

# **Chapter one**

## **:Introduction 1.1**

The eye ball is the dominant structure in the anterior orbit, embedded in fat, but separated from by a membranous sac called Tenon's capsule. This capsule is applied to the eye ball from attachment at the corneoscleral junction and the optic nerve. The eye ball is supported by the muscle sheaths termed the check ligaments that pass to the orbital walls. The eye ball is composed of two different sized spheres. The transparent anterior segment and the opaque posterior segment. The optic axis is a line, joining the anterior pole with posterior pole. The normal axial length of the eye is 24mm. The eye consists of three primary layers — sclera, choroid and retina. Orbit is bony cavity whose stalk is the optic nerve passing through the optic canal. The orbits are directed backwards, slightly upwards and inwards to their apices. The lacrimal gland fossa is situated anterolaterally. The orbit contains the eye ball, the nerve which innervates it, including the optic nerve in its bed fat, the extrinsic muscles which move it, and the nerves and vessels which

supply them. The optic nerve and ocular muscles pass anterolaterally from the apex of the orbit to (their ocular attachment. (Satish K - 2010

Low vision is defined as visual acuity of less than 6/18. Also is described as bilateral sub normal visual acuity or abnormal visual field resulting from disorders in visual system, the defect may be in globe, cornea, iris, lens vitreous, retina or the optic path ways or visual cortex, it may be hereditary, (congenital or acquired. (Dickinson – 2001

## **:(Problem. of thesis (study 1.2**

Loss of vision will result from several causes such as dens cataract, corneal opacity , hyphema and vitreous hemorrhage , which make the direct view by the ophthalmoscope is difficult or impossible , which need accurate diagnose ophthalmic ultrasound play good role in evaluating . those causes and others different phathologies

## **:Objectives 1.3**

### **:General objectives 1.3.1**

To assess the causes of low vision in patient . below 40 years using Ophthalmic ultrasongraphy

### **:Specific Objectives 1.3.2**

To diagnose the causes of the loss and drop of •  
.vision accurately and its differential diagnosis

To detect deferent intraocular disorders that •  
.cause vision loss

To assess the major causes of the low vision in •  
.patients below 40 years

To assess others deffernt pathologies •  
associated with causes that led to the low  
.vision

## **: Over view 1.4**

The study will give an excellent Idea and informations about ultrasonography of the eye , which to be considered as modality of choise , because enable and establish good and definitive diagnosis of the eye disorders and accurately assesses the differential diagnosis . Most surgical operation and treatment are performed depending on ophthalmic ultrasonography findings (reports) .

.This indicates the efficiency of this modality

# **Chapter two**

## **Literature Review 2.1**

### **-.: Introduction 2.1.1**

Low vision is defined by (WHO) as, or refers to patients with best corrected vision in the better eye of less than 6/60 (log MAR 1.0) and equal to or better than 3/60 (Log MAR 1.3) on the snellen's chart , or a visual field less than 10 degree from the point of fixation , for which treatment is not possible , but who use , or are potentially able tom use, vision for the planning and or execution of tasks for which vision is essential. (Monica C - (2006

### **-.:Definition of low vision 2.1.2**

Low vision has been described as bilateral subnormal visual acuity abnormal visual field resulting from a disorder in the visual system the defect may be in the globe cornea, iris, lens, vitreous, or retina, the optic pathways or the visual cortex. It may be hereditary, con genital, or (acquired. (Faye - 1984

Low vision, partial sight, visual Impairment, and even subnormal vision are synonyms for the same state: reduced visual acuity, which even with the best optical correction provided by regular lenses still results in a visual performance on standardized clinical test which is less expected for a patient of that age. The definition does not .include those who are monocle

The term also Implies that some form vision remains and that vision is not simply confined to (light perception. (Dickinson, 2001

### **International classification of 2.1.3**

#### **:Impairment**

Disabilities and Handicaps (ICDH): which attempts to standardize the description of the functional consequences of disease at various levels, and have made suggestions concerning the use of these definitions for people with impaired . vision



Classing in to multiple ranges of vision loss

. ( based on visual acuity ( decimal system

:Thus

(Normal vision ( $> 0.8$

( Mild vision loss ( $< 0.8$  and  $> 0.3$

( Moderate vision loss ( $< 0.3$  and  $> 0.05$

( Severe vision loss : (  $< 0.05$  and  $> 0.02$

( Profound vision loss : (  $< 0.02$  and  $> 0.01$

Near – total vision loss ( Near blindness ,  $< 0.01$  ,  
02 and  $> NPL$  No perception of light). Atif B (2010 –

(2011

.( Total vision loss ( total blindness = NPL

The international council of ophthalmology  
( ICO ) (2002) recommended to world vision  
community the use of the following terminologies .

((Atif B - 2010 - 2011

## **: Role of Ultrasound 2.1.4**

Sonographic ultrasound is helpful in evaluating the patients with low vision, that, the physical and fundusoscopic examination is limited because. of the pain and swelling, or the patients eyelids cannot be sufficiently opened, corneal opacity, anterior chamber hemorrhage (hyphema), vitreous hemorrhage, anterior chamber hemorrhage (hypherna), vitreous hemorrhage, retinal or vitreous detachment, sever astroidhyalosis dense cataract, retinoblastoma and others. (Megan.Kristin

(- 2011

Since, the eye is a fluid-filled structure, providing an ideal acoustic window for sonographic assessment of the intraocular and adjacent structures. Ultrasound is compared with other modalities such as computed tomography (CT) or magnetic resonance imaging (MRI) is considered the modality of choice and first line of investigation, because of the ultrasound is a quick, accurate, noninvasive, cheap and available tool.

((Megan.Kristin - 2011

### **A. Scan and B. scan Ultrasonography 2.1.4.1**

The A. scan, is one - dimensional graphic display with vertical deflections ( Spikes) along the base line . The height of the- deflection ( Spike) represents the amplitude ,or strength of the echo , that means the height of the spikes in proportional to the strength of the echo . The greater the distance to the right, the greater the distance between the source of the sound and the reflecting surface. The distance between the spikes can be precisely measured , it is used mainly to measure anterior chamber depth , lens thickness and axial length. Simply A.mode is peaks and distances , and performed with a single ultrasound source .

((Ibrahim Ishaq - 2014

B. Scan ultrasonography may be performed with sector probe or a linear probe - the sector or vector probe has one main source of ultrasound. In a linear probe multiple sources of ultrasound are aligned in a grid to cover a specific area

B. Scan ultrasonography is two dimensional images in which the echo amplitude depicted as

dots of different brightness . The more sound reflected, the brighter the dot. (Ibrahim Ishaq -

(2014

## **Indications of the ophthalmic 2.1.5**

### **:ultrasonography**

- Decreased vision/loss of vision -
- Ocular pain -
- Eye trauma -
- Evaluation of anterior or posterior segment in -  
.eyes with opaque ocular media
- Assessment of dimension of ocular tumors as -  
well as their tissue characteristics, such as  
.calcium in retinoblastoma or choroidal osteoma
- .Evaluation of orbital disorders -
- Detection and localization of intraocular foreign -  
.body
- Measurement of distance within eye and orbit -  
(biometry)

### **:Frequencies used 2.1.6**

Low frequency transducers are particularly .1  
.useful in detecting orbital pathology

Moderate frequency ( 7-10 MHZ) is used to .2  
.examine the globe

High frequency :- (30-50MHZ) allows high .3  
definition imaging of the anterior segment but  
only to a depth of 5mm. It is of particular value  
in the evaluation of congenital corneal  
(pathology). (Ibrahim Ishaq - 2014)

## **-: Embryology 2.2**

### **: Introduction 2.2.1**

The globe is formed from both ectoderm and  
.mesoderm

The rudimentary eyeballs appear as two hollow diverticula (optic pits) from the lateral aspects of the forebrain (diencephalon). The diverticula grow out laterally and their ends become dilated to form the optic vesicles, while the proximal part of each becomes constricted to form the optic stalk. At the same time, a small area of surface ectoderm overlying the optic vesicle thickens to form the lens placode (lens pit). The lens placode invaginates and sinks below the surface ectoderm to form hollow lens vesicle. In the meantime, the outer wall of the optic vesicle becomes invaginated toward the wall of diencephalon to form the double-layered optic cup. For a time, a wide hiatus groove, the optic fissure or choroidal fissure (embryonic fissure), exists along the optic stalk in the inferior edge of the optic cup. Through the embryonic fissure, the



mesenchyme extends into the optic stalk and cup,  
carrying the hyaloid artery with it. (Galdin ,  
(Valvassori - 2006

## **:Retina 2.2.2**

The retina develops from the optic cup. For purposes of description, the retina may be divided into two developmental layers, the pigment layer and the neural layer. The pigment layer is formed from the outer, thinner, layer of the optic cup. It is a single layer of cells that become columnar in shape and develop pigment granules within their cytoplasm. The neural layer is formed from the inner layer of the optic cup. The ganglion cells, the amacrine cells, and the somata of the sustentacular fibers of Muller are formed from the inner neuroblastic layer of the retina. The horizontal cells, the nuclei, of the bipolar rod and cone nerve cells, and probably the rod and cone cells are formed from the outer neuroblastic layer (of the retina. (Galdin , Valvassori – 2006

