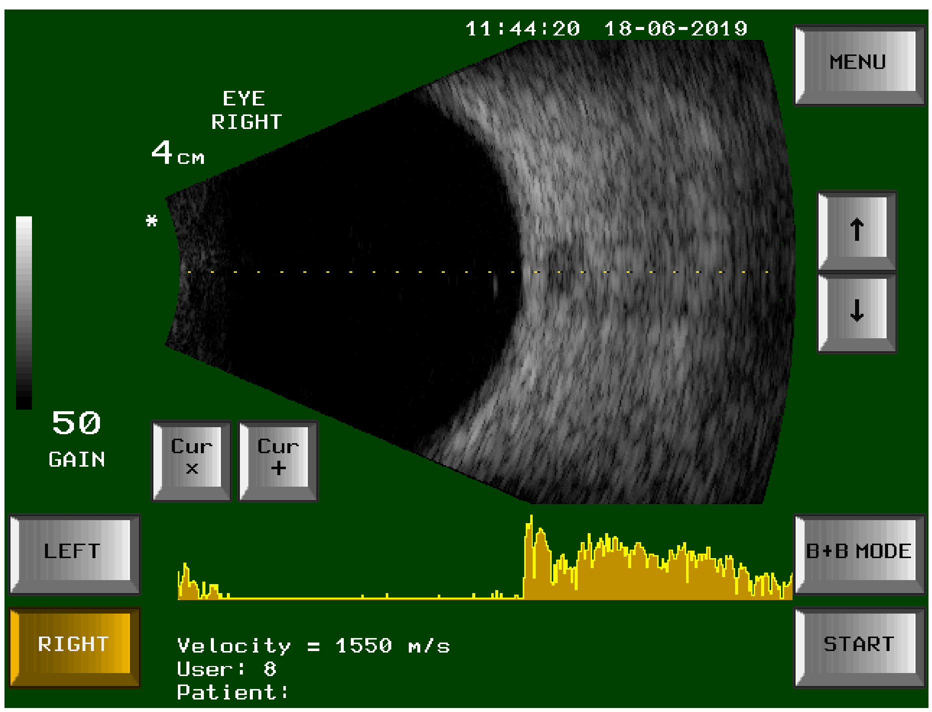

Fig (16): right B scan images transverse scanning Patient 57 year male shows vitreous change .

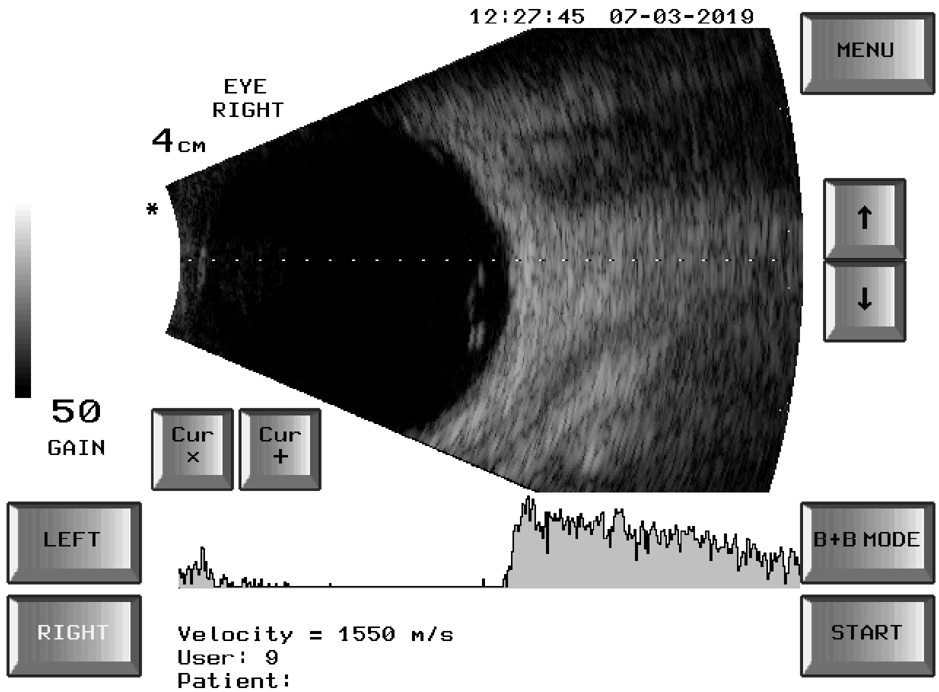

Fig (17): right B scan images transverse scanning Patient 66 year old male shows flotars (vitreous change) .

Fig (18) : right B scan images transverse scanning Patient 63 year old female shows retinal detachment .

