Sudan University of Sciences and Technology

College of Graduate Studies

Study of Retinal Detachment in Sudanese Patients Using Ultrasonography

دراسة انفصال الشبكية لدى المرضى السودانيين باستخدام الموجات فوق الصوتية

A thesis Submitted for Partial Fulfillment of the Requirements of

M.Sc. Degree in Medical Diagnostic Ultrasound

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الآية

بسم الله الرحمن الرحيم

قال الله تعالى في محكم آياته: ﴿أَيَحْسَبُ أَن لَّمْ يَرَهُۥٓ أَحَدٌ ۝٧ أَلَمْ نَجْعَل لَّهُۥ عَيْنَيْنِ ۝٨ وَلِسَانًا وَشَفَتَيْنِ ۝٩ وَهَدَيْنَٰهُ ٱلنَّجْدَيْنِ ۝١٠﴾

صدق الله العظيم

سورة البلد

Dedication

To the man who taught me the true meaning of illimitable love, I'll keep him forever in my heart. I am honored to write my name next to his name, to my father soul (Yousif).

To the woman who gave me care and who sacrificed for our happiness, to my lovely mother soul(Badria).

To my face my sisters and kids.

To the man who shared with me every moment in my life my husband (Hatim). To all people who supported and stood behind me, Especially my best friend (Nehad).

Acknowledgement

Foremost thanks to Allah who gave me the patience to complete this research. For the man who gave me the motivation, standing behind me in every step and supported me with his advice and guidance to accomplish this research my supervisor Dr. Salah Ali Fadlalla Ahmed.

My thanks are extended to AL-Faisal Eye Center & Makkah Eye Complex.

Abstract

This was cross sectional descriptive study aimed to evaluate the retinal detachment in Sudanese patients by using ultrasonography done in alfisal eye center and Makkah hospital in the period from January to April 2019, Retinal Detachment is common in Sudanese Patients but there is few researches in it, the data of this study was collected by data master sheet and analyzed by SPSS statistical program based on descriptive statistics and hypothesis tests (0.05 sig. level), included 50 patients males (64%) and females (36%)from different ages complaining of retinal detachment. To demonstrate the retinal detachment with respect to (Age, gender, hypertension, DM, types of detachment and Trauma).

The study found that the mean age of retinal detachment was (51) ± A ratio of (10%) of the sample had ages less than or equal to 20 years, (10%) had ages between 21 to 40 years, (48%) from 41 to 60 years, and (32%) had ages more than 60 years. (40%) had no diabetes mellitus (DM), and (60%) had diabetes mellitus (DM) a ratio (52%) of the patients had no control on the disease. (48%) of the patients had control on the disease. The results showed that there was no statistically significant.(74%) of the patients had no hyper tension, and (26%) had hyper tension. The study showed that there was no statistically significant relationship between the hyper tension and RD. a ratio (84%) had retinal detachment in one eye, and (16%) the retinal detachment in both eyes, and that there was no statistically significant relationship between the number of affected eyes and RD. The result as well, showed that (46.2%) had direct truma, (46.2%) hadPost-operative truma, and (7.7%) had Myopiaof the sample hadtruma, and there was no statistically significant relationship between the Truma and RD. A ratio of (48%) had partially detachment, and the most common type (52%) had complete detachment, there was no statistically significant relationship between the type of detachment and RD.

There is no statistically significant relationship between all parameters due to P>0.05 further studies are recommended using larger sample.

المستخلص

كانت هذه دراسة وصفية مقطعية تهدف هذه الدراسة الى تقييم انفصال الشبكية في المرضى السودانيين باستخدام الموجات فوق الصوتية أجريت في مركز الفيصل للعيون ومستشفى مكة في الفترة من يناير إلى أبريل 2019 ، انفصال الشبكية أمر شائع لدى المرضى السودانيين ولكن هناك القليل من الأبحاث ، ، تم جمع بيانات هذه الدراسة بواسطة ورقة البيانات الرئيسية وتحليلها من قبل البرنامج الإحصائي SPSSعلى أساس الإحصاءات الوصفية واختبارات الفرضيات)مستوى 05.0 سيج(، وشملت 50 مريضا من الذكور) 64 ٪(والإناث) 36 ٪((من مختلف الأعمار يشكون من انفصال الشبكية. لإظهار انفصال الشبكية فيما يتعلق بـ)العمر ، الجنس ، ارتفاع ضغط الدم ، مارك ألماني ، أنواع الانفصال والصدمات.(

وجدت الدراسة أن متوسط عمر انفصال الشبكية كان) 51(± نسبة) 10 ٪(من العينة كانت أعمارهم أقل من أو تساوي 20 سنة) ، 10 ٪(تتراوح أعمارهم بين 21 إلى 40 سنة) ، 48 ٪ (من 41 إلى 60 عامًا ، و)32٪(تتراوح أعمارهم بين 60 عامًا.)40 ٪(لم يكن لديهم داء السكري ، و) 60 ٪(لديهم داء السكري نسبة) 52 ٪(من المرضى ليس لديهم السيطرة على المرض) .48 ٪(من المرضى قد السيطرة على المرض. أظهرت النتائج أنه لم يكن هناك دلالة إحصائية)74٪(من المرضى ليس لديهم ارتفاع ضغط الدم ، و) 26٪(لديهم ارتفاع ضغط الدم. أظهرت الدراسة أنه لا توجد علاقة ذات دلالة إحصائية بين ارتفاع ضغط الدم والانفصال الشبكي .كانت نسبة)84 ٪(انفصال الشبكية في عين واحدة ، و) 16 ٪(في كلتا العينين ، وأنه لا توجد علاقة ذات دلالة إحصائية بين عدد العينين المتض ررة والانفصال الشبكي .والنتيجة أيضًا ، أظهرت أن)2.46٪(مصاب بصدمة مباشرة) ، 2.46٪(مصاب بصدمة ما بعد الجراحة ، و) 7.7٪(مصاب بقصر النظر ، ولم تكن هناك علاقة ذات دلالة إحصائية بين الصدمة والانفصال الشبكي .كانت نسبة) 48 ٪(انفصال الشبكي جزئي ، والنوع الأكثر شيوعا) 52 ٪(كان انفصال الشبكي كامل ، لم يكن هناك علاقة ذات دلالة إحصائية بين نوع الانفصال الشبكي

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لا توجد علاقة ذات دلالة إحصائية بين جميع المعلمات بسبب P> 0.05 ينصح بإجراء مزيد من الدراسات باستخدام عينة أكبر.

Table of Contents

List of Tables

List of Figures

List of Abbreviations

Abbreviations	Meaning
CRD	Complete Retinal Detachment
DM	Diabetes Mellitus
ED	Emergency Department
HT	Hyper Tension
MHz	Megahertz
PRD	Retinal Detachment
PVD	Posterior Vitreous Detachment
PVR	Proliferative Vitreoretinopathy
RD	Partial Retinal Detachment
RPE	Retinal Pigment Epithelium
RRD	Rhegmatogenous Retinal Detachment
SPSS	Statistical Package for Social Sciences
TRD	Tractional Retinal Detachment
VHs	Vitreous hemorrhages

Chapter One
Introduction

Chapter One
Introduction

1.1 Introduction:

Detachment of the retina is a serious event, which may result in complete blindness. The outer segments of the photoreceptors receive oxygen and nutrition from the choroid. If the retina is detached from the choroid, the photoreceptors will fail. The fovea has no retinal blood vessels and depends wholly on the choroid for its oxygen, so detachment of the macula leads to permanent damage to the cones and rods at the posterior pole, and loss of vision. If the macula is not detached then good vision can be retained if the retina is reattached promptly (Subhadra Jalali,2003).