The wall of the optic vesicle invaginates (becomes cup shaped) resulting in two layers instead of one. The outer layer exhibits pigmentation and called the pigmented layer of the retina. The inner layer is the nervous layer of the retina and consists of several strata. The innermost

layer is composed of ganglion cell layer. The nerve fibres of these cells group together to form the .optic nerve

The two ends of the developed cup become the iary and the iridial parts of the retina. (Gohn . G  
(– 2003

### **:Lens 2.2.3**

The rudimentary lens, the lens placode, invaginates below the surface ectoderm to form the lens vesicle. The lens is invested by a vascular mesenchymal condensation termed the vascular capsule of the lens. The lens is supplied by the hyaloid artery, Which forms a plexus on the posterior surface of the lens- capsule. (Galdin ,

(Valvassori – 2006

It develops as an ectodermal invagination which invades the optic vesicle. The latter shows a concavity in the surface within which the lens vesicle embeds itself. The concavity of the optic vesicle increases more and more until the lens vesicle is completely embedded. The cells at the periphery of the lens vesicle remain as such to form the epithelial layer of the lens. The cells which are located more posteriorly form the lens fibres. The surrounding mesenchyme separates the developing lens from the outer ectodermal layer. Moreover, this mesenchyme forms a capsule around the lens and then proceeds towards the optic disc (choroidal or fetal fissure later on). At

the second month of intrauterine life, this part of mesenchyme is invaded by blood vessels coming from the anterior ciliary artery (anteriorly) and the hyaloid artery (posteriorly). At the sixth month of gestation the anterior ciliary artery and the pupillary membrane (the part of the capsule covering the anterior surface of the lens) disappear. The posterior part of the hyaloid artery which runs inside the mesenchyma tissue of the foetal fissure . persists as the central retinal artery

As development proceeds, the choroidal or (foetal fissure close . (Gohn . G - 2003

### **:The Ciliary Ligaments of lens 2.2.4**

The connective tissue of the body, the smooth-muscle fibers of the ciliary muscle, and the suspensory ligaments of the lens are formed from the mesenchyme, situated at the border of the optic cup. The iris sphincter and dilator smooth muscles are formed from neuroectoderm. The iris vasculatures derive from the mesoderm. (Galdin ,

((Valvassori - 2006

## **:The Vitreous 2.2.5**

The primitive or primary vitreous body is derived partly from the ectoderm and partly from the mesoderm. The primitive vitreous is supplied by the hyaloid artery and its branches.. The definitive or secondary vitreous arises between the primitive vitreous and the retina. It is at first a homogeneous gel, which rapidly increases in volume and pushes the primitive vitreous anteriorly to behind the iris. Hyalocytes, derived from the mesenchyme around the hyaloid vessels, now migrate into the secondary vitreous. Later the hyaloid vessels atrophy and disappear leaving the (a cellular hyaloid canal. (Galdin , Valvassori - 2006

It develops between the lens and the optic cup. It is ectodermal and mesodermal in origin. The ectodermal portion develops from the cells of the lens and the mesodermal portion from the cells of (the retina. (John G - 2003

## **:(Uvea (Choroid, Ciliary Body, and iris 2.2.6**

The uveal tract is the vascular layer of the eyeball which lies between the sclera and the retina. It consists of choroid, ciliary body and iris. The choroid is the section of the uveal tract that lies between the sclera and the retinal pigment epithelium (RPE), the outer layer of the retina. It forms a membrane of predominantly vascular tissue extending from optic nerve to the ora serrata, beyond which it continues as the ciliary.

((Galdin , Valvassori - 2006

The choroid, the posterior segment of the uveal tract, develops early and is formed from the mesenchyme surrounding the optic cup. The anterior part of the choroid is modified to form the ciliary body and ciliary processes. (Galdin ,

(Valvassori - 2006

Develop from the mesenchyme of the optic cup. The anterior part of the choroid modifies to give the ciliary

(body and ciliary process. (John G - 2003

### **: The Iris 2.2.7**

Develops as a cleft in the mesenchymal layer between the lens and the ectodermal covering. The mesenchyme anterior and posterior to the iris gives the anterior and posterior chambers respectively. The substantial propria of the cornea lies anterior to the cleft and the pupillary membrane posterior to it. when the latter breaks, the two chambers become continuous with each

(other . (John G. – 2003

### **: The Sclera 2.2.8**

The sclera is derived from a condensation of the mesenchyme surrounding the optic cup. It first forms near the future insertion of the rectus

(muscles. (Galdin , Valvassori – 2006

### **: The Cornea 2.2.9**

The surface ectoderm overlying the optic vesicle forms the corneal epithelium, and the adjacent mesenchyme forms the mesothelium of the anterior chamber. The substantia propria and



the endothelium covering the posterior surface of the cornea are formed from mesenchyme. (Galdin ,  
(Valvassori - 2006

### **: Vascular System 2.2.10**

The development of the vascular system of the eye is a complex process that involves the appearance of vessels to meet the nutritional needs of the developing eye and subsequent regression of those same vessels. In the early embryo the internal carotid artery supplies a fine capillary plexus to the dorsal aspect of the optic cup (ventral and dorsal ophthalmic arteries). The hyaloid artery is a branch of the dorsal ophthalmic artery which passes through the embryonic fissure into the optic cup. During the sixth week of gestation, the primitive dorsal ophthalmic is transformed into the definitive ophthalmic artery and the ventral ophthalmic artery regresses and transforms into the posterior nasal ciliary artery. In the third trimester, the hyaloid system begins to regress. Remnants of this system may sometimes be seen in the adult as a persistent papillary

membrane. The hyaloid artery is no longer patent and loses its connection to the disk in the seventh month of gestation. (Galdin , Valvassori – 2006

### **: Extraocular Muscles 2.2.11**

The eyeball is surrounded by a highly cellular paraxial mesoderm. This mesodermal tissue in the region of the developing eye forms the extraocular muscles of the eye. The extraocular muscles during the developmental course become associated with the third, fourth, and sixth cranial nerves. Eye movement can be demonstrated by fetal ultrasonography. (Galdin , Valvassori – 2006

## **: The Eyelids 2.2.12**

The eyelids develop from surface ectoderm. and adjacent mesoderm. The eyelash and sebaceous glands are formed from surface ectoderm; however, the tarsus of the eyelid is developed from neural crest cells. The surface ectoderm forms the conjunctival epithelium. The eyelids, as they grow, become united with each other at about the third month of gestation. The lids remain fused until about the fifth month fetal life, when the eyelids begin to separate. Separation of the eyelids is completed by the seventh month of gestation. While the lids are fused, a closed space—the conjunctival sac—exists in front of the cornea.

((Galdin , Valvassori – 2006

They are ectodermal in origin. They develop at the middle of the third month. The two eye lids are adhered together until the end of the sixth month of intrauterine life after which they start to

(separate. (John G – 2003

## **:The Lacrimal Gland 2.2.13**

The lacrimal gland forms from epithelial buds, developing from the surface ectoderm, and grows superolaterally from the superior conjunctival fornix into the underlying mesenchyme. The gland becomes divided into orbital and palpebral parts with the development of the levator palpebrae

(superioris). (Galdin , Valvassori – 2006

The alveoli and ducts of the gland originate from the ectoderm of the superior conjunctival sac. The nasolacrimal duct develops as an epithelial bud at the region of the nasooptic furrow. The bud elongates to form a rod like structure. Canalisation of the latter follows giving origin to the

(nasolacrimal duct. ( John G – 2003

### **:The Lacrimal Sac and Nasolacrimal Duct 2.2.14**

The lacrimal sac and nasolacrimal duct initially develop as a solid cord of ectodermal cells that are trapped between the maxillary and lateral nasal elevations or processes. Later the central cells of the epithelial solid cord break down and the cord becomes canalized to form the nasolacrimal duct and the superior end becomes dilated to form the

lacrimal sac. Further cellular proliferation results in the formation of lacrimal ducts (inferior and superior and common canaliculi) that enter each (eyelid. (Galdin , Valvassori – 2006

### **:The Orbit 2.2.15**

The mesenchyme that encircles the optic vesicle forms the orbital bones. The bony orbit is formed from a combination of membranous and cartilaginous anlage. The base of the skull, the cranial bones, and the ethmoid and sphenoid bones arise from the cartilage of the more primitive chondrocranium, and the ethmoid and sphenoid bones contribute to a large portion of the orbit. The superior portions of the orbit and calvaria developed from a membranous anlage. The medial wall forms from the lateral nasal process. The lateral wall and inferior wall developed from the maxillary process (see Chapter 4). The bony orbit undergoes rapid changes in size and shape between six months of fetal life and .eighteen months after birth

The fovea centralis is a depression in the center of the macula lutea. It measures about 1.5 mm in diameter. A rise in CSF pressure causes the optic disk to bulge into the eyeball. (Galdin , Valvassori - (2006

### **:Vitreous 2.2.16**

The vitreous body occupies the space between the lens and retina and represents about two-thirds of the volume of the eye or approximately 4ml. The vitreous is the largest and simplest connective tissue present as a single structure in the human body. Any insult to the vitreous body may result in a fibroproliferative reaction (such as proliferative vitreoretinopathy), which can subsequently result in a tractional retinal detachment. The vitreous body is bounded by the anterior and posterior hyaloid membranes. The vitreous body is attached to the sensory retina, especially at the ora serrata and the margin of the optic disk. Within the vitreous, the hyaloid (colloquet) canal (channel) runs forward from the optic disk to the posterior pole of the lens. The vitreous body transmits light, supports the posterior surface of the lens, and

assists in holding the sensory retina against the  
(RPE. (Galdin , Valvassori – 2006

### **: The Optic Nerve 2.2.17**

It commences at the optic disc where the optic fibres group together. Medullation of these fibres starts shortly before birth and becomes complete at the second week after birth. (Galdin , Valvassori  
. (- 2006

## **-: Anatomy 2.3**

### **:Introduction 2.3.1**

The eye is peripheral organ of vision. It is suspended in a bony cage (orbit) by extra fascial sheaths. The retro bulbar pad of fat provides a protective cushion. A fibro elastic membrane called (Tenon's Capsule). Surrounds the eye half from the optic nerve almost to the limbus anteriorly. The eye ball is not typically spherical but an oblate spheroid due to flattening from above down words. The antero posterior diameter of the eye is about 24

(mm) . (Nema H.v - 1970)

The eyeball is made up of two segments, the anterior and posterior segments. The anterior, smaller, segment is transparent (cornea) and forms about one-sixth of the eyeball. The posterior larger, segment is opaque (sclera) and forms about five-sixths of the eyeball.