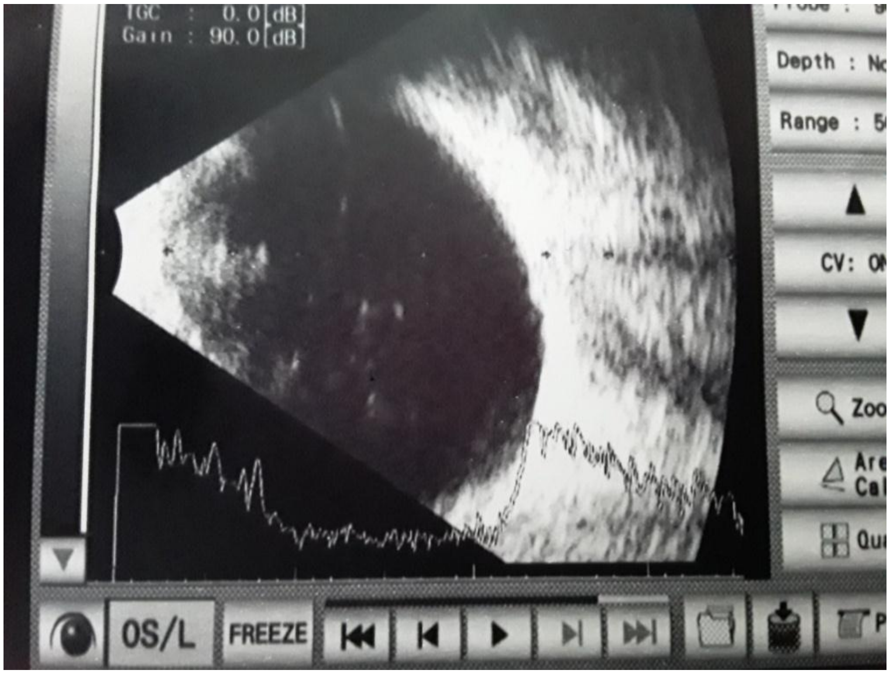

Fig (19): left B scan images transverse scanning Patient 66 year old male shows flotars

Fig (20): right B scan images transverse scanning Patient 71 year old male shows hyper mature catract + vitreous change .

Fig (21): right B scan images transverse scanning Patient 41 year old female shows hyper mature catract + high myopia .

Fig (22): left B scan images transverse scanning Patient 65 year old male shows hyper mature catract + retinal detachment + vitreous change .

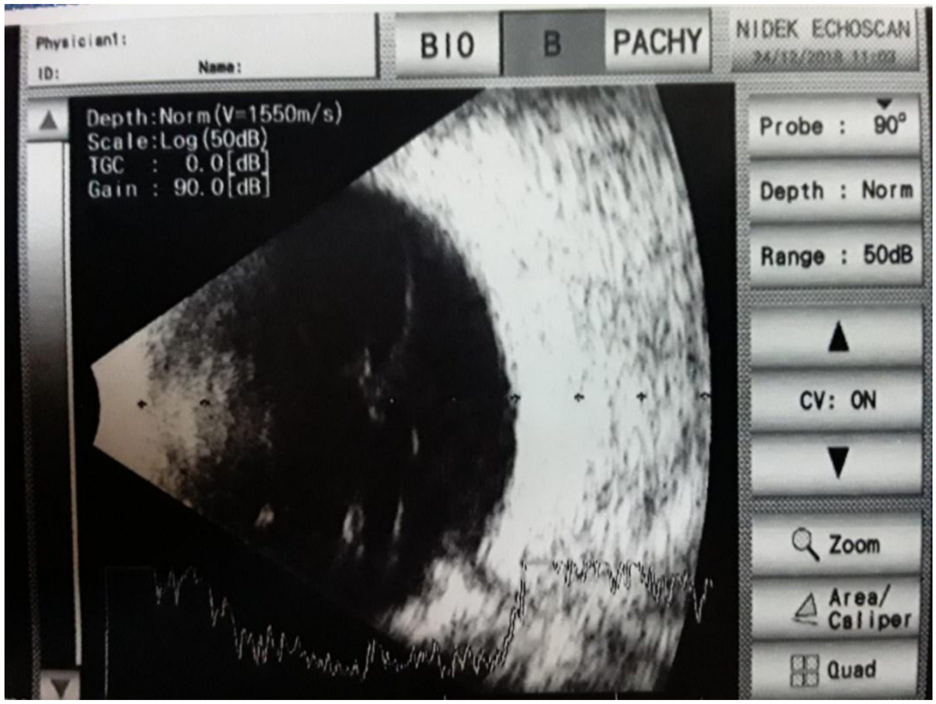

Fig (23): left B scan images transverse scanning Patient 56 year old male shows hyper mature catract + vitreous hemorrhage .

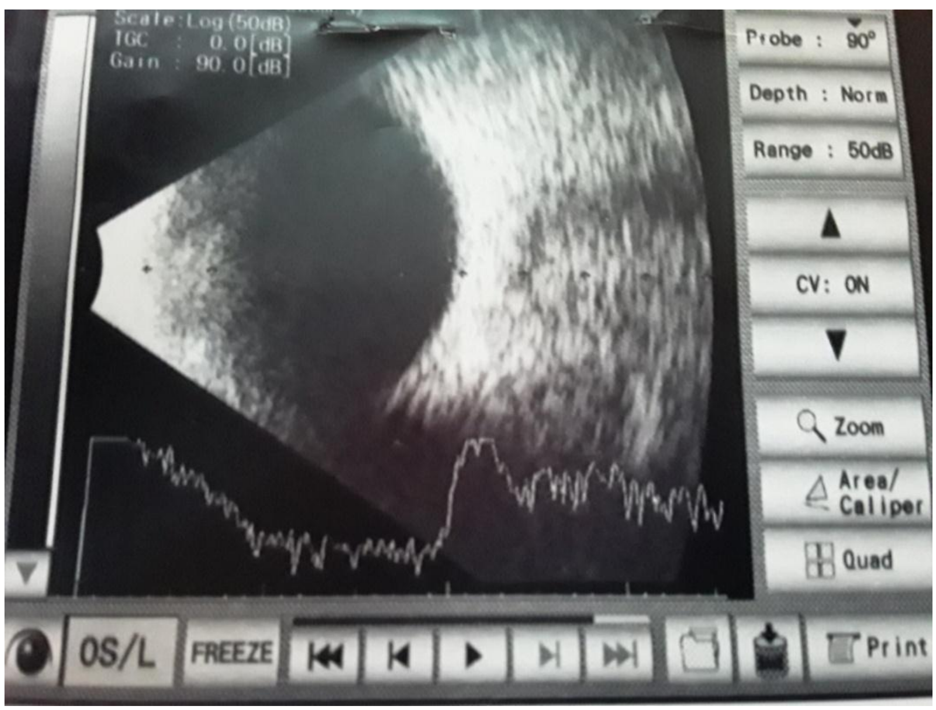

Fig (24): left B scan images transverse scanning Patient 61 year old female shows mature catract .