Retinal detachment (RD) is an ocular emergency that often requires immediate intervention to prevent rapid, irreversible visual loss. Definitive diagnosis is made on dilated evaluation by an ophthalmologist, but patients frequently present first to the emergency department (ED). Classically, patients with RD complain of visual ‘‘flashes’’ and ‘‘floaters,’’ occasionally with monocular clouding or shadowing in a portion of the visual field, but these complaints can also be associated with diabetic retinopathy or vitreous hemorrhages. Likewise, while fundoscopic examination may reveal other findings such as hemorrhage or papilledema, fundoscopy can be difficult, especially in patients with cataracts or intraocular hemorrhages, making definitive diagnosis challenging. Therefore, evaluation by an ophthalmologist is often required for definitive diagnosis, with some groups specifically recommending early referral to a retinal specialist. (Subhadra Jalali,2003).

Retinal detachment is broadly classified into three types based on the clinical appearance and underlying etiology: Rhegmatogenous retinal detachment (RRD) where the RD develops due to a retinal break (‘rhegma’, meaning a rent or a fissure). Fluid, from the vitreous cavity, passes through the retinal break into the potential space under the retina, leading to separation of the retina from the underlying choroid. This requires surgical treatment. (Subhadra Jalali MS,2003). Tractional retinal detachment (TRD) which occurs due to pre-retinal membrane formation and scarring that pulls the retina from its attachment. This may require surgery depending on the extent of the RD. The commonest causes of TRD are diabetes, Eales’s disease, sickle cell retinopathy and trauma. (Subhadra Jalali ,2003).

Exudative and serous retinal detachments occur due to abnormalities inwater transport across the bed of the retina (retinal pigment epithelium) or in its blood supply. Tractional and exudative/serous retinal detachments are less common. (Subhadra Jalali, 2003).

Ultrasonography has become an important diagnostic technique in ophthalmology, particularly during past few years. Ultrasound was first used in the year 1956 by two American ophthalmologists, Mundts and Hughes. The experience about cross-sectional B-scan display of the eye was reported by Baum and Greenwood (1958).

The cystic nature of the eye, its superficial location, and high-frequency transducers make it possible to clearly show normal anatomy and pathology of eye and orbits. Sonography is used more commonly by ophthalmologists to evaluate the eye, particularly when direct examination by slit-lamp and fundoscopy is not sufficient. Detailed cross-sectional anatomy of the entire globe is possible with conventional sonographic equipment. (Subhadra Jalali ,2003).

Doppler and A-mode sonography are reported to be useful in characterizing masses. (Subhadra Jalali ,2003).

1.2. Problem of the study:

No study and researches about retinal detachment ultrasonography.

1.3 Objectives of the study:

1.3.1. General objective:

To Study Retinal Detachment in Sudanese Patients Using Ultrasonography.

1.3.2 Specific objectives:

To identify sonographic appearance of the retinal detachment. To evaluate the type of retinal detachment.

To identify the relationship between RD with patients Clinical history and age.

1.4. Over view of the study:

This study includes five chapters, chapter one is introduction which, included, objectives and problem of study. Chapter two include back ground and literature review, Chapter three describes the material and method. Chapter four includes results presentation, finally chapter five includes the discussion, conclusion and recommendation**.**

Chapter Two
Literature Review and Previous Studies

Chapter Two

Literature review & Previous Studies

2.1 Theoretical background

2.1.1 Anatomy of the eye:

Eyes are like windows to the outside world, but their intricacies and functionalities are far more extensive than. Those of any given glass window. They are able to capture, adjust, and transform light into a chemical code that only the brain can decipher. Each structure of the eye works in accord with the next – refracting, constricting, dilating and chemically reacting to convert patterns of light. This article uses the mammalian eye as a primary model and follows the path that light takes on its journey through the functional eye, detailing the essential components of one of the smallest, yet most complex organs in the body.

Many have attempted to emulate its abilities, but even top-of-the-line digital single lens reflex cameras dare not compare with the elegant,efficient design infused in this multifaceted unit of anatomical machinery.(Kent M. Van De Graaff.… et al 2010).

2.1.1.1 The Eye and Supporting Structures

The eye has three layers or coats, three compartments and contains three fluids.

The three coats of the eye are as follows:

Outer fibrous layer: cornea, sclera and lamina cribrosa, Middle vascular layer ("uveal tract"), iris, ciliary body (consisting of the pars plicata and pars plana) and choroids, Inner nervous layer: pigment epithelium of the retina, retinal photoreceptors and retinal neurons. (Nicholas 2016)

The three compartments of the eye are as follows: Anterior chamber – the space between the cornea and the iris diaphragm, Posterior chamber – the triangular space between the iris anteriorly, the lens and zonule posteriorly, and the ciliary body, Vitreous chamber – the space behind the lens and zonule. (Nicholas 2016)

The three intraocular fluids are as follows: Aqueous humour – a watery, optically clear solution of water and electrolytes similar to tissue fluids except that aqueous humour has low protein content normally, Vitreous humour – a transparent gel consisting of a three-dimensional network of collagen fibres with the interspaces filled with polymerized hyaluronic acid molecules and water. It fills the space between the posterior surface of the lens, ciliary body and retina. (Nicholas 2016)

Blood – in addition to its usual functions, blood contributes to the maintenance of intraocular pressure. Most of the blood within the eye is in the choroid. The choroidal blood flow represents the largest blood flow per unit tissue in the body. The degree of desaturation of efferent choroidal blood is relatively small and indicates that the choroidal vasculature has functions beyond retinal nutrition. It might be that the choroid serves as a heat exchanger for the retina, which absorbs energy as light strikes the retinal pigment epithelium. (Nicholas 2016)

2.1.1.2 The Outer Layer of the Eye

The anterior one-sixth of the fibrous layer of the eye is formed by the cornea. The posterior fivesixths are formed by the sclera and lamina cribrosa. The cornea is transparent,whereas the sclera, which is continuous within it, is white.

The junction of cornea and sclera is known as the limbus.

The cornea has five layers anteroposteriorly: Epithelium and its basement membrane –stratified squamous type of epithelium with five to six cell layers of regular

arrangement, Bowman's layer homogeneous sheet of modified stroma, Stroma – consists of approximately 90% of total corneal thickness. Consists of lamellae of collagen, cells and ground substance, Descemet's membrane – the basement membrane of the endothelium, Endothelium – a single layer of cells lining the inner surface of Descemet's membrane. (Nicholas 2016)

In the region of the limbus, the epithelium on the outer surface of the cornea becomes continuous with that of the conjunctiva, a thin, loose transparent nonkeratinising mucous membrane that covers the anterior part of the sclera, from which it is separated by loose connective tissue.Above and below, the conjunctiva is reflected onto the inner surface of the upper and lower lids. This mucous membrane, therefore, lines the posterior surface of the eyelids and there is a mucocutaneous junction on the lid margin. Although the conjunctiva is continuous, it can be divided descriptively into three parts: palpebral (tarsal), bulbar and fornix. (Nicholas 2016)

The sclera consists of irregular lamellae of collagen fibres. Posteriorly, the external twothirds of the sclera become continuous with the dural sheath of the optic nerve, while the inner one-third becomes the lamina cribrosa – the fenestrated layer of dense collagen fibres through which the nerve fibres pass from the retina to the optic nerve. The sclera is thickest posteriorly and thinnest beneath the insertions of the recti muscles. There is a layer of loose connective tissue deep to the conjunctiva, overlying the sclera, called the episclera. (Nicholas 2016)

2.1.1.3 Middle Layer

The middle layer is highly vascular. If one were to peel the sclera away from this layer (not an easy task), the remaining structure would resemble a grape, as this middle layer, which is called the uvea, is heavily pigmented as well as being

vascular. The anterior part of the uvea forms the bulk of the iris body and hence inflammation of the iris is called either anterior uveitis or iritis. The posterior part of the uvea iscalled the choroid. The iris is the most anterior part of the uvea.