: The eye consists of three primary layers



The sclera, or outer layer, which is composed .1  
.primary of collagen-elastic tissue

The uvea or middle layer of the eye, which is .2  
richly vascular and contains pigmented tissue  
consisting of three com- ponents: the choroid,  
.ciliary body, and iris

The retina, or inner layer, which is the neural, .3  
sensory stratum of the eye. (Galdin E.  
(valvassori – 2006

The eyeball has a diameter of about 2.5 cm. It is  
basically composed of three layers, which are, from  
without inwards, the sclera, the choroid and the  
.retina

## **Blood Supply and Venous Drainage of the 2.3.2**

### **:Choroid**

The choroid receives its blood supply mainly  
from the posterior ciliary arteries. The four or five

vortex (vorticose) veins drain the choroid into the  
(ophthalmic veins. (Galdin E. valvassori – 2006

### **:Blood Supply of Retina 2.3.3**

The blood supply of the retina is from two sources. These include choroidal capillaries and the central retinal artery. the choroidal capillaries do not enter the retinal laminae, but tissue fluid exudes between these cells (cones, rods and outer nuclear layer). The retinal inner laminae are supplied by the central retinal artery. The retinal arteries are anastomotic end arteries, and there are no arteriovenous anastomoses. The retina depends on both of these circulations, neither of which alone is sufficient. The central retinal artery is the first branch of the ophthalmic artery. it measures about 0.3mm in diameter and runs forward adhering to the dural sheath of the optic nerve, It enters the inferior and medial side of the optic nerve about 12mm posterior to the eyeball. The artery is surrounded by a sympathetic plexus by the central vein, It pierces the lamina cribrosa to enter the eyeball. Small anastomoses occur between the branches of the posterior ciliary

arteries and the central retinal artery (cilioretinal artery). The central vein of the retina leaves the eyeball through the lamina cribrosa. The vein crosses the subarachnoid space and drains directly into the cavernous sinus or the superior ophthalmic vein.<sup>14</sup> The retina has no lymphatic vessels. (Galdin

(, Valvassori – 2006

### **-.:Nerves of the orbit 2.3.4**

The four recti arise rising from a fibrous cuff, called the annulus tendineus, that encircles : the dural sheath of the optic nerve, CN VI, and the superior and inferior branches of CN III, the Nasociliary nerve also passes through this cuff, but CN IV . clings to the bony roof of the cavity

Cranial nerves IV and VI supplying one muscle each and CN III supplying the remaining five orbital muscles two via its superior branch, three via its inferior branch. The oculomotor (CN III) through the ciliary ganglion supplies parasympathetic fibers to the ciliary muscle and sphincter iridis. (Anne M.R. – (1991

## **Blood Supply and Nerve Supply of the 2.3.5**

### **:Cornea**

The cornea is avascular and devoid of lymphatic drainage. nourishment of the cornea is established by virtue of diffusion from the aqueous humor and from the sclera and conjunctival Capillaries that end at its edge. Innervation of the cornea is via the ophthalmic division of the trigeminal nerve, mainly through the long ciliary

(nerves. (Galdin E. valvassori – 2006

### **:Nerve Supply of the Choroid 2.3.6**

Innervation of the choroid is provided by the long and short ciliary nerves. The nasociliary

(nerve. (Galdin E. valvassori – 2006

### **:Retina 2.3.7**

The retina the inner layer of the eyeball, is a thin, transparent membrane having a purplish-red color in living subjects. The external surface of the retina is in contact with the choroid, and the

internal surface with the vitreous body. Posteriorly, the retina is continuous with the optic nerve. The optic nerve and the inner layer of the eye represent an anteriorly protruding portion of the brain. Grossly the retina has two layers: (1) the inner layer, which comprises the sensory retina, i.e., photoreceptors, and the first and second-order neurons (ganglion cells) and neuroglial elements of the retina (Müller cells, or sustentacular gliocytes); and (2) the outer layer, which is the retinal pigment epithelium (RPE), consisting of a single lamina of cells whose nuclei are adjacent to the basal lamina (Bruch's membrane) of the choroid.

The retina is very thin, measuring 0.056mm near the disk or 0.1 mm anteriorly at the ora serrata. It is much thinner at the optic disk and thinnest at the fovea of the macula. The sensory retina extends forward from the optic nerve to a point just posterior to the ciliary body. Here the nervous tissues of the retina end and its anterior edge forms a crenated wavy ring, called the ora serrata. The anterior, nonsensory, part of the retina at the ora serrata becomes continuous with the pigmented and nonpigmented cell layers of the

ciliary body and its process. The macula the center of the retina lies 3.5mm temporal to the margin of the optic nerve. The retina is attached eighthly at the margin of the optic disk and at its anterior termination It the ora serrata. It is also firmly attached to the vitreous but loosely to the retinal pigment epithelium (RPE), and it is nourished by the choroid and the RPE. (Galdin E. valvassori - (2006

The retina consists of an outer piented layer and an inner neious layer. The posterior three — fourths of the retina is the receptor organ, it is anterior edge from a wavy ring, the ora serrata and .the nervous tissues end here

The anterior part of the retina is nor receptive and consists Merly of pigment cells with a deeper layer of columnar epithelium. At the centre of the posterior part of the retina is an oval, yellowish area, the macula lutea, which is the area of the retina for the most distinct vision. It has a central .depression the fovea

The optic nerve leaves the retina about 3mm to the medial side of the macula lutea by the optic disc, the optic disc is slightly depressed at its center, where it is pierced by the central artery of the retina. The optic disc is complete absence of rods and cones so that it is insensitive to light and is referred to as the "blind spot". (Nema H.v - (1970

### **: The ciliary body 2.3.8**

The ciliary body is continuous posteriorly with the choroid and anteriorly with the peripheral margin of the iris. The ciliary body is made up of the ciliary epithelium, the ciliary stroma and the ciliary muscle. The ciliary stroma consists of loose connective tissue, rich in blood vessels and melanocytes. The ciliary muscle consists of smooth-muscle fibers. The ciliary muscle is innervated by the postganglionic parasympathetic fibers derived from the oculomotor nerve. The nerve fibers reach the muscle via the short ciliary (nerves. (Galdin E. valvassori - 2006

### **: The iris 2.3.9**

The iris is a thin, Cataractile, pigmented diaphragm with a central aperture, the pupil. It is suspended in the aqueous humor between the cornea and the lens. The iris divides the space between the lens and cornea into an anterior and a posterior chamber. The aqueous humor, formed by the ciliary processes in the posterior chamber, circulates through the pupil into the anterior chamber and exits into the sinus venosus (canal of Schlemm) at the iridocorneal angle. The iris consists of a stroma and two epithelial layers. The stroma consists of highly vascular connective tissue containing melanocytes. The stroma also contains nerve fibers, the smooth muscle of the sphincter pupillae, and the myoepithelial cells of the dilator pupillae.<sup>1</sup> The arterial blood supply of the iris is from the two long posterior ciliary arteries and the seven anterior ciliary arteries.