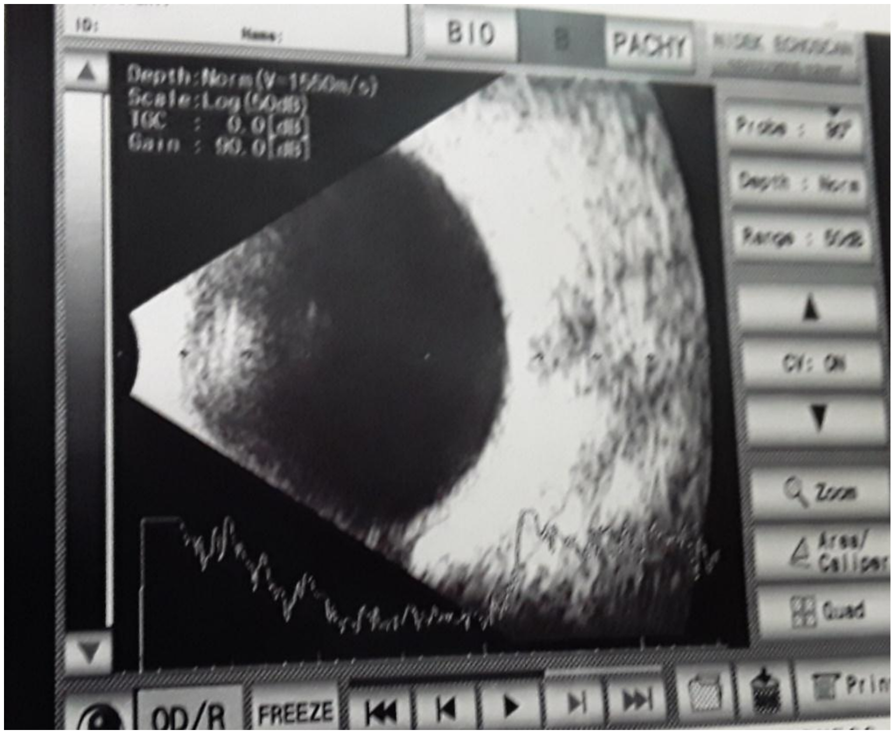

Fig (25): right B scan images transverse scanning Patient 65 year old female shows mature catract.

Fig (26): left B scan images transverse scanning Patient 55 year old male shows high myopia + vitreous change .

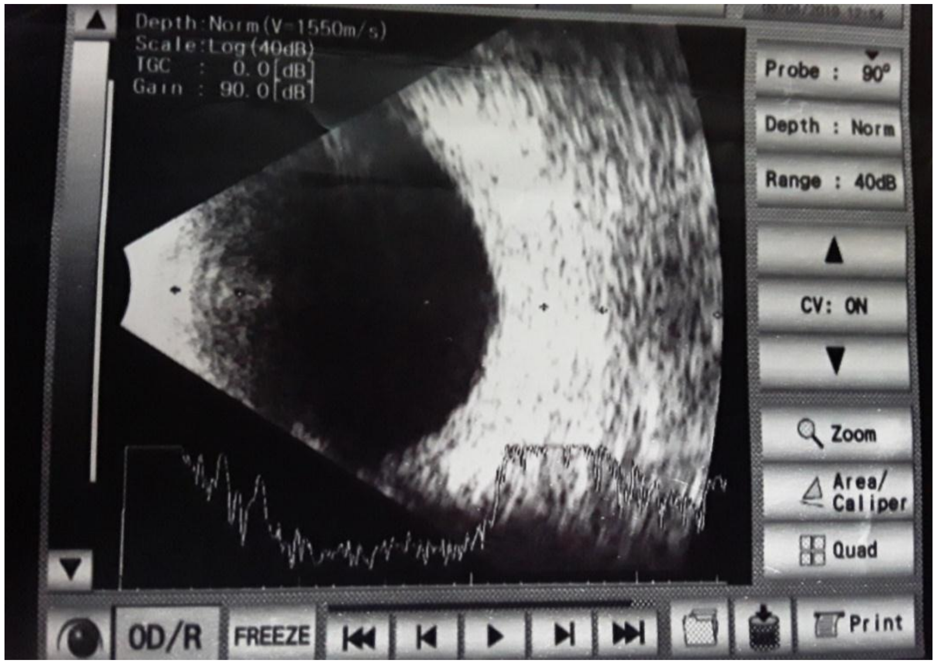

Fig (27): left B scan images transverse scanning Patient 38 year old male shows normal scan .

Fig (28): left B scan images transverse scanning Patient 70 year old male shows optic nerve change .