It is a thin circular disc perforated centrally by the pupil. Contraction of the iris sphincter muscle constricts the pupil,while contraction of the dilator pupillae muscle dilates the pupil. The ciliary body is part of the uveal tissue and is attached anteriorly to the iris and the sclera spur; posteriorly it is continuous with the choroid and retina. The ciliary body is also referred to as the intermediate uvea. (Nicholas 2016)

The ciliary body is triangular in cross-section.

The anterior side of the ciliary body is the shortest and borders the anterior chamber angle; it gives origin to the iris. The outer side of the triangle (mainly ciliary muscles) lies against the sclera. The inner side is divided into: two zones;the pars plicata forms the anterior 2mm and is covered by ciliary processes and the pars plana constitutes the posterior 4.5-mm flattened portion of the ciliary body. (Nicholas 2016)

The pars plana is continuous with the choroid and retina, The choroid consists of the following:

Bruch's membrane – membrane on the external surface of the retinal pigment epithelium (RPE). It consists of the basement membrane of RPE cells and choriocapillaris, Between the two layers of basement membrane are the elastic and collagenous layers. Small localised thickenings of Bruch's membrane (which increase with age) are called drusen, The choriocapillaris – a network of capillaries supplying the RPE and outer retina, Layer of larger choroidal blood vessels external to the choriocapillaris, Pigmented cells scattered in the choroid external to the choriocapillaris. (Nicholas 2016)

2.1.1.4 Inner Layer

The inner layer of the eye, which lines the vascular uvea, is the neurosensory layer. This layer forms the retina posteriorly; but, anteriorly it comes to line the inner surface of the ciliary body and iris as a two-layered pigment epithelium. (Nicholas 2016)

These same layers can be traced into the retina, which is composed of an outer pigment epithelium and an inner sensory part, which contains the rods and cones, bipolar cells and ganglion cells. The junction of the retina and the pars plana forms a scalloped border known as the ora serrata. It is important to note that the photoreceptor cells are on the external side of the sensory retina. The relationship of the retinal elements can be understood most readily by following the formation of the optic cup. As the single-cell layer optic vesicle “invaginates” to form the two cell layered optic cup, the initially superficial cells become the inner layer of the cup. The RPE develops from the outer layer of the cup, facing the photoreceptors across the now obliterated cavity of the optic vesicle. The neurons of the sensory retina differentiate from the inner layer of the optic cup. (Nicholas 2016)

2.1.1.5 Blood Supply

The blood supply to the eye is primarily from the ophthalmic artery, which gives off its first branch, the central retinal artery. The central retinal artery and vein can be identified within the optic nerve sheath using color flow Doppler. Spectral Doppler can be used to obtain waveforms that depict the flow velocity within the blood vessels. These waveforms can be used to differentiate arterial from venous blood flow. (Timothy Roo.2010).

2.1.1.6 Optic Nerve

The optic nerve meets the posterior part of the globe slightly nasal to the posterior pole and slightly above the horizontal meridian. Inside the eye this point is seen as the optic disc. There are no light-sensitive cells on the optic disc –and hence the blind spot that anyone can find in their field of vision. The optic nerve contains about one million nerve fibres, each of which has a cell body in the ganglion cell layer of the retina. Nerve fibres sweep across the innermost part of the retina to reach the optic disc. They can be seen with the ophthalmoscope by carefully observing the way light is reflected off the inner surface of the retina. The retinal vessels are also embedded on the inner surface of the retina. There is therefore a gap, which is the thickness of the transparent retina, between the retinal vessels and the stippled pigment epithelium. Apart from the optic nerve, the posterior pole of the globe is also perforated by several long and short ciliary nerves. These contain parasympathetic, sympathetic and sensory fibres, which mainly supply muscles of the iris (dilator and sphincter) and ciliary body (ciliary muscles). Patients can experience pain when the iris is handled under inadequate local anaesthesia, and pain is also sometimes experienced during laser coagulation treatment of the chorioretina– this would seem to prove the existence of sensory fibres in the iris and choroid. The cornea is extremely sensitive, but again, the only sensory endings are those for pain. (Nicholas 2016)

The visual pathways include the following:

The retina: rods and cones, bipolar cells and ganglion cells, Axons of the ganglion cells visual and pupillary reflex pathways: nerve fibre layer of retina, optic nerve, optic chiasm and optic tract, Subcortical centres and relays: superior colliculus – reflex control of eye movements, pretectal nuclei – pupillary reflexes and lateral geniculate body –cortical relay.Cortical connections: optic radiations, visual cortex

(area 17) – vision and reflex eye movements, association areas (areas 18 and 19), and frontal eye field –voluntary eye movements. If the rods and cones are considered analogous to the sensory organs for touch, pressure, temperature, etc. then the bipolar cells may be compared to the first-order sensory neurons of the dorsal root ganglia. By the same token, the retinal ganglion cells can be compared to the second-order sensory neurons, whose cell bodies lie within the spinal cord or medulla. (Nicholas 2016)

2.1.1.7 The Eyelids

The eyelids may be divided into anterior and posterior parts by the mucocutaneous junctio– the grey line. The eyelashes arise from hair follicles anterior to the grey line,while the ducts of the meibomian glands (modified sebaceous glands) open behind the grey line. The meibomian glands are long and slender, and run parallel to each other, perpendicular to the eyelid margin, and are located in the tarsal plate of the eyelids. The tarsal plate gives stiffness to the eyelids and helps maintain its contour. The upper and lower tarsal plates are about 1mm thick. The lower tarsus measures about 5mm in height, while the upper tarsus measures about 10–12mm. The orbicularis oculi muscle lies between the skin and the tarsus and serves to close the eyelids. It is supplied by the facial nerve. The skin and subcutaneous tissue of the lids are thin. The inner surface of the eyelids is lined by the palpebral conjunctiva. (Nicholas 2016)

2.1.1.8 The Lacrimal Apparatus

The major lacrimal gland occupies the superior temporal anterior portion of the orbit. It has ducts that open into the palpebral conjunctiva above the upper border of the upper tarsus. Tears collect at the medial part of the palpebral fissure and pass through the puncta and the canaliculi into the lacrimal sac, which terminates in the

nasolacrimal duct inferiorly. The nasolacrimal duct opens into the inferior meatus of the nose. (Nicholas 2016)

2.1.1.9 The Extraocular Muscles

Four rectus muscles control each eye. These muscles insert at the sclera, behind the limbus, and each pull the eye in the direction of their attachment.