((Galdin E. valvassori – 2006

### **:Tenon's Capsule 2.3.10**



Tenon's capsule is a thin membrane that envelops the eyeball and separates it from the central orbital fat, It thus forms a socket for the eyeball. The tenon's capsule blends with the sclera just behind the corneoscleral junction and fuses with the bulbar conjunctiva. Tenon's capsule is perforated behind by the optic nerve. The inner surface Tenon's capsule is smooth and shiny and is separated from the outer surface of the sclera by the episcleral (Tenon's space). (Galdin E. valvassori

(– 2006

### **:Sclera 2.3.11**

The sclera is the globe's outer white, leathery coat. It extends from the limbus at the margin of the cornea to the optic nerve where becomes contrnuous with the dural sheath. The external side the sclera lies against Tenon's capsule. The internal surface of sclera blends with the suprachoroidal tissues. Posteriorly, sclera is perforated by the

((vortex veins. (Galdin E. valvassori – 2006

The sclera consists of connective tissue, which is opaque, except anteriorly where it is modified by

becoming transparent and more curved to form the  
(cornea. (Sukkar M. – 1993

### **:The cornea 2.3.12**

The cornea has five layers, Epithelium membrane, Bowman's membrane, Descemet's membrane, Stroma and the Endothelium membrane. The cornea and the overlying tear film make up the major refractive surface of the eye:

((Nema H.v – 1970

Microscopically, the cornea consists of five layers. From front to back, they are: (1) the corneal epithelium, (2) Bowman's layer membrane), (3) the substantia propria, (4) Descemet's membrane, and (5) the corneal endothelium. Descemet's membrane is thicker than the endothelium. (Galdin

(E. valvassori – 2006

### **: The lens 2.3.13**

The lens is crystalline and biconvex, consisting of concentric laminae of elongated epithelial cells

and surrounded by a capsule. The iris is the coloured part of the eye, with the aperture or pupil in its centre. It has circular smooth-muscle fibres, which constrict the pupil when they contract, and radial or longitudinal fibres, which dilate the pupil, in this way varying the amount of light that enters the eye. The circular fibres are supplied by parasympathetic cholinergic nerves, while the longitudinal fibres are innervated by sympathetic adrenergic nerves. The retina lines the posterior two-thirds of the choroid and contains the receptors for light, the rods and cones. Medial to the anteroposterior axis of the eyeball is the spot where the optic nerve fibres leave the eye, called the optic disc, which measures about 1.5 mm in diameter. About 3 mm lateral or temporal to the optic disc and very close to the anteroposterior axis is the macula lutea (yellow spot), at the center of which is a depression called the fovea centralis. Clinically, the pupil is usually dilated by instilling drops of atropine like drugs into the eye, which paralyse the parasympathetic (nerves. (Sukkar M. – 1993

The space between the retina and the lens is filled with a transparent gelatinous material, called the vitreous', humour or body. The space between the cornea anteriorly and the iris and lens posteriorly is called the anterior chamber. The posterior chamber is the narrow circular space bounded anteriorly by the iris and posteriorly by the ciliary body and lens. Both the anterior and posterior chambers are filled with aqueous humour. This is a fluid similar in composition to the plasma without the proteins. but it has lower glucose and urea concentrations than in the plasma. Aqueous humour is produced in the ciliary glands through active transport and diffusion. The aqueous humour moves forward in the posterior chamber, going between the lens-and the iris into the anterior chamber, and moves on to the iridocorneal angle, between the cornea and iris and through trabeculae or vacuoles in the lining endothelial cells, to drain into the sinus venosus sclera or (canal of Schlemm. (Sukkar M. – 1993

## : **Sonographic Anatomy 2.3.14**

The chorioretinoid complex appear closely approximated. Choroid appear hypoechoic while the retina and sclera appear echogenic. Optic nerve on the other end appears hypoechoic at the level of the optic nerve. Muscles also appear hypoechoic. Retrobulbar fat is echogenic in appearance. Aqueous and vitreous appear (echopoor with no internal echoes. (Satish K – 2010

Lens appear hyperechoic and moves with the eye gaze. Pupil is seen as echofree area, while the iris appear echogenic. Temporal and nasal gaze are performed for visualization of internal echoes, optic nerve movement and lens status. The retrobulbar fat is a highly reflective tissue and forms a triangular mass which is traversed by the poorly reflective optic nerve. There is also a narrow sheet of fat between the muscles and orbital walls.

((Satish K – 2010

The normal eye appears as a circular hypoechoic structure. The cornea is seen as a thin hypoechoic layer parallel to the eyelid. The

anterior chamber is filled with anechoic fluid and is bordered by the cornea, iris and anterior reflection of the lens capsule. The iris and ciliary body are seen as echogenic linear structures extending from the peripheral globe towards lens. The normal lens is anechoic. The normal vitreous chamber is filled with anechoic fluid. Vitreous is relatively echolucent in a young healthy eye. Sonographically, the normal retina cannot be differentiated from the other choroidal layers. The evaluation of the retrobulbar area includes optic nerve, extraocular muscles and bony orbit. The optic nerve is visible posteriorly as a hypoechoic linear region radiating away from globe. (Satish K - (2010

### **Sonographic Appearance of The Normal 2.3.15**

#### **:Eye**

Choroid appears hypo echoic; while the retina and sclera appear acrogenic, optic nerve on the other end appears hypo echoic at the level of the optic nerve. Muscles also appear hypo echoic. Retro bulbar fat is acrogenic in appearance. The

cornea is seen as a thin hypoechoic layer parallel to the eye lid. Aqueous and vitreous appear echo poor with no internal echoes. Lens appears hypoechoic and moves with eye gaze, pupils is seen as echofree area, while the iris appears echogenic. The iris and ciliary body are seen as echogenic linear structures extending from the peripheral globe toward lens. The chorioretinoid complex appear closely approximated, the normal retina cannot be differentiated from the other chorodial layers sonographically. (Ibrahim Ishaq -

(2014

## **-: Physiology of the eye 2.4**

### **: The retina 2.4.1**

The retina has 10 layers. The arrangement of these layers can be appreciated when it is realized that the light receptors, the rods and cones. Each eye has about 120 million rods and 6 million cones. Rods are extremely sensitive to light and operate under dim light conditions. Cones have a higher threshold and operate under bright light conditions. There are no rods or cones on the optic disc, which is consequently blind (the blind spot). The fovea centralis contains only cones. At the fovea, the blood-vessels and retinal neurons are displaced to the sides, so that light rays pass directly to the cones. The density of cones falls sharply in the periphery of the retina. The density of rods increases from outside the fovea towards the periphery of the retina. The fovea centralis is the spot with the highest acuity of vision: details of objects are distinguished and colour is appreciated.

((Sukkar M. – 1993



### **: The choroid 2.4.2**

Is composed an outer pigment layer and inner, highly vascular layer. The choroid is a pigmented layer with numerous blood vessels, it is modified anteriorly to give the ciliary body and the iris.

((Sukkar M. – 1993

### **:The ciliary body 2.4.3**

Is continuous posteriorly with the choroids and anteriorly, it lies behind the peripheral margin of the iris. it composed of the ciliary ring, the ciliary processes and the ciliary muscle. The ciliaiy ring is the posterior part of the body. The ciliray processes are radially arranged folds or ridges to the posterior surface of which are connected the suspensory ligaments of the lens. The ciliary muscle is composed of meridional and circular fibers of smooth muscle. Is supplied by the parasympathetic fibers from ocul omotor nerve. Cataraction of this muscle, pull the ciliary body forward. This relieves. the tension in suspensory ligament and elastic lens becomes more convex. This increase the refractive power of the lens. This

process is known as (Mechanism of  
(accommodation) . (Nema H.v – 1970

The ciliary body is a circular structure consisting of the ciliary glands and smooth muscle. The ciliary muscle consists of circular fibres and longitudinal fibres, which are inserted near the corneoscleral junction. Suspensory ligaments from the ciliary muscle are joined to the zonule or lens (ligament). (Sukkar M. – 1993

#### **: Iris 2.4.4**

Is a thin contractile pigmented diaphragm with a central aperture, 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 posterior chamber. The muscle fibers of the iris are involuntary and consist of circular and radiating fibers. The circular fibers form the sphincter pupillae, the radial fibers form the dilator pupillae. The sphincter pupillae is supplied by parasympathetic fibers, the dilator pupillae is supplied by sympathetic fibers. 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 occur in fright. (Nema

(H.v - 1970

### **:Vitreous body 2.4.5**

Is fill the aye ball behind the lens and is a transparent gel. The function of the vitreous body is to contribute slightly to the magniring 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

((Nema H.v – 1970

### **:The Aqueous humor 2.4.6**

Is a clear fluid that fills the anterior and posterior chambers of the eye ball by exerting internal pressure and thus maintaining its optical shape. It is also nourishes the cornea and lens and removes the products of metabolism. (Nema H.v –

(1970

### **:The lens 2.4.7**

Is a transparent biconvex structure it is situated behind the iris and in front of the vitreous

body and is circled by the ciliary processes. The main function of the lens is accommodation.

Accommodation: is adjustment of the dioptric power of the eye. It is generally involuntary and made to see clearly objectives at any distance. In man, this adjustment is brought about by a change (in shape of the crystalline lens . (Nema H.v – 1970

## **:Pathology 2.5**

### **:Cataract 2.5.1**

is opacity of the natural crystalline lens, it is an extremely cause of visual impairment in older patients . Is defined as an opacity of and portion of the lens, regardless of visual acuity .In some advanced cases of cataracts , in which good fundus visualization is not possible, an ultrasound examination provides better assessment of the posterior segment of the globe. Cataract comes from the Greek word (cataracts) which describes rapidly running water, rapidly, running water turns white, as do mature cataracts. Cataracts which are treatable , remain one of the leading causes of blindness worldwide. There are some types of cataract, of which – a nuclear sclerotic cataract that describes

the sclerosis or darkening that is seen in the central portion of the lens nucleus, this type in older patients. In young cause high (myopia. (Jack. Kanski – 2005

### **:Posterior sub capsular cataracts 2.5.2**

Posterior sub capsular cataracts are granular opacities seen mainly in the central posterior cortex just under the posterior capsule, they have a hyaline type of appearance. Patients with type of cataract often have good distance vision but have blurred (near vision . (Vander. Gault – 2002

In addition , patients with types of cataracts often have extreme difficulty with glare so that in dim illumination they function well, where with bright illumination their vision decreases significantly. Congenital cataracts in infants caused by familial inheritance , intrauterine infection (rubella) metabolic diseases (galactosemia) and chromosomal abnormalities. (Gault – 2002

### **:A Morgagnian cataracts 2.5.3**

Is a mature in which the cortex liquefies and the mature central nucleus can be seen within the liquefied cortex. (Gault – (2002

#### **:Ultrasound finding 2.5.3.1**

The entire lens can be seen with an immersion scan , it is seen as an oval high reflective structure with interalesional

echoes from none to highly reflective depending on the amount  
(of cataract. (Sankara – 2006

The average lens thickness is 4.63mm, with cataractous  
changes increase to 7mm in extremely dens cases. (Enas G. –  
(2010

A normal lens creates reverberation (propagation) artifact  
seen as linear, repetitive , hyperechoic lines coming from its  
(posterior surface. (Megan . Kristin – 2011



#### **:Lens dislocation 2.5.4**

Lens dislocation is most often caused by trauma to the orbit , it occurs when the zonular fibers that hold the lens in place are disrupted. The lens appears sonographically as an oval echogenic structure that lies posterior to the ciliary body and normally has many reverberation artifacts. A complet lens dislocation can be obvious on ultrasound because the lens is seen remote from its usual position behind the pupil and is often suspended within the vitreous body of the posterior orbit.