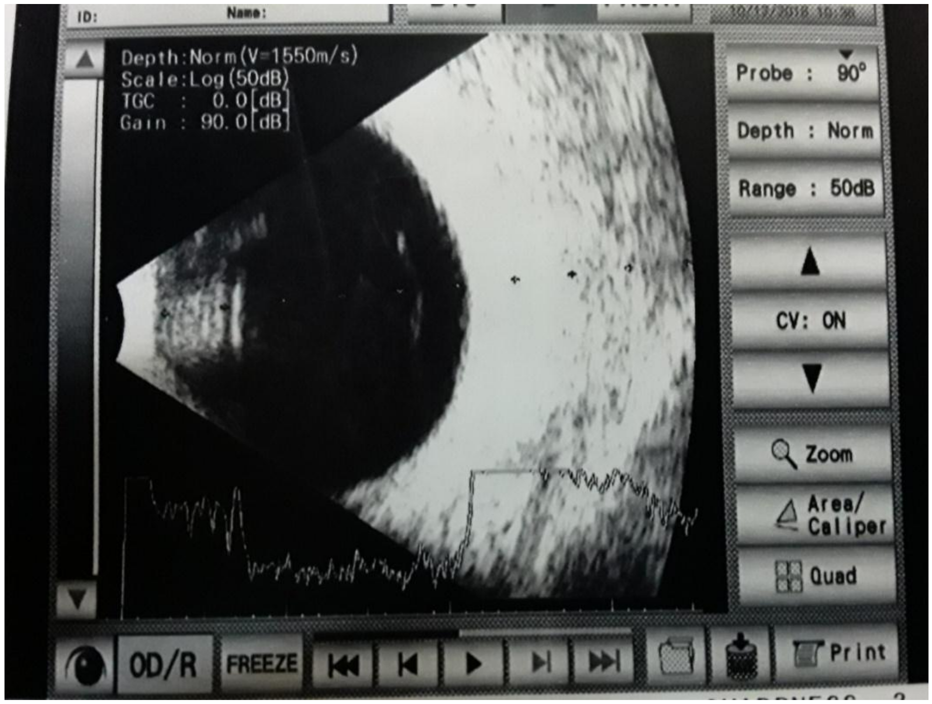

Fig (29): right B scan images transverse scanning Patient 62 year old male shows posterior vitreous detachment.

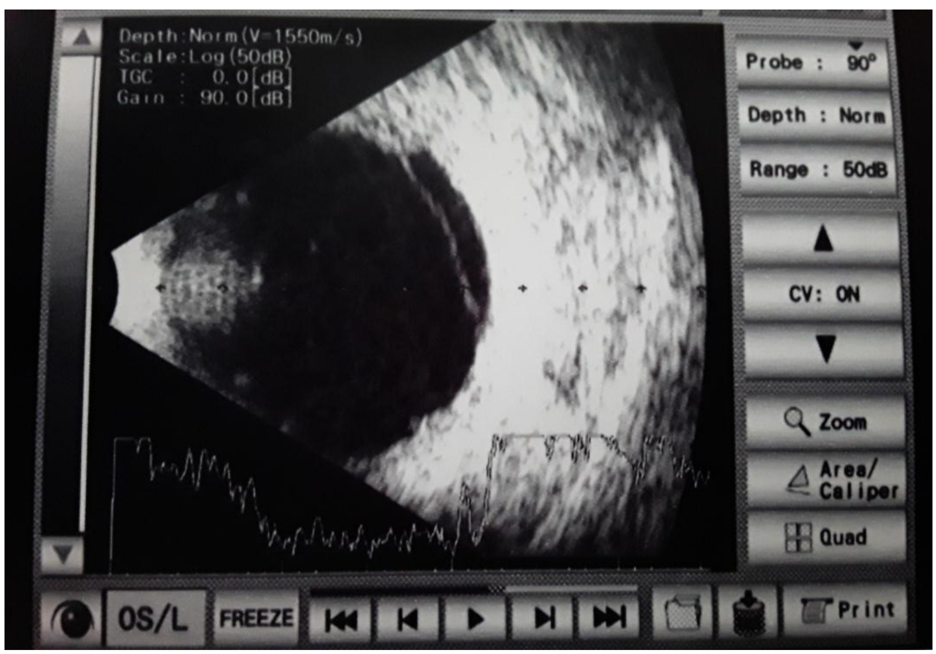

Fig (30): left B scan images transverse scanning Patient 67 year old female shows posterior vitreous detachment .

Fig (31): left B scan images transverse scanning Patient 73 year old male shows posterior vitreous detachment + vitreous change .

Fig (32): left B scan images transverse scanning Patient 59 year female shows posterior vitreous detachment + high myopia .

Fig (33): right B scan images transverse scanning Patient 54year old female shows posterior vitreous detachment + vitreous change .