The superior, medial, and inferior rectus muscles are all controlled by the oculomotor nerve (III). The lateral rectus ,is controlled by the abducens (VI) nerve, which makes sense as the lateral rectus “abducts” the eye. The remaining two eye muscles are the superior and inferior oblique muscles. The superior oblique also originates in the posterior orbit, but courses nasally until it reaches the trochlea before inserting onto the eye. The inferior oblique originates from the orbital floor and inserts behind the globe near the macula. Because of these posterior insertions, the oblique muscles are primarily responsible for in torsion and extorsion (rotation of the eye sideways), though they also contribute some vertical gaze action. (Sidney L. Palmer, et al 2010)

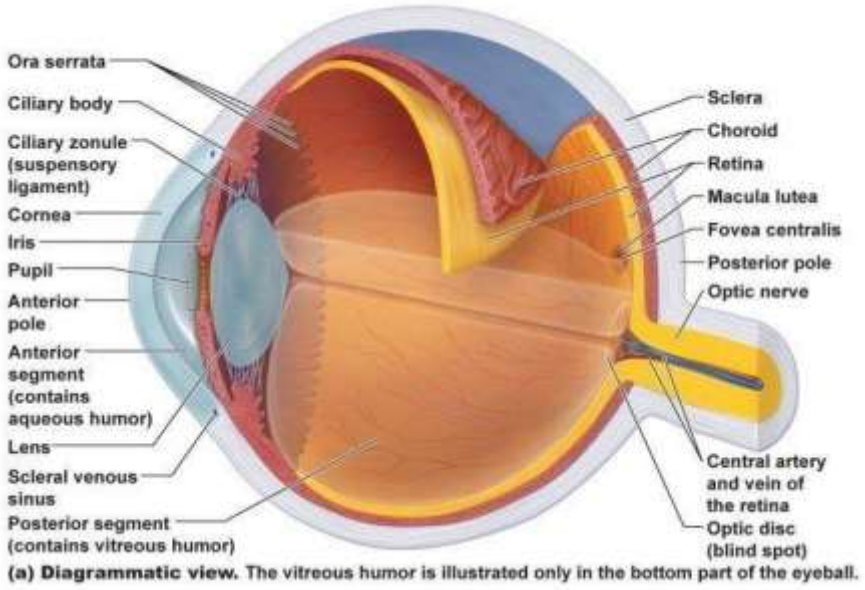

Figure (2.1): Eye anatomy (anatomybodydiagram.com)

2.1.2 Ultrasonography 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 LensThe 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. Vitreous 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.(Sankara Nethralaya… et al 2006)

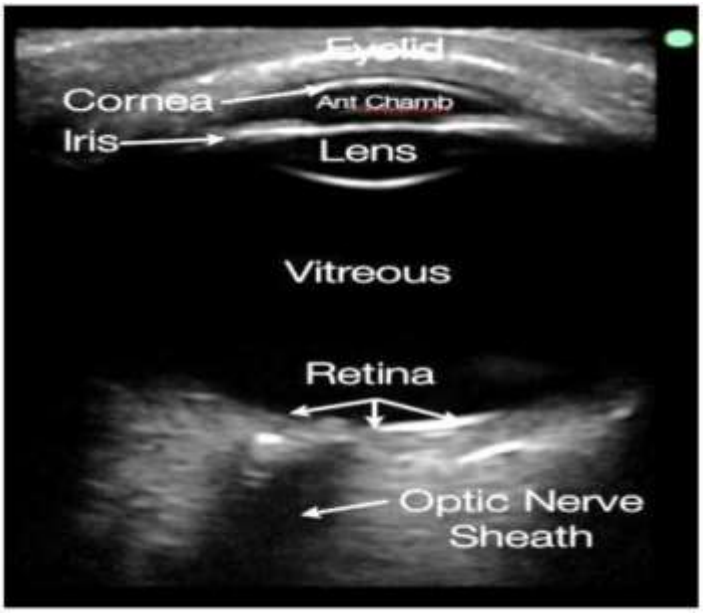

Fig2.2: Normal Ultrasongraphy vitreous cavity, concave retinochoroidal layer and the optic nerve show (Sankara Nethralaya, et al 2006)

2.1.3 Physiology of the Eye

The primary function of the eye is to form a clear image of objects in our environment. These images are transmitted to the brain through the optic nerve and the posterior visual pathways. The various tissues of the eye and its adnexae are thus designed to facilitate this function. (Nicholas 2016)

2.1.3.1 The Eyelids Functions

Protection of the eye from mechanical trauma, extremes of temperature and bright light. Maintenance of the normal precorneal tear film, which is important for maintenance of corneal health and clarity. Normal eyelid closure requires an intact nerve supply to the orbicularis oculi muscles (facial nerve). Eyelid opening is affected by the levator palpebrae superioris supplied by the IIIrd cranial nerve. (Nicholas 2016)

2.1.3.2 The Tear Film

The tear film consists of three layers: the mucoid, aqueous and oily layers. The mucoid layer lies adjacent to the corneal epithelium. It improves the wetting properties of the tears. It is produced by the goblet cells in the conjunctival epithelium. The watery (aqueous) layer is produced by the main lacrimal gland in the superotemporal part of the orbit and accessory lacrimal glands found in the conjunctival stroma. This aqueous layer contains electrolytes, proteins, lysozyme,

Immunoglobulins, glucose and dissolved oxygen (from the atmosphere). The oily layer (superficial layer of the tear film) is produced by the meibomian glands (modified sebaceous glands) of the eyelid margins. This oily layer helps maintain the vertical column of tears between the upper and lower lids and prevents excessive evaporation. The tears normally flow away through a drainage system formed by the puncta (inferior and superior), canaliculi (inferior and superior), the common canaliculus (opening into the lacrimal sac) and the nasolacrimal duct (which drains into the nose). (Corina van dePol, 2010)

2.1.3.3 The Cornea

The primary function of the cornea is refraction. In order to perform this function, the cornea requires the; transparency, smooth and regular surface, spherical curvature of proper refractive power and appropriate index of refraction.

Corneal transparency is contributed to by anatomical and physiological factors:

Anatomical: absence of keratinisation of epithelium, tight packing of epithelial cells, mucous layer providing smooth lubricated surface, homogeneity of membranes – Bowman’s and Descemet’s, regular arrangement of corneal lamellae (parallel collagen fibres within each lamella, with adjacent lamellae being perpendicular).

Regularity produces a diffraction grating, paucity of corneal stromal cells, which are flattened within lamellae and interspaces – absence of blood vessels. Physiological: active dehydration of the cornea through Na+/HCO3- metabolic pump located in the corneal endothelium. This dehydration is supplemented by the physical barrier provided by the corneal epithelium and endothelium. (Corina van dePol, 2010)

2.1.3.4 The Aqueous Humour

The aqueous humour is an optically clear solution of electrolytes (in water) that fills the space between the cornea and the lens. Normal volume is 0.3 ml. Its function is to nourish the lens and cornea. The aqueous is formed by active secretion and ultrafiltration from the ciliary processes in the posterior chamber. The fluid enters the anterior chamber through the pupil,circulates in the anterior chamber and drains through the trabecular meshwork into the canal of Schlemm,the aqueous veins and the conjunctival episceral veins. The aqueous normally contains a low concentration of proteins, but a higher concentration of ascorbic acid compared with plasma. Inflammation of the anterior uvea leads to leakage of proteins from the iris circulation into the aqueous (= plasmoid aqueous). (Corina van dePol, 2010)

2.1.3.5 The Vitreous Body

The vitreous consists of a three-dimensional network of collagen fibres with the interspaces filled with polymerised hyaluronic acid molecules, which are capable of holding large quantities of water. The vitreous does not normally flow but is percolated slowly by small amounts of aqueous.There is liquefaction of the jelly with age, with bits breaking off to form floaters. This degeneration occurs at an earlier age in myopes. (Corina van dePol, 2010)

2.1.3.6 The Lens

The lens, like the cornea, is transparent. It is avascular and depends on the aqueous for nourishment. It has a thick elastic capsule, which prevents molecules (e.g., proteins) moving into or out of it. The lens continues to grow throughout life, new lens fibers being produced from the outside and moving inwards towards the nucleus with age. The lens is comprised of 65% water and 35% protein. The water content of the lens decreases with age and the lens becomes less pliable. The lens is suspended from the ciliary body by the zonule,which arises from the ciliary body and inserts into the lens capsule near the equator. (Nicholas 2016)

2.1.3.7 The Ciliary Body

The ciliary muscle (within the ciliary body) is a mass of smooth muscle, which runs circumferentially inside the globe and is attached to the scleral spur anteriorly.