((Megan . Kristin – 2011

#### **: Lens subluxation 2.5.5**

Lens subluxation (partial dislocation) can be much more difficult to diagnose because there are only slight changes in the position of the lens. A subluxed may be detected on ultrasound by asking patients to move their eyes during the examination. A normal lens moves in concordance with other orbital structures, whereas a subluxed lens may appear to move out of position behind the iris. A comparison with the contra lateral eye should always be done to evaluate for symmetry. (Megan . Kristin –

(2011

### **:Hyphema 2.5.6**

Hyphema is the occurrence of blood in the anterior chamber and is associated with an acute increase in intraocular pressure. It is most often caused by blunt trauma but can also occur in the presence of abnormal vessels in the eye caused by diabetes, chronic inflammation, surgery or malignancy. Although hyphema is usually a clinical diagnosis, ultrasound can aid in the diagnosis when periorbital swelling prevents a complete examination of the anterior chamber. Sonographically a hyphema appears as a hyperechoic layering in the anterior chamber. (Megan . Kristin – 2011)

### **:Globe Rupture 2.5.7**

Globe rupture occurs by penetrating trauma. Globe rupture can be detected on an ultrasound examination by noting a collapsed anterior chamber, an asymmetric posterior chamber, scleral fold. There is often an associated hemorrhage. (Megan . Kristin – 2011)

The traumatic globe rupture is a major ophthalmologic emergency and almost always requires surgical intervention. Ultrasound findings of globe rupture include decrease in the size of the globe, anterior chamber collapse and buckling of the sclera. (Blaivas M. Theodoro – 2002)

### **:Vitreous hemorrhage 2.5.8**

It is extravasations of blood into the spaces formed within and round the vitreous body. Occurs due to trauma and direct retinal tear or diabetes. This bleeding can result in a cute visual changes depending on the amount of opaque blood within the vitreous. On ultrasound a vitreous hemorrhage appears as a bright echogenic layer within posterior eye. (Megan . Kristin – (2011

Vitreous hemorrhage can interfere with vision and if it is large can cause blindness , it appears as echogenic material in the posterior chamber. The sonographic appearance of vitreous hemorrhage depends on its age and severity. Fresh mild hemorrhage appear as small dots or linear areas of areas of low reflective mobile vitreous opacities. In more severe and older hemorrhages, blood organizes and forms membranes. (Blaivas (MTheodoro – 2002

Vitreous hemorrhage is a common cause of reduced vision, occurs due to proliferative vascular retinopathies , trauma , disorders of coagulation , retinal breaks. Fresh vitreous hemorrhage is echolucent or low reflective vitreous hemorrhage may or not be associated with a posterior vitreous detachment ((PVD). (Sankara N. – 2006

### **:(Posterior vitreous detachment (PVD 2.5.9**

Vitreous detachment occurs when the vitreous body becomes detached from the retina. This detachment occurs due trauma, after surgery, or spontaneously over time as the vitreous plus away from the retina in older patients. Patients often describe (floaters) or (shadows) in their field of vision. Sonographically, it is typically seen as (v) shaped line within the vitreous and does not float with eye movement. There is often a (vitreous hemorrhage associated with it. (Megan . Kristin – 2011

Vitreous detachment may be a physiological or pathological phenomenon , it can be complete or partial seen as a freely membranous echo with variable attachments to the optic nerve head or retina and could be focal or broad , single or multiple. Mobility of the (PVD) is more than that of a retinal detachment, this help in differentiation between the two.

((Sankara . N – 2006

### **:Retinal Detachment 2.5.10**

Retinal detachment occurs when the sensory retina is separated from retinal pigment epithelial layer by fluid. Detachment can be classified as rehegmatogenous, tractional , combined traction – rhemotogenous and exudative, non rehegmatogenous depending on whether a rhegma , (hole) exists in the sensory retina. Most detachments are rehegmatogenous. Retinal holes are secondary to retinal degeneration or vitreous

traction from liquefaction of the vitreous. Haward , (Krishna –  
 . (1999

Non rhegmatogenous detachments are caused by  
subretinal fluid accumulation from abnormal vessels, most often  
in neoplastic tissues (choroidal melanoma , choroidal  
hemangioma , retinoblastoma), also can be caused by the  
vitreoretinopathy of diabetes mellitus , trauma , senile macular  
degeneration. Persistent hyperplastic primary vitreous. (Galdin .  
(E – 2006

Sonographically regmatogenous retinal detachment seen as  
thin , continuous , membrane on the B-scan separated from and  
located anterior to the echoes from the globe wall a highly  
elevated, totally detached retina appears as convex shape  
extending far into the vitreous from attachment points at the  
nasal and temporal ora serrata and at the optic nerve. Retinal  
(echoes on A-scan have high amplitude. (Sankara . N – 2006

#### **:(Tractional Retinal Detachment (TRD 2.5.10.1**

Typically seen as a concave membrane with a varying  
extent of vitreous adhesion , it may be either focal or broad  
 . depending upon the extent of vitreoretinal adhesion

Tractional retinal detachment often occurs in diabetic  
(retinopathy , vascular occlusions , trauma. (Sankara . N – 2006

### **:Exudative Retinal Detachment 2.5.10.2**

In exudative retinal detachment , the detachment may be seen in periphery or seen as isolated pockets of elevated retina. Typical features on ultrasound include the presence of smooth bullae and shifting fluid. The latter can be diagnosed by having the patient sit up or change head position which changes the configuration of the retinal detachment. It is necessary to (look for a tumor mass granuloma. (Sankara . N – 2006

### **:Retinal Breaks 2.5.10.3**

Retinal breaks or (tears) can be seen at the edge of the detached vitreous in cases of attached retina as high reflective elevations from the retinal surface with a free edge. Small tears can be seen as slight , hyper echoic , linear protrusions into the vitreous . Retinal detachment , significant causes of visual morbidity. Patients describe symptoms flashing lights. ((Sankara , Megan – 2006 – 2011

### **:Vitreous Opacities 2.5.11**

Any disease , such as uveitis , vitreous hemorrhage endophthalmitis , or organized vitreous , associated with cells in vitreous can simulate retinoblastoma with vitreous seeding. Vitreous opacities often obscure the view of the retina , causing more difficulty for clinician in differentiating the etiology of the vitreous cells. Sonographically vitreous opacities appear from

moderate to high echogenic areas may be focal or diffuse.

((Galdin . E – 2006

### **Globe shape Abnormalities \***

#### **: Coloboma 2.5.12**

Colobomas are congenital defects in the retina, choroid , iris , optic nerve and lens which result from deficient closure of the fetal optic fissure along the inferonasal aspects of the globe and optic nerve. The posterior globe and optic nerve are most commonly affected. The defect is transmitted as an autosomal dominant trait with variable penetrance , occurring bilaterally in 60 percent of cases. Visual field effects and decreased visual (acuity are present. (Howard , Krishna – 1999

Optic disc coloboma is caused by defective closure of the fetal fissure, the optic nerve head contains a large inferior excavation. Visual acuity is usually impaired and a superior (visual field defect is typical. (Jack , Kanski – 2005

A coloboma of the choroid appears as an excavation of varying depth involving the choroid , optic disc or both. There may be an associated cystic orbital component. Sonographically coloboma is seen as an excavation of the ocular wall, of varying depth. The contour may be smooth or have an outpouching.