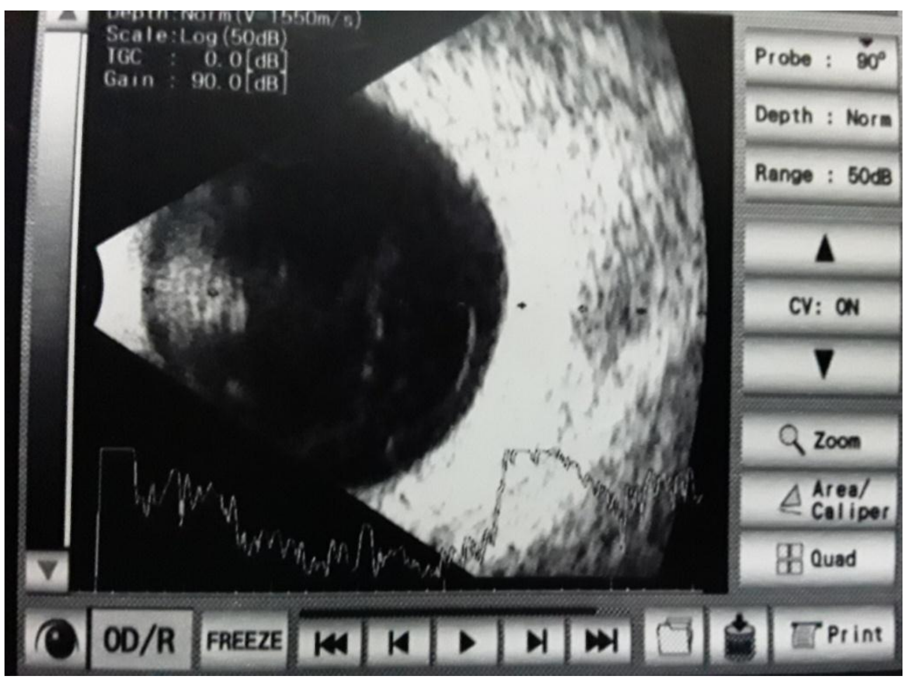

Fig (34): right B scan images transverse scanning Patient 58year female shows posterior vitreous detachment+ vitreous detachment .

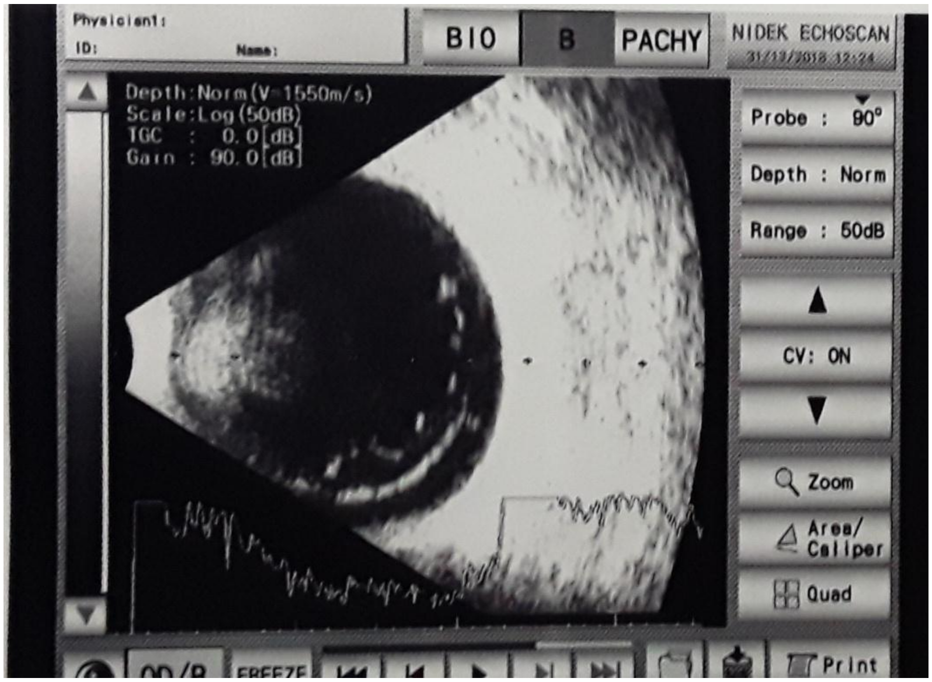

Fig (35): right B scan images transverse scanning Patient 61 year old female shows posterior vitreous detachment.

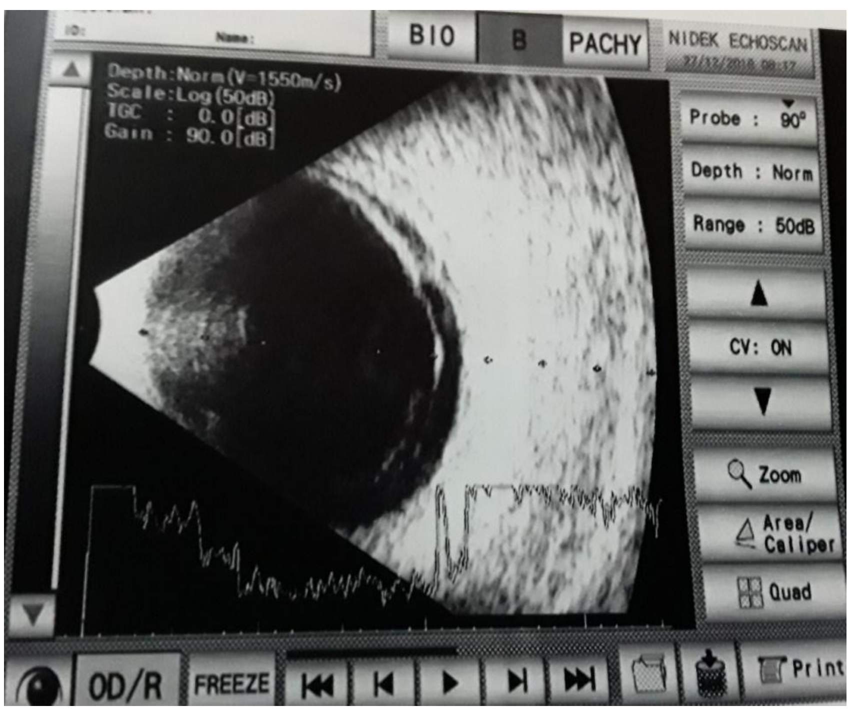

Fig (36): right B scan images transverse scanning Patient 59 year female shows posterior vitreous detachment.