It consists of two main parts:

Longitudinal (meridional) fibres – form the outer layers and arise from the sclera spur and insert into the choroid. Contraction of this part of the muscle exerts traction on the trabecular meshwork and also the choroid and retina. Circular fibres form the inner part and run circumferentially. Contraction moves the ciliary processing inwards towards the center of the pupil leading to relaxation of the zonules. (Nicholas 2016)

2.1.3.8 Accommodation

Accommodation is the process whereby relaxation of zonular fibres allows the lens to become more globular, thereby increasing its refractive power. When the ciliary muscles relax, the zonular fibres become taut and flatten the lens, reducing its refractive power. This is associated with constriction of the pupil and increased depth of focus. Accommodation is a reflex initiated by visual blurring and/or

awareness of proximity of the object of interest. The maximum amount of accommodation (amplitude of accommodation) is dependent on the rigidity of the lens and contractility of the ciliary muscle. As the lens becomes more rigid with age (and contractions of the ciliary body reduce), accommodation decreases. Reading and other close work become impossible without optical correction – presbyopia. (Nicholas 2016)

2.1.3.9 The Retina

This is the "photographic film" of the eye that converts light into electrical energy (transduction) for transmission to the brain. It consists of two main parts:

The neuroretina – all layers of t retina that is derived from the inner layer of the embryological optic cup. The RPE – derived from the outer layer of the optic cup.

It is comprised of a single layer of cells, which are fixed to Bruch's membrane. Bruch's membrane separates the outer retina from the choroid. The retinal photoreceptors are located on the outer aspect of the neuroretina, an arrangement that arose from inversion of the optic cup and allows close proximity between the photosensitive portion of the receptor cells and the opaque RPE cells, which reduce light scattering. The RPE also plays an important role in regeneration/recycling of photopigments of the eye and during light–dark adaptation. In order for the light to reach the photoreceptors to form sharp images, all layers of the retina inner to the photoreceptors must be transparent. This transparency is contributed to by the absence of myelin fibres from the retinal neurons. The axons of the retina ganglion cells normally become myelinated only as they pass through the optic disc to enter the optic nerve. There are two main types of photoreceptors in the retina – the rods and the cones. In the fovea centralis the only photoreceptors are cones, which are responsible for acute vision (visual details) and colour vision. Outside the fovea,

rods become more abundant towards the retinal periphery. The rods are responsible for vision in poor (dim) light and for the wide field of vision. The retinal capillary network (derived from the central retinal artery) extends no deeper than the inner nuclear layer and nourishes the neuroretina from inside up to part of the outer plexiform layer. It is an end-arterial system. The choroid serves to nourish the RPE and the Photoreceptors (bydiffusion of nutrients). There are no blood vessels in the outer retina. The central fovea is completely avascular anddepends on diffusion from the choroidal circulation for its nourishment. Thus, normal functioning of the retina requires normal retinal and choroidal circulation. (Corina van dePol, 2010)

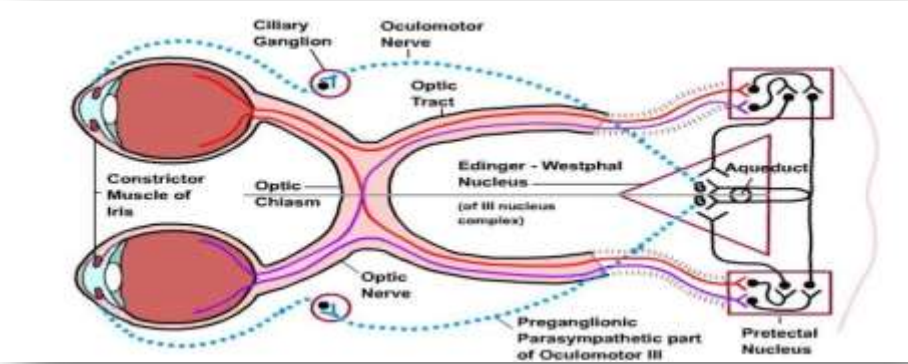

Figure (2.3) Pupillary Light Reflex Pathway (http://www.eastonfootwear.com)

2.1.4 Ultrasound of Retinal detachment:

Retinal detachment describes an emergency situation in which a thin layer of tissue (the retina) at the back of the eye pulls away from its normal position. Retinal detachment separates the retinal cells from the layer of blood vessels that provides oxygen and nourishment. The longer retinal detachment goes untreated, the greater your risk of permanent vision loss in the affected eye. (De, 2016)

Warning signs of retinal detachment may include one or all of the following: the sudden appearance of floaters and flashes and reduced vision. Contacting an eye specialist (ophthalmologist) right away can help save your vision. (De, 2016)

2.1.4.1 Technique

Ocular ultrasound is a useful when patients present with an acute visual abnormality. The linear high-frequency probe (7.5-15.0 MHz) provides optimal resolution. Choose the “superficial”• or “small parts”• preset and adjust the depth to optimize visualization of the globe. Gain should be turned down to interrogate the anechoic vitreous humor, after which the gain should be slowly increased to identify subtle abnormalities without creating false artifacts. (De, 2016)

2.1.4.2 Ultrasound Findings

It may be challenging to differentiate a retinal from vitreous detachment depending on the angle of visualization. The retina will always remain attached at the optic disc because the retina is continuous with the optic sheath, whereas the vitreous body is not. In a partial detachment, the operator will see a “V”• shape in the posterior segment, representing the retina attached to the optic disc posteriorly and the ora serrata anteriorly. Notably, to differentiate between a retinal and a vitreous detachment, the optic nerve must be visualized. The retina may or may not remain attached to its anterior attachment site at the ora serrata. (Tham, 2011)

Figure 2.4. Retinal Detachment

2.2 Previous Studies

PEDIATRIC RETINAL DETACHMENT DUE TO COATS' DISEASE DIAGNOSED WITH BEDSIDE EMERGENCY DEPARTMENT ULTRASOUND, by: Aaron K. Buzzard, and Derek R. Linklater, 2009 Published by Elsevier Inc.:

Atraumatic retinal detachment in a pediatric patient is an extremely rare but visionthreatening disease process. Obtaining an adequate history and physical examination in children presenting with eye complaints can be extremely challenging, as young children are frequently unable to provide a good history or comply with a detailed physical examination. The use of high-resolution bedside ultrasonography in the Emergency Department can assist practitioners with obtaining detailed images of structural intraocular pathology. We present the

unusual case of a suspected atraumatic retinal detachment in a pediatric patient that was confirmed using this novel imaging modality.

Bedside Ocular Ultrasound for the Detection of Retinal Detachment in the Emergency Department, by: Roxana Yoonessi, MD, Aliasgher Hussain, MD, and Timothy B. Jang, 2010:

Acute retinal detachments (RD) can be difficult to diagnose and may require emergent intervention. This study was designed to assess the performance of emergency department ocular ultrasound (EOUS) for the diagnosis of RD. This was a prospective, observational study using a convenience sample of emergency department (ED) patients. Physicians performed EOUS for the diagnosis of RD prior to evaluation by an ophthalmologist. The criterion standard was the diagnosis of a RD by the ophthalmologist who was blinded to the results of EOUS.

Fifteen physicians evaluated 48 patients with acute visual changes. Eighteen patients (38%) had RDs and all were correctly identified (true positives). Of the 30 patients (62%) without RD, 25 patients were correctly identified (true negatives), and five patients with vitreous hemorrhages were misidentified as having RDs (false positives). Therefore, the sensitivity and specificity of EOUS for RD were 100% (95% confidence interval [CI] = 78% to 100%) and 83% (95% CI = 65% to 94%), respectively.

Emergency department ocular ultrasound is sensitive for the diagnosis of RD and may have a role in excluding RD in patients presenting to the ED.

Chapter Three

Materials and Methods

Chapter Three

Materials and Methods

3.1 Materials

3.1.1 Machine Used

Quantel medical ultrasound machine with10 MHz, linear probe in two centers.