((Sankara N. – 2006

Coloboma result from a failure of the embryonic fissure to close and are characteristically located in the inferonasal part of the fundus, they may involve or be confined to optic nerve head . The etiology of colobomas is varied and includes genetic as well as environmental factors. The sclera in the area of the coloboma can be ectatic and this abnormality is evident on B-scan ultrasonography. (Singh , Hayden – 2010

Colobomas can involves one or more ocular structures including the cornea...coloboma is an important cause of childhood visual impairment and blindness. An extensive list of syndromes and genetics conditions associated with coloboma can be evaluation of axial length by ultrasound and cornea (diameter. (Info/doctor – 2013

### **:Staphyloma 2.5.13**

Staphylomas are acquired defects in the wall of the globe that result in protrusion of either the cornea or the sclera. These defects are lined with iris or choroid tissue. In severe myopia , accompanying staphylomas typically are seen as focal bulges in the posterior surface of the globe on the temporal side of the optic disk . anterior staphylomas can be seen in inflammatory (entities such as rheumatoid arthritis. (Howard , Krishna – 1999



Staphylomas are due to expansion of the globe and sclera thinning. They may be peripallary or involve the posterior pole and be associated with macular hole formation. (Kanski , B – (2011

The possibility of a posterior staphyloma should be considered in all eyes with high axial myopia , particularly when axial length is difficult to measure and greater then(26 mm) .In this cases, the retinal peak is difficult to capture during the A-scan measurement because the macula may lie on aslop. B-scan is useful to confirm the unusual shape of posterior ocular (wall. (Singh , Hayden – 2010

Sonogrphically staphylomas appear as excessive anteroposterior elongation of the globe with smooth edge of the (posterior globe wall. (Sankara N. – 2006

### **:(Axial Myopia (High myopia 2.5.14**

High myopia is defined as an eye with a refractive error < -6D (Dioptres) and an axial length of the globe < 26 mm. It affects approximately 0.5% of the general population and 30% (of myopic eyes. (Kanski – Bowling – 2011

Axial myopia is characterized by an enlarged anteroposterior diameter of the globe. Anterior protrusion may be noted and may result in proptosis. Axial myopia is distinguished from staphyloma by the absence of a focal bulge

in an elongated globe. Retinal detachment and staphyloma may (a company the myopic globe. (Howard , Krishna – 1999

### **:Choroidal Detachment 2.5.15**

Choroidal detachment may occur spontaneously after trauma or surgical procedure. Clinically , it appears as single or multiple , dom-shaped elevations with a smooth surface. Choroidal detachments are either serous or hemorrhagic. Ultra sonography is useful in diagnosing and differentiating the types and extent of choroidal detachment and for follow up. (Sankara (N. – 2006

Sonographically , the choroidal detachment is smooth, dome –shaped and thick. Virtually no movement is seen with eye movement, when extensive, one can see multiple dome-shape detachments, which may meet in the central vitreous cavity. When choroidal detachments are hemorrhagic (rather than serous (increase) in case of trauma) , the subchoroidal space is filled with multitude of dots in contrast to the echolucent subchoroidal space of a serous choroidal detachment. ((Enas . G – 2010

The A-scan shows a typical double peak or (M) shaped spike representing echoes from the choroid and the retina. ((Sankara N. – 2006

### **:Central retinal vessels occlusion 2.5.16**

Central retinal artery or vein occlusion can present as painless , sudden loss of vision. Color Doppler placed posterior to the globe , where the vessels enter, can be used to identify the presence of blood flow. Absence of bidirectional flow suggests vascular occlusion and disorders. Spectral Doppler can be used .to confirm both the presence of venous and arterial wave forms

In color flow Doppler which identify the vessels posterior to the retina, the red color represents flow toward the probe and the blue color is flow away from the probe. The presence of both blue and red on color flow Doppler suggests normal (bidirectional flow. (Megan , Kristin – 2011

In the spectral Doppler (pulse-wave) which identify central retinal vessels. The tracing at the bottom of the screen depicts velocity over time , with venous flow depicted above the base line and arterial flow depicted below the base line. (Megan , (Kristin – 2011

## **:Ocular Tumours 2.5.17**

### **:Introduction 2.5.17.1**

Both benign and malignant melanomas arise intraocularly from the uveal tract. Extraocular extension through the vortex veins. Malignant Melanoma of the uveal tract (iris , choroid ciliary body) is most common intraocular malignant in adults. Predominantly occurring in white and rare in African. Hemangiomas of choroid are benign lesions that usually are detected in patients 10 to 20 years of age. Retinoblastoma , the most common intraocular malignancy of childhood. (Galdino (Valvassori – 2006

### **:Retinoblastoma 2.5.17.2**

The most common malignant ocular tumour in children bilateral in 30% of cases; 6% of patients have a positive family history. Presents typically at about 18 months with a white pupil (leukocoria). Grows either into the vitreous cavity (endophytic) (or subretinal space (exophytic). (Jack J . Kanski – 2006

Retinoblastoma occurs with a frequency of approximately 1 in 14.000 live birth. Approximately 250-300 children in the unite states each year are diagnosed with retinoblastoma . It is belived to arise from primitive retinoblasts. There are no determined causes for the cancer. Advanced paternal age and excess instances of cancer in relatives have been found to be

associated with retinoblastoma. One study found human papilloma virus in some eyes with retinoblastoma. (Jack J .  
(Kanski – 2006

Ultrasound is an important diagnostic tool. Sonographically it appears as single or multiple mass lesions in the vitreous cavity arising from the retina, irregular high internal reflectivity presence of calcium , seen as high reflective spikes within the lesion causing orbital shadowing . the echographic findings depend on the degree of calcification within the tumor. Differential diagnosis are retina cytoma uveal melanoma , neuroblastoma , chronic retinal detachment , persistent (hyperplastic primary vitreous. (Sankara , Robert – 2000 , 2006

### **:Choroidal Melanoma 2.5.17.3**

This is the most common primary malignant intraocular tumor in adults. Examination shows a pigmented or melanotic subretinal mass associated with exudative retinal detachment.  
((Jack J . Kanski – 2006

The tumor arises from malignant transformation of melanocytes in the uveal tract, melanoma in choroid is believed to originate pre existing nevi. Choroidal nevi are congenital lesions usually recognized late in the first decade of life and most commonly located in the posterior third of the choroid.  
((Robert , Alexandra – 2000

Ultrasound shows dome shaped or mushroom collar button configuration due to tumor growth through a ruptured Bruch's membrane. Regular internal structure on B. scan low to medium internal reflectivity on A scan. The differential diagnosis – retinoblastoma , choroidal metastases , (hemangioma , intra choroidal hemorrhage. (Sankara N. – 2006

#### **:Choroidal Haemangioma 2.5.17.4**

Hemangioma of the choroid are benign lesions that usually are detected in patient 10 to 20 years of age. These lesions are cavernous , and up to 90% have associated retinal detachment.

((Howard , Krishna – 1999

A very rare dome – shaped , located at the posterior pole which may be associated with secondary cystoids degeneration. Visual loss occurs due to hyperopic amblyopia, or secondary glaucoma. Ultrasonography shows , dome shaped mass at the posterior pole, regular internal structure on B. scan, high internal reflectivity on A. scan . no demonstrable internal blood flow. High reflective spikes on the surface may indicate fibrous. The differential diagnosis choroidal metastases , nodular scleritis.

((Sankara N – 2006

### **:Choroidal Metastases 2.5.17.5**

Metastases are most often due to hematogenous spread from carcinomas. Commonest site of involvement is the choroid. Approximately 25% of patients with ocular metastases have no known history of systemic malignancy and 10% eventually have no detectable primary tumor . Choroidal metastases involve the posterior pole. May be single or multiple unilateral or bilateral. There is associated exudative retinal detachment , which may be quite extensive. Sonographically seen as solid mass at the posterior pole. Variable internal structure which can be regular , irregular or have a central excavation moderate to high internal reflectivity on A. scan , no demonstratable internal blood flow, extensive retinal detachment usually over the tumor surface as well. Differential diagnosis , subretinal hemorrhage , subretinal abscess, ocular lymphoma , (diffuse amelanotic melanoma . (Sankara N. – 2006

### **-:Asteroid Hyalosis 2.5.17.6**

Asteroid Hyalosis is a degenerative condition of the vitreous of unknown etiology in which calcium soaps accumulate on vitreous fibrils in the eye . It is characterized by shiny discrete objects suspended in the vitreous disturbing a clear view of the fundus . The patient may complain of floaters or reduced vision . Thirty to seventy percent of patients with asteroid hyalosis have diabetes mellitus , sonographically the

vitreous cavity shows a varying number of discrete mobile point like bright echoes on the B-scan with a high spike on the A-scan , there is a clear space between the particles and the posterior globe wall , and this can mimic a posterior vitreous detachment. Differential diagnosis, retinoblastoma, (endophthalmitis and vitreous hemorrhage. (Sankara N. – 2006



## **Imaging Techniques 2.6**

### **: Introduction 2.6.1**

Computed tomography (CT) provided a major imaging advance over conventional radiography in examining the eye. The major application of (CT) for ocular lesions includes detecting foreign bodies , eye trauma , and intraocular calcification. The intraocular tumors and other intraocular pathologies. Magnetic resonance imaging (MRI) , is preferred to (CT) scanning . The development of magnetic resonance imaging has proved to be an even greater breakthrough in diagnostic . medical imaging

Ultrasonography , computed tomography and magnetic resonance imaging are the most useful imaging techniques in the evaluation of the eye . (Galdin , . (Valvassori – 2006

### **: Ultrasonography 2.6.2**

#### **: Protocol 2.6.2.1**

#### **,B. scan Ultrasonography of the globe**

## **-: Patient Prepration •**

.No specific Preparation is needed

### **Choice of transducer 2.6.2.2**

Us in 7.5-10MHz real time small part probe . Each probe has a marker for orientation that correlate with appoint on .the display screen, usually the left

An aesthetic drop are instilled ( Put) and patient placed -  
.in supine position or sitting

The Examiner should sit behind the patient's head and -  
.hold the probe with the dominate hand

Methylcellulose or an ophthalmic gel is placed on the tip -  
.of the probe to act as a coupling Agent

Vertical Scanning is performed with the marker on the -  
.probe superiorly oriented

Horizontal scan is performed with the marker on the -  
.probe pointed towards the nose

The eye is then examined with the patient looking -  
straight ahead up, down, left and right. For each

position a vertical and horizontal scan can be performed.