Fig (37): right B scan images transverse scanning Patient 59year old female shows retinal detachment + vitreous hemorrhage .

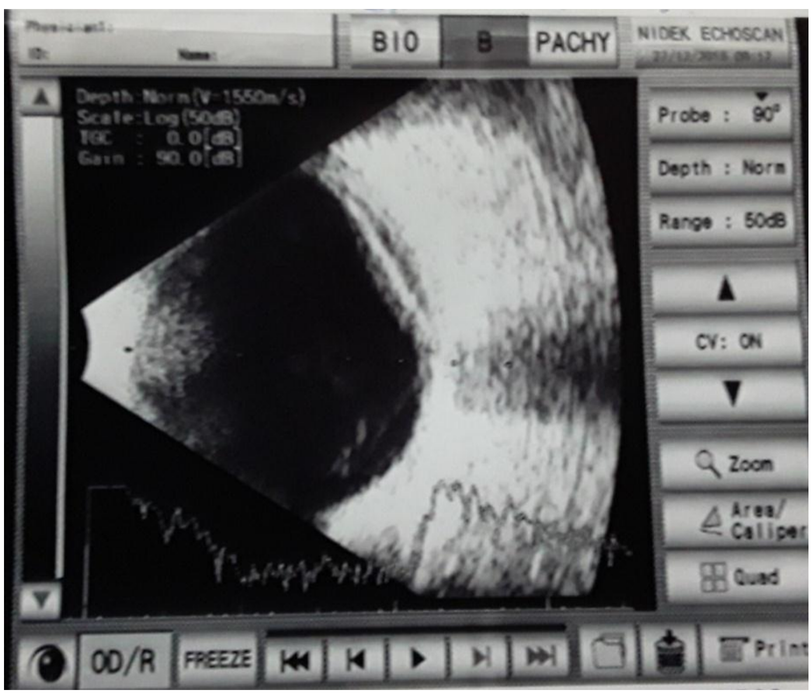

Fig (38): right B scan images transverse scanning Patient 59 year old female shows posterior vitreous detachment.

Fig (39): right B scan images transverse scanning Patient 64year old female shows retinal detachment + vitreous hemorrhage .

Fig (40): left B scan images transverse scanning Patient 68 year old male shows retinal detachment.

Fig (41): left B scan images transverse scanning Patient 66 year old male shows retinal detachment + vitreous hemorrhage.

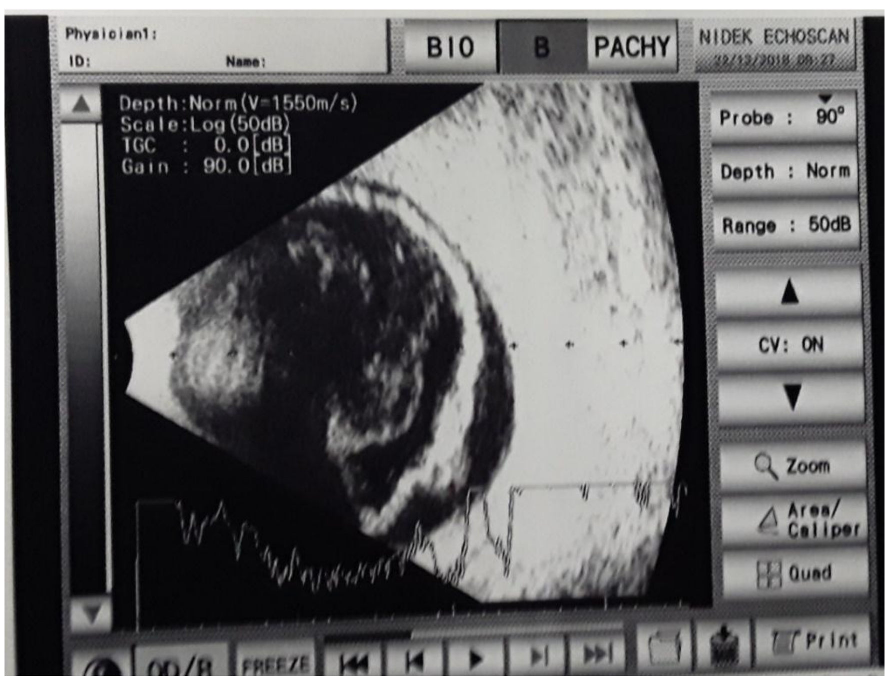

Fig (42): right B scan images transverse scanning Patient 66 year old female shows retinal detachment + vitreous hemorrhage .