3.1.2 Study Area

Al-Feisal eye center, Khartoum – Sudan.

3.1.3 Study duration

Study done at period from January to April 2019.

3.1.4 Study Design

This study was designed as a cross sectional descriptive study deals with the any one complaining of retinal detachment.

3.1.5 Population of Study

Patients complaining of retinal detachment.

3.1.6 Indication of Study

Any patient comes with Cute/Subacute vision changes or loss Symptoms of increased ICP Suspect FB or globe rupture Trauma (assess for reactive pupils)

3.1.7 Study Sample

Fifty case of Sudanese patient were selected randomly.

3.1.8 Inclusion criteria

Any patients complaining of retinal detachment.

3.1.9 Exclusion criteria

Patients with retinal detachment with family history.

3.2 Methods:

3.2.1 Technique

The method used is direct interviewing the patients when they call in ultrasound department. Asking them about their history, recent complain and other investigations. The patients undergoing ultrasound investigation were well no preparation. All patients were examined, and then gel was applied in eyelids area and both longitudinal and transverse views of the patient's eye.

Hold the probe with the thumb and index finger and rest the remainder of the hand on the bony structures of the face to maintain a stable view.3 Placement of a protective film (such as transparent dressings) over the closed eye with a generous layer of gel allows for better visualization of structures without needing to apply pressure onto the orbit. Pan through the globe in both the transverse and longitudinal axes. (De, 2016)

3.2.2 Data Collection

All the data was collected by master data sheets using the following variables Age Six and Type of RD .

3.2.3 Data Analysis and presentation

Data were analyzed by using SPSS program version 16 and the results were presented in the form of graph and tables.

3.2.4 Data Storage

The data was stored on Personal computer, Patients data collection sheet, Storage devise (external)

3.2.5 Ethical Consideration

The individual details and identification were not published. The information or the patient details will be not disclosed or used for other reasons than the study.

Chapter Four

Results

Chapter Four

Results

Table (4.1) Frequency distribution of gender

	Frequency	Percent
Male	32	64%
Female	18	36%
Total	**50**	**100%**

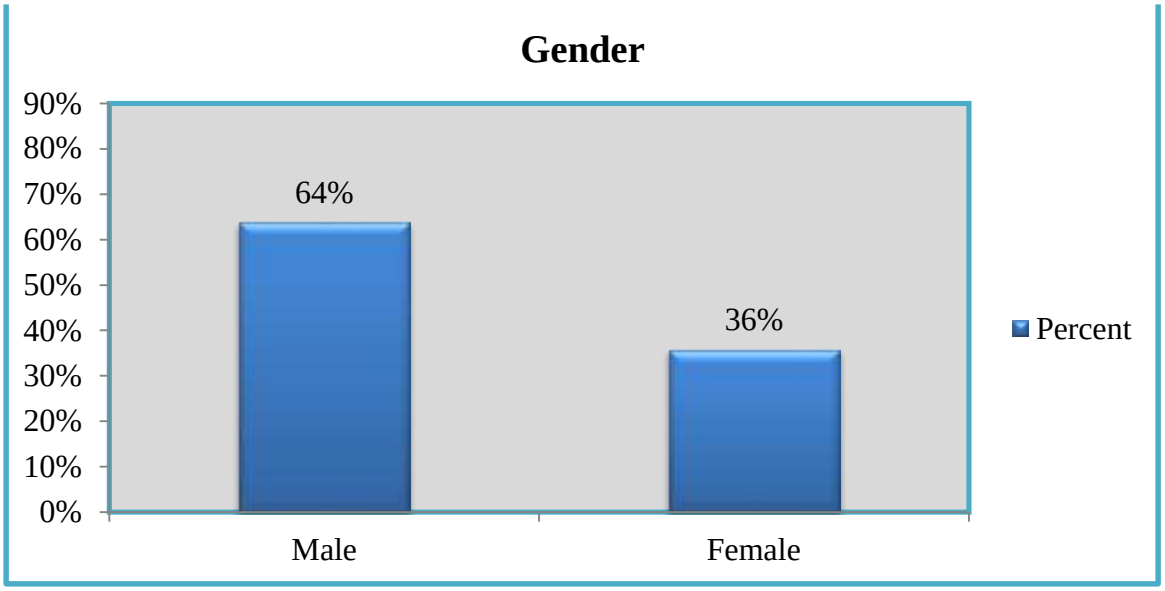

Figure (4.1) Frequency distribution of gender

Table (4.2) Descriptive statistics for age

Mean	Standard Deviation	Minimum	Maximum
51	18.834	6	80

Table (4.3) Frequency distribution of age

	Frequency	**Percent**
Less than or equal 20	5	10%
21 to 40	5	10%
41 to 60	24	48%
Greater than 60	16	32%
Total	**50**	**100%**

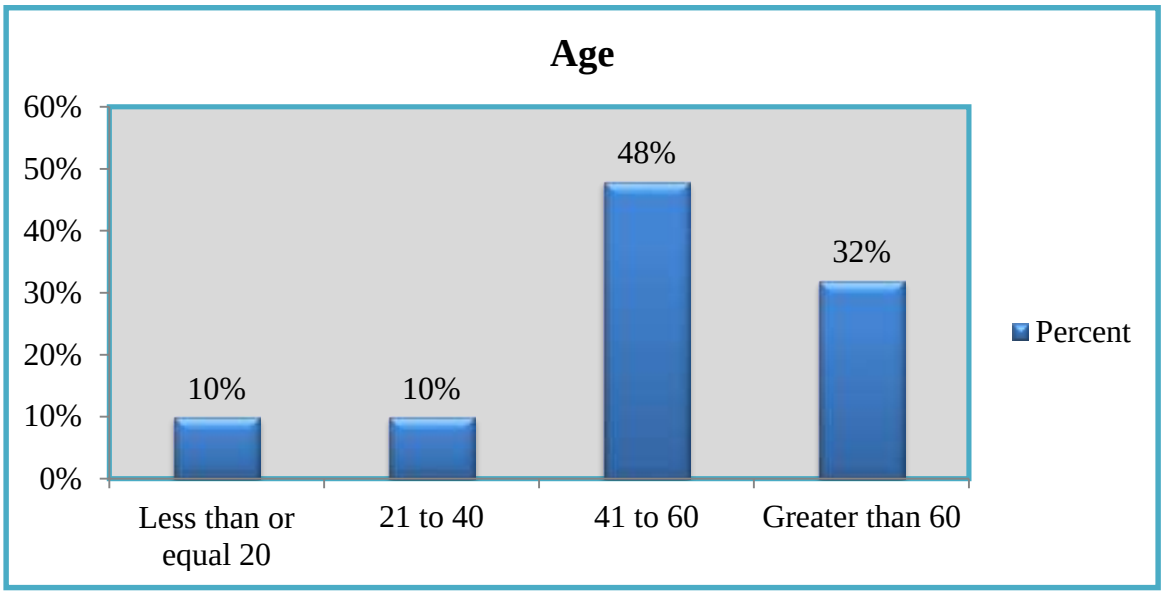

Figure (4.2) Frequency distribution of age

Table (4.4) Frequency distribution of clinical history and risk factor:

	Frequency
DM	30
Hypertension	13
Trauma	6
Post-operative	6
Myopia	1
Total	

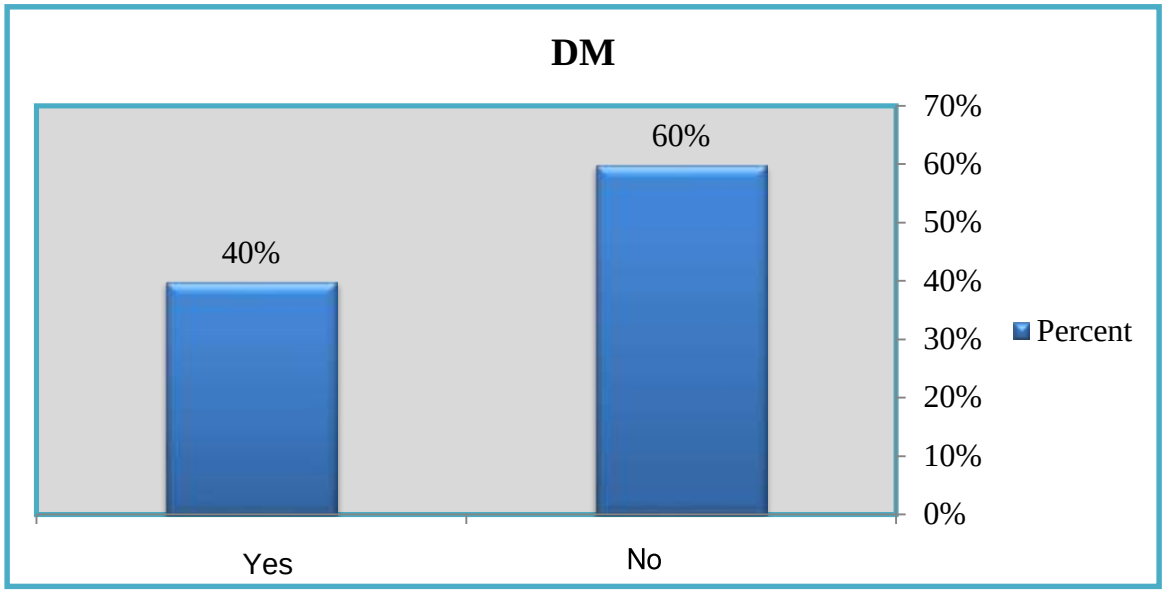

Figure (4.3) Sample distribution by diabetes mellitus

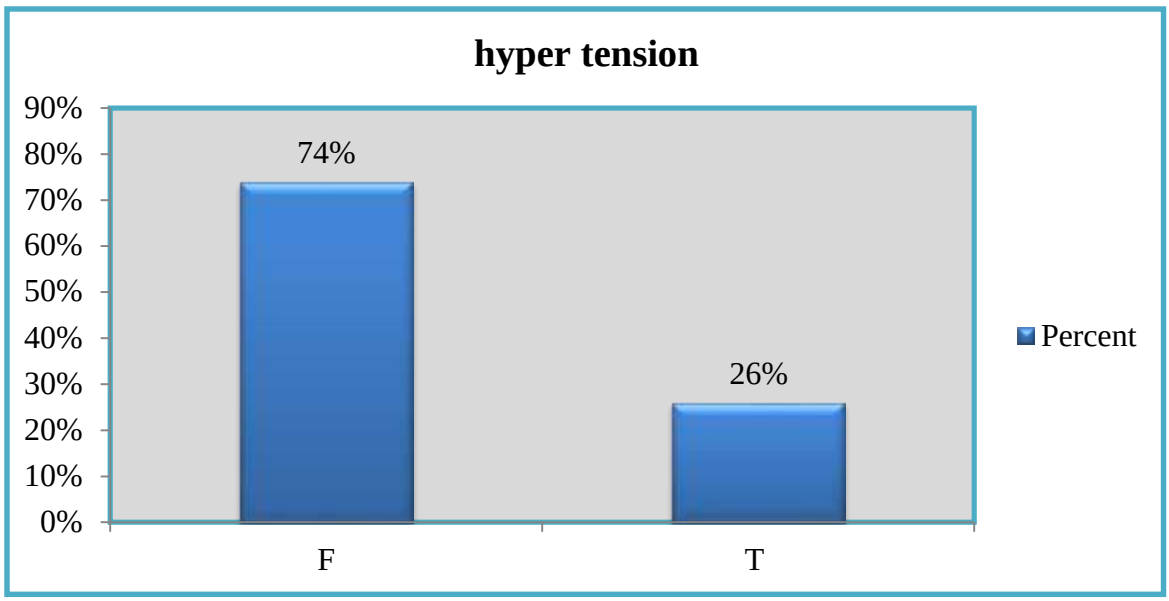

Figure (4.4) Frequency distribution by hyper tension

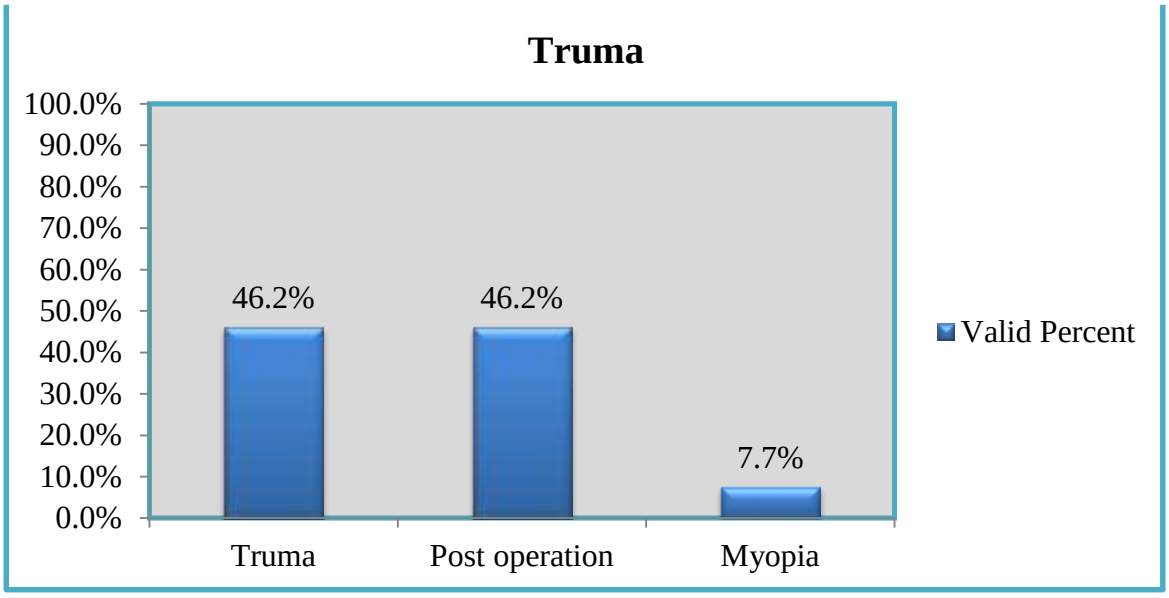

Figure (4.5) Frequency distribution by truma

Table (4.5) Frequency distribution of side effective by Retinal detachment

	Frequency	Percent
One eye	42	84%
Both eyes	8	16%
Total	**50**	**100%**

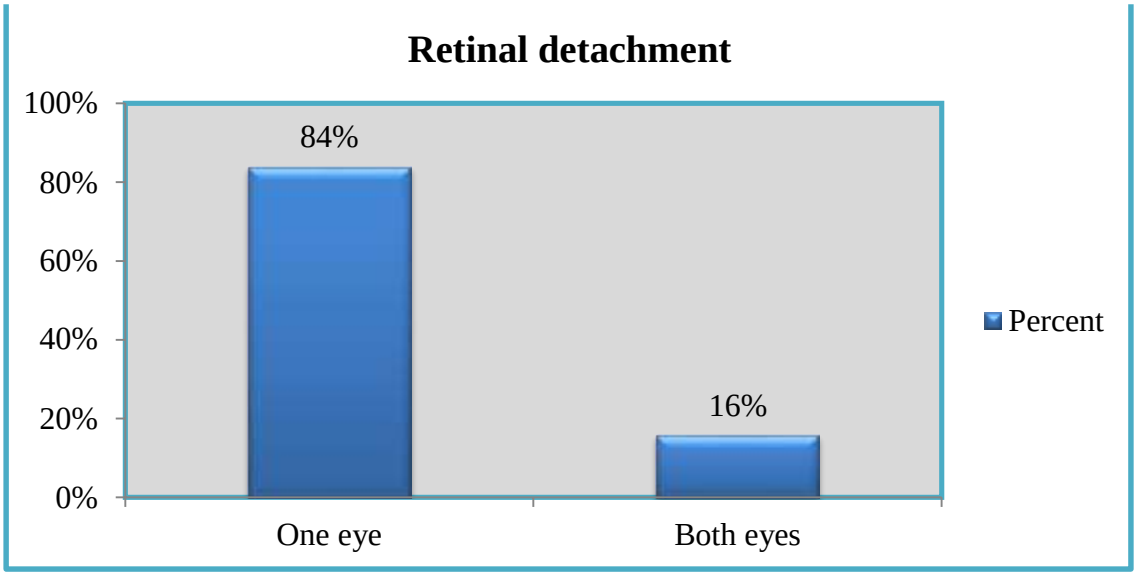

Figure (4.6) Frequency distribution of side effective by Retinal detachment

Table(4.6) Frequency distribution by trum

	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Truma	6	12%	46.2%	46.2%
Post operation	6	12%	46.2%	92.3%
Myopia	1	2%	7.7%	100%
Total	**13**	**26%**	**100.0%**	
System	37	74%		
	50	**100%**		

Table (4.7) Frequency distribution of RD

	Frequency	**Percent**
Partially	24	48%
Complete	26	52%
Total	**50**	**100%**

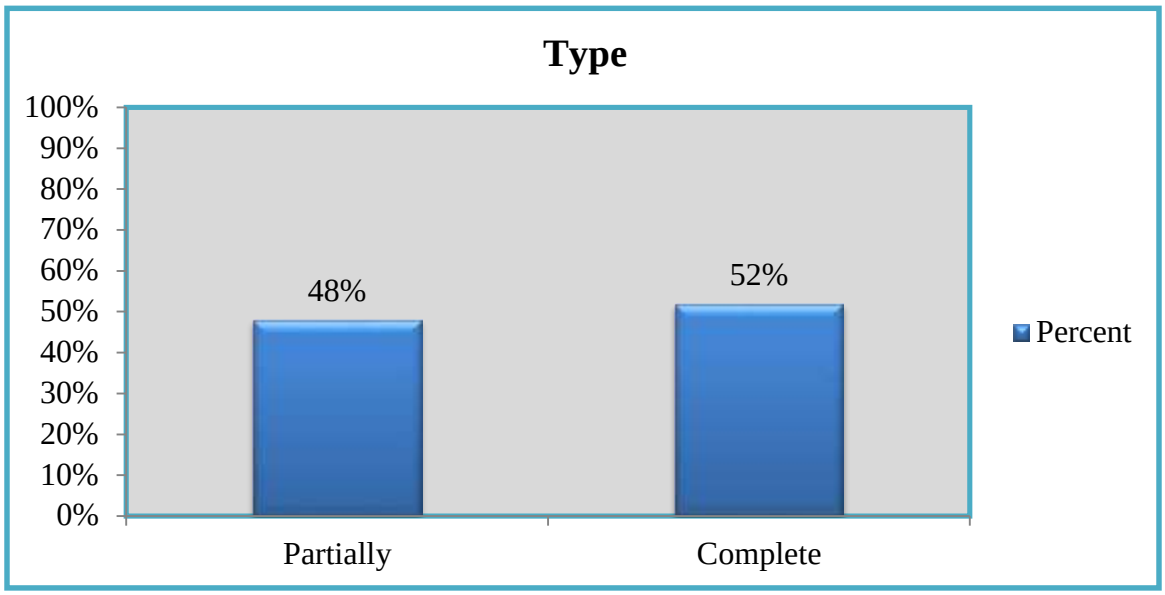

Figure (4.7) Frequency distribution of RD

Table (4.8) Gender and Side of RD cross tabulation

			RD side		Total
			One eye	Both eyes	
gender	Male	Count	25	7	32
		% RD	59.5%	87.5%	64%
	Female	Count	17	1	18
		% RD	40.5%	12.5%	36%
	Value	df	P-value		
Pearson Chi-Square	2.283	1	0.131		

Table (4.9) Age and Side of RD cross tabulation

			RD side		Total
			One eye	Both eyes	
Age group	Less than or equal 20	Count	5	0	5
		%RD	11.9%	0%	10%
	21 to 40	Count	5	0	5
		%RD	11.9%	0%	10%
	41 to 60	Count	19	5	24
		%RD	45.2%	62.5%	48%
	Greater than 60	Count	13	3	16
		%RD	31%	37.5%	32%
	Value	df	P-value		
Pearson ChiSquare	2.412	3	0.491		

Table (4.10) DM and Side of RD cross tabulation

			RD side		Total
			One eye	Both eyes	
Dm	FALSE	Count	19	1	20
		%RD	45.2%	12.5%	40%
	TRUE	Count	23	7	30
		%RD	54.8%	87.5%	60%
	Value	df	P-value		
Pearson Chi-Square	3.001	1	0.083		

Table (4.11) DM control and Side of RD cross tabulation

			RD side		Total
			One eye	Both eyes	
Dm control	FALSE	Count	22	4	26
		%RD	52.4%	50%	52%
	TRUE	Count	20	4	24
		%RD	47.6%	50%	48%
	Value	df	P-value		
Pearson Chi-Square	0.015	1	0.902		