The examiner then moves the probe in the opposite direction to the movement of the eye, for example, when examining the right eye the patient looks to the left and the probe is moved to the patient's right, the nasal fundus anterior to the equator is scanned and vice versa. (Enas G. - 2010)

### **: Technique 2.6.3**

#### **-: Dynamic Scanning 2.6.3.1**

.Is performed by moving the eye but not the probe

#### **-: Basic Screen 2.6.3.2**

During basic screening, the entire globe must be • examined, from the posterior pole out to the far periphery. Each quadrant is evaluated carefully. The 4 major quadrants include the 12-o'clock, 3-o'clock, 6-o'clock and 9-o'clock positions. (Enas G. - 2010)

#### **:Marker over U\S probe 2.6.3.3**

The marker on the probe always corresponds the  
.top of scan plane

-: Axial scan •

.(Horizontal (Nasal side

(Vertical (up side)

.(Transverse Scan:- Horizontal (Nasal side •

.(Vertical (up side

Longitudinal scan (toward centre of corena). (Enas G. – •  
(2010

### : (Clinical Imaging (examination 2.6.3.4

: Refraction -

Refraction , is performed in refraction department to  
determine the visual acuity . refraction is done using  
illuminated Snellen chart . In case that , the patient is  
unable to recognize the largest test symbol , the fingers  
. are used

: (Intraocular pressure (I.O.P -

Aplanation tonometry is used to check the intraocular  
(pressure or air puff is used . (Elkandaw - 2003

## **:Previous studies 2.7**

Some previous studies were performed on patients below 40 years of age with low vision, ophthalmic ultrasonography was used to show the role of this modality to examine intraocular structures that the direct visualization is difficult or impossible for posterior segment, due to lens opacity, hyphema. vitreous hemorrhage or eye lids cannot be sufficiently opened.

Study involved 48 patients presented with a cut visual : **2.7.1** change ultrasound was performed and ophthalmic evaluations. Detection of retinal detachment (RD) presented in 18 patients, some patients were excluded, , ultrasound played good role in evaluating causes of the drop of the vision. (Yoonessi R. – (2010

In the study included a sample 61 of patients with drop of : **2.7.2** vision due ocular trauma. Ophthalmic evaluation was used as the gold standard. Ultrasound was performed and revealed diagnosis of ocular pathology including (8) patients with retinal (detachment. (Sierzenski – 2002

In the study that , was prepared in hospital das clinica : **2.7.3** ( saopaulo) between 2005 and 2007 (215) patients that , were examined in cataract. The ultrasonographic findings obtained from total (284) eyes from (215) , patients revealed ( (77%) presented with findings in the vitreous cavity and posterior pole.

A posterior vitreous detachment with no other complications was observed in 47.4% of eyes . the remaining 30.1% presented with eye disease that could result in a reduced visual function (vision drop). The most frequent eye diseases observed were diffuse vitreous opacity (12.1%) of the eye and detachment of (the (9.3%) of the eyes. (Alberto – 2009

Finally ocular ultrasound is a quick and accurate tool for the assessment of ocular pathology , including globe rupture , retinal detachment, cataract , lens subluxation , hyphema and .vitreous hemorrhage

## **Chapter Three**

### **Materials And Methods**

#### **: Material 3.1**

Patients referred to ultrasound department  
.with low vision below 40 years

#### **: study design 3.1.1**

Cross- section study

#### **study Area 3.1.2**

. Makkah Eye Hospital – Khartoum , Sudan

#### **study population 3.1.3**

Patients present with low vision to  
. ophthalmic Ultrasound department

#### **: inclusion criteria 3.1.4**



. Patients below 40 years with low vision\*

Patients whose direct view of the intraocular \*  
structures is difficult or impossible due to opacity  
.of cornea or dens cataract or any others causes

### **Exclusion criteria 3.1.5**

Patients more than 40 years -

Patients previous intraoperative -

### **study period 3.1.6**

Study was conducted during period from

. September to December 2015

### **Sampling size 3.1.7**

Patients satisfying the inclusion criteria  
within study period were included in the study  
. about one hundred patients

### **Tools 3.1.8**

#### **: Ophthalmic Ultrasound system**

I illuminated snellen chart -

Applanation tonometer -

Air puff -

### **Data collection technique 3.1.9**

Data was collected using the following

History taking and examination or -  
questionnaire sheet filled by the researcher

(( attached

Investigation : ophthalmic ultrasound B . scan -

## **Methodology 3.2**

The study covered one hundred patients of different sex and ages , present with low vision . They were randimly selected in the ophthalmic ultrasound department . Also refraction was done using illuminated snelled chart to check the visual acuity. In cases that the patients were unable to recognize the largest test symbol , the fingers were not seen , then hand was moved in front of the patient . Moreover intraocular pressure (I.O.P) was . checked , but difficult with children

Ultrasound was performed using probe of 10 MH real time , patient in erect or supine position , closed eye technique , no specific preparation was needed . limaging of the eye should be performed in two planes to ensure a complete evaluation ( ( transvers and sagittal planes

A questionnaira was designed and completed for each patients ( see appendix ) . The questionnaire consisted of general information about the patient , such as gender, Age , job , state

vision acuity and its type , intraocular pressure,  
Medical history , family history of wearing glasses ,  
history of trauma , tumor, vitamin (A) deficiency as  
.well as Retinitis pimentos and Ultrasound findings

### **: Data analysis 3.2.1**

Computer was utilized for data analysis using spss ( statistical package for social sciences ) program . Computer program (Excel ) was used for . graphical presentation

### **limitation of the study 3.2.2**

Lack of more advanced high frequency technique ( 30 - 50 MHZ) which allows high definition imaging of the anterior chamber . ( hyphema) hemorrhage

Difficulty in measuring visual acuity and intro . ocular pressure in children

### **Ethical consideration 3.2.3**

A written consent was obtained from the .medical director of makkah hospital

Verbal consent from patients were obtained with clear understanding that they are under no obligation to do so and there will be no negative consequences for them if they don't assisted in this . research

### **Dynamics scanning 3.2.4**

Is performed by moving the eye but not the probe

### **Basic screen 3.2.5**

During basic screening , the entire globe must be examined , from the posterior pole out to the far periphery. Each quadrant is evaluated carefully . The 4 major quadrant include the 12

. - o'clock , 6 -o'clock and 9 o'clock positions

### **-: Marker over U\S probe 3.2.6**

The marker on the probe always corresponds -

. the top of scan plane

-: Axial scan -

.( Horizontal (Nasal side

.( Vertical ( Up side

-: Transverse scan

.( Horizontal (Nasal side

.( Vertical ( Up side

( Longitudinal scan ( toward center of cornea



(Ibrahim ishaq – 2014)

### **Clinical examination** 3.2.7

-: Refraction -

Refraction is performed in refraction department to determine the visual acuity . refraction is done using illuminated snellen chart . In cases that , the patient is unable to recognize the largest test . symbol , the fingers are used

(Intra ocular pressure (I.O.P -

A planation tonometry is used to check the intraocular pressure or air puff is also used.

((Babiker Elkandaw – 2003

### **:Type of the study 3.3**

Crosse-section study which assess the patients .with low vision and its causes songraphically

## Chapter four

### 4.1Result

**: Table (4.1) Gender distribution**

<b>Percent</b>	<b>Frequency</b>	<b>Gender</b>
75%	75	Male
25%	25	Female
100%	100	Total

Figure (4.1) showing the Gender distribution among study population

**: Table (4.2) Job and low vision distribution**

<b>Percent</b>	<b>Frequency</b>	<b>Low vision</b>	<b>Job</b>	<b>Group</b>
33%	33	33	33	Student
24%	24	24	24	Laborer
43%	43	43	43	Others
100%	100	100	100	Total

Figure (4.2) showing the job and low vision distribution  
. among study population

**: Table (4.3) Type of Cataract distribution**

<b>Percent</b>	<b>Frequency</b>	<b>Cataract type</b>
91.4%	85	Acquired
8.6	8	Congenital
100%	93	Total

Figure (4.3) showing Cataract types distribution among  
. study population

**Table (4.4) : Intraocular pressure : distribution**

<b>Percent</b>	<b>Frequency</b>	<b>Intraocular pressure</b>
75%	75	Normal
5%	5	High
20%	20	Unco-operative
100%	100	Total

Figure (4.4) showing the distribution of Intraocular pressure among study population

**: Table (4.5) Chronic diseases distribution**

<b>Percent</b>	<b>Frequency</b>	<b>Diseases</b>
2%	2	Diabetes Mellitus
2%	2	Hypertension
3%	3	Glaucoma
93%	93	Normal
100%	100	Total

Figure (4.5) showing the distribution of the chronic . diseases among study population

**Table (4.6) Distribution of cataract and  
: vitreous hemorrhage**

Percent	Frequency of	Group
	C V H	
36.8%	7	Student
26.4%	5	Laborer
36.8%	7	Others
100%	19	Total