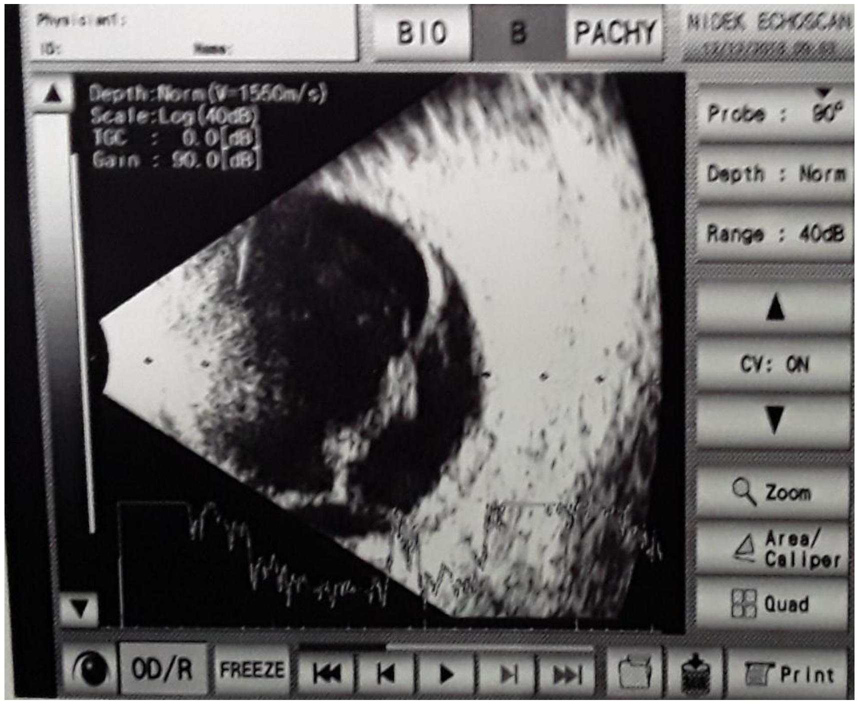

Fig (43): right B scan images transverse scanning Patient 61 year old female shows retinal detachment .

Fig (44): right B scans images transverse scanning Patient 53 year female steroid hylosis (vitreous change).

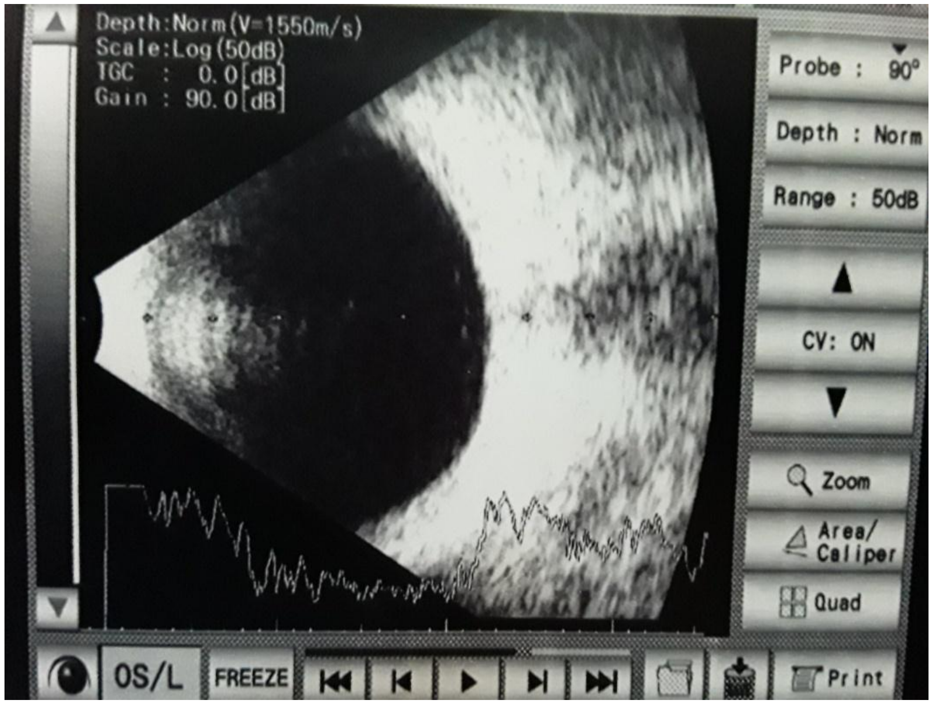

Fig (45): left B scan images transverse scanning Patient 54 year female shows normal .vitreous change.

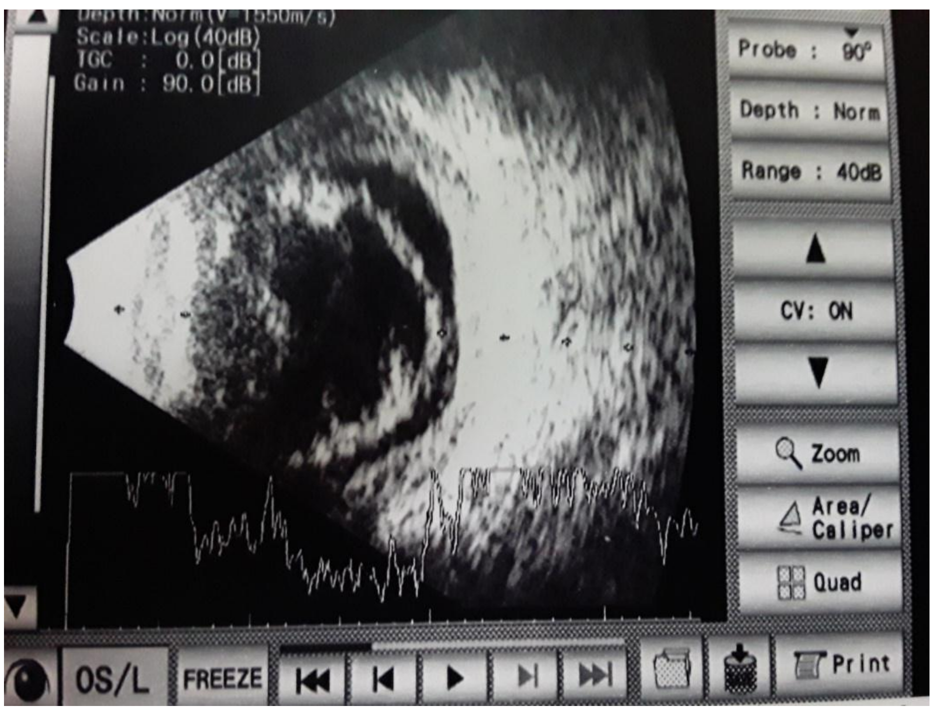

Fig (46): left B scan images transverse scanning Patient 66 year old male shows retinal detachment + vitreous change.

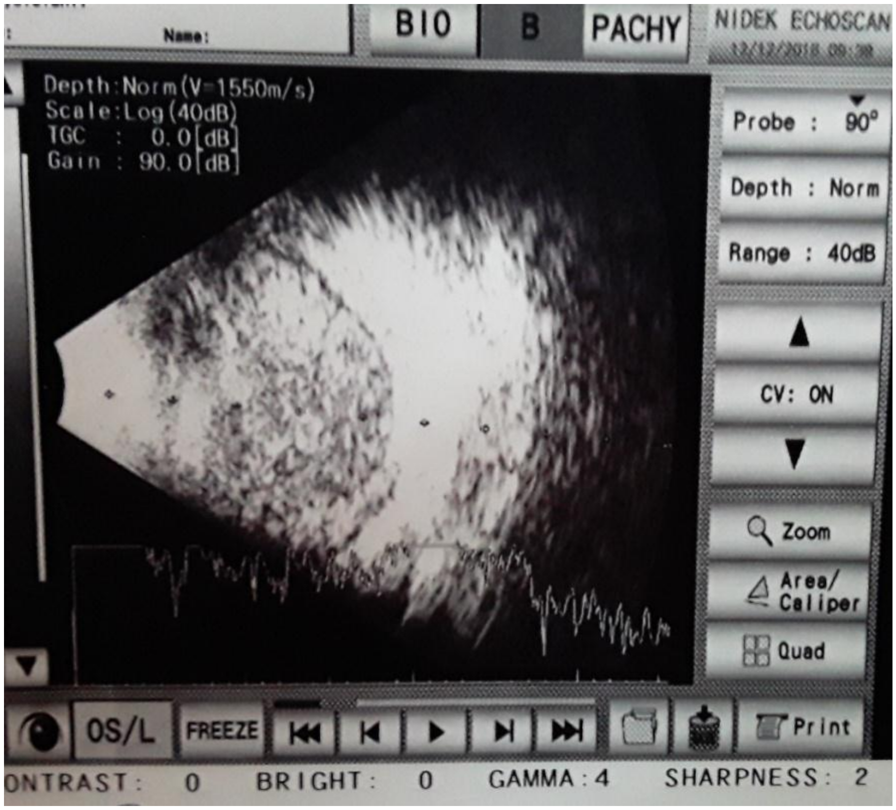

Fig (47): left B scan images transverse scanning Patient 54year female shows vitreous hemorrhage.

Fig (48): left B scan images transverse scanning Patient 39year female shows vitreous hemorrhage.

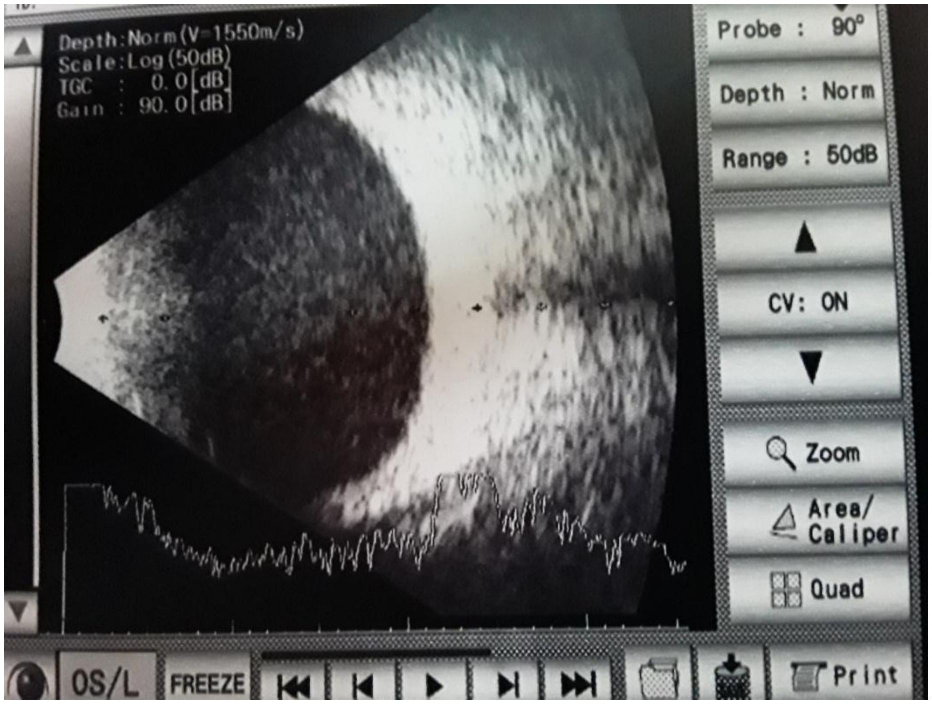

Fig (49):left B scan images transverse scanning Patient 65 year old female shows vitreous hemorrhage