Figure (4.6) showing the distribution of the cataract and . vitreous hemorrhage (C V H) among study population

**Table (4.7) Distribution of cataract and : posterior vitreous detachment**

Percent	Frequency of	Group
	C P V D	
50%	4	Student
12.5%	1	Laborer
37.5%	3	Others
100%	8	Total

Figure (4.7) showing distribution of Cataract and posterior . vitreous detachment (C P V D) among study population



**Table (4.8) Distribution of cataract and : retinal detachment**

Percent	Frequency of	Group
	C R D	
44.4%	4	Student
22.3%	2	Laborer
33.3%	3	Others
100%	9	Total

Figure (4.8) showing distribution of cataract and retinal . detachment (CRD) among study population

**Table (4.9) Distribution of cataract,  
: vitreous and retinal detachment**

Percent	Frequency of	Group
	C V R D	
0%	-	Student
40%	2	Laborer
60%	3	Others
100%	5	Total

Figure (4.9) showing distribution of cataract, vitreous and . retinal detachment (CVRD) among study population

**Table (4.10) Distribution of cataract and  
: choroid detachment**

<b>Percent</b>	<b>Frequency of C C H O R D</b>	<b>Group</b>
0%	-	Student
100%	1	Laborer
0%	-	Others
100%	1	Total

Figure (4.10) showing distribution of cataract and . choroidal detachment (CCHORD) among study population

**Table (4.11) Distribution of cataract an  
: staphyloma among study population**

Percent	Frequency of	Group
	C S T A	
0%	-	Student
16.7%	1	Laborer
83.3%	5	Others
100%	6	Total

Figure (4.11) showing distribution of cataract an  
. staphyloma (CSTA) among study population

**Table (4.12) Distribution of cataract and : coloboma**

<b>Percent</b>	<b>Frequency of C C O L O</b>	<b>Group</b>
20%	1	Student
20%	1	Laborer
60%	3	Others
100%	5	Total

Figure (4.12) showing distribution of cataract and . coloboma (CCOLO) among study population

**Table (4.13) Distribution of cataract and  
: stroispyalosis**

<b>Percent</b>	<b>Frequency of C S T R</b>	<b>Group</b>
0%	-	Student
50%	1	Laborer
50%	1	Others
100%	2	Total

Figure (4.13) showing distribution of cataract and  
. stroispyalosis (CSTR) among study population

**Table (4.14) Distribution of corneal opacity  
: and vitreous changes**

<b>Percent</b>	<b>Frequency of C O V C H</b>	<b>Group</b>
50%	1	Student
0%	-	Laborer
50%	1	Others
100%	2	Total

Figure (4.14) showing distribution of corneal opacity and . vitreous changes (COVCH) among study population

**Table (4.15) Distribution of lens sublexation  
: and dislocation**

<b>Percent</b>	<b>Frequency of L S D</b>	<b>Group</b>
0%	-	Student
66.7%	2	Laborer
33.3%	1	Others
100%	3	Total

Figure (4.15) showing distribution of lens sublexation and . dislocation (LSD) among study population



**: Table (4.16) Distribution of cataract**

<b>Percent</b>	<b>Frequency of C</b>	<b>Group</b>
42.1%	16	Student
21.1%	8	Laborer
36.8%	14	Others
100%	38	Total

Figure (4.16) showing distribution of cataract (C) among  
. study population

**: Table (4.17) : Types of tumor**

<b>Percent</b>	<b>Malignant</b>	<b>Benign</b>	<b>Group</b>
0%	-	-	Student
0%	-	-	Laborer
100%	2	-	Others
100%	2	-	Total

Figure (4.17) showing Tumor distribution among study population

**: Table (4.18) Ultrasound findings**

<b>C</b>	<b>CSTA</b>	<b>CVRD</b>	<b>CRD</b>	<b>CPVD</b>	<b>CVH</b>	<b>Pathology</b>
38	6	5	9	8	19	<b>Frequency</b>
38%	6%	5%	9%	8%	19%	<b>Percent</b>

Figure (4.18) showing ultrasound findings demonstrating cataracts with others different pathologies led to drop . vision

CVH) cataract and vitreous hemorrhage. (CPVD)) •  
 cataract and posterior vitreous detachment. (CRD)  
 cataract retinal detachment. (CVRD) cataract  
 vitreous and retinal detachment. (CSTA) cataract and  
 . staphyloma. (C) cataract

## **Chaper five**

### **: Discussion 5.1**

One hundred patients were included in this study , they of different sex , 75 patients male (75%) and 25 female (25%) , Table (4.1) . The jobs distribution among study population as well as low vision as following 33 students (33%) , 24 laborers (24%) and 43 others (43%) . Table (4.2) . All the patients below 40 year and their mean age is 22 , 39 year . The male patients were predominate and this may be explained that ,the males were commonly involved in out door activities than females , and more subjected to trauma than females . In this study, the population of the study below 40 years similar to previous study by Alberto Jorge , (2005 - 2007) , which examine the eye for cataract . Ultrasound reveal causes if vision drop nearly to our study result , where the study found 8 patients (8.6%) congenital cataract , and 85 patients (91.4%) acquired cataract result in drop vision , due to trauma and this majority of cataract . Ttable (4.3) , Jorge (2005 - 2007) study

showed 77 patients (77%) cases of cataract due . trauma , which led to vision drop

The study found that 75 patients (75%) with normal intraocular pressure (I.O.P) les than 21 mm Hg , while 5 patients (5%) with more than 21 mm hg , more increased . There were others 20 patients (20%) un co-operative to check their intraocular pressure , Table (4.4) . There were seven cases of chronic diseases – diabetes mellitus , hypertension and glaucoma , Table (4.5) . Eighty patients (80%) without eye glasses , No history of family with eye glasses . We found two (2%) cases of malignant tumor (retinoblastoma) were . detected

Ophthalmic ultrasonography , in this study evaluated 19 cases (19%) of cataract with vitreous hemorrhage among study population . Table (4.6) . Also 8 cases (8%) of cataract associated with vitreous detachment among study population . Table (4.7) . Sonographically 9 cases (9%) of cataract and retinal detachment were detected among study population table (4.8) . The detected

causes here which led to the vision drop , this study agrees with results of study by yoonessi R , Ussain A (2010). Also ultrasound showed 5 cases of cataract (5%) , associated with vitreous and retinal detachment among study population . those causes which led to low vision were seen in the study by Blaivas M . Thedor (2002) . Table (4.9) . Only one case (1%) of cataract and choroidal detachment was seen . Table (4.10) . more over 6 cases (6%) of cataract and staphyloma were detected among study population , table (4.11) the study found 5 cases (5%) of cataract associated coloboma . Table (4.12) . Only 2 cases (2%) of cataract with steroid hyalosis were seen among study population . Table (4.13) . Ultrasound revealed 2 cases (2%) of corneal opacity with vitreous changes . Table (4.14) . Ultrasound showed 3 cases (3%) of lens subluxations and dislocation among the study population . Table (4.15) . In this study cataract without any others different pathologies were seen , the main causes of the loss of vision , where 32 cases (32%) were detected . Table (4.16) . Ultrasound revealed 2 cases (2%) of malignant tumor (retinoblastoma) among study population . Table (4.17) . Finally

ultrasound showed that cataract the major cause of the drop vision in compare with others causes .

. (Table (4.18

## **Conclusion 5.2**

The study found that , the causes of low vision , In the age below 40 years , some acquired due to trauma and others are congenital . It found that , low vision is more among the male patients than female because males are more commonly involved in outdoor activities . so it's very noticeable that the cataract cases incidence are more due to trauma . In some cases associated with others different pathologies such as vitreous hemorrhage , hyphema and retinal or vitreous . detachment

There are some causes contribute in causation of low vision beside cataract such as retinoblastoma (malignant tumor) , staphyloma , coloboma strabismic, choroidal detachment and corneal opacity , dense cataract and corneal opacities and swelling of patient eye lid . They all share in obscure the direct view of the intraocular structures and become difficult or impossible . The ophthalmic Ultrasonography is found to be the best imaging modality of choice for evaluating



intraocular structures and posterior segment .  
Ophthalmic Ultrasound in comparing with others  
medical imaging modalities such as , computed  
tomography or magnetic resonance imaging is  
considered the modality of choice and first line of  
investigation because of the ultrasound is quick ,  
. accurate , noninvasive , cheap and available tool

### **Recommendations 5.3**

The low vision is no doubt problem among the  
Age below 40 in recent time ,so the study  
: recommend the following

Workers and farmers must be advised and -  
encouraged to wear glasses during the work to  
. protect their eyes from trauma

Children toys should not be harmful to their -  
. eyes

Ultrasound department should be provided with -  
more advanced equipment

The diagnostic ultrasound specialist must be -  
well trained and experienced to perform the  
diagnose

The use of 3D ultrasound in cases where there -  
is no ophthalmoscopy view into the eye

The use of high - resolution technique 20Mhz -  
B -scan in more - mode to measure the  
intraocular tumors , and Doppler Ultra sound

The use computerized coronal C. scan Ultra -  
sound section to measure the orbital portion of  
the optic nerve , to detect optic nerve sheath  
meningioma's and invasion of retinoblastoma  
into the optic nerve

The use of high - frequency Ultra sound for anterior  
segment

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