Table (4.12) Ht control and RD side cross tabulation

			RD side		Total
			One eye	Both eyes	
hyper tension control	FALSE	Count	31	7	38
		%RD	73.8%	87.5%	76%
	TRUE	Count	11	1	12
		%RD	26.2%	12.5%	24%
	Value	df	P-value		
Pearson ChiSquare	0.691	1	0.406		

Table (4.13) type of detachment and RD side cross tabulation

			RD side		Total
			One eye	Both eyes	
type of detachment	Partially	Count	21	3	24
		%RD	50%	37.5%	48%
	Complete	Count	21	5	26
		%RD	50%	62.5%	52%
	Value	df	P-value		
Pearson ChiSquare	0.421	1	0.517		

Chapter Five

Discussion, Conclusion, and Recommendations

Chapter Five
Discussion, conclusion, and recommendations

5.1 Discussion:

This is a retrospective descriptive cross-sectional study with convenient sample of 50 retinal detachment cases. The cases included on basis of their referral to ocular Ultrasonography and availability of cases diagnostic profile (diagnosed with hypertension or diabetes mellitus) or affected by previous trauma. The cases with no sonographic sign for retinal detachment were excluded. The of the study sample were withdrawn from two hospitals records.

The results of the current study was as follow: Table (4.1) and bar plot (4.1) was describing the distribution of the study sample which was comprised of (64%) (n= 32) males and (36%) (n=18) of the sample were females.

Table (4.2) showed that The ages were ranged from 6 to 80 years with mean (51) years and standard deviation (18.934.

Figure (4.3) showed that (40%) from the sample had no diabetes mellitus (DM) are false, and (60%) had diabetes mellitus (DM).

Notes from Figure (4.6) showed (84%) from sample were selected the retinal detachment in one eye, and (16%) the retinal detachment in both eyes, There was no association between hyper tension control and RD, p-value (0.406 was greater than 0.05) which indicates that these variables are independent of each other and that there was no statistically significant relationship between hyper tension and RD.

Notes from the table (4.7) and Figure (4.7) showed that the (48%) from sample the type of detachment was partially, and (52%) the type of detachment was complete.

There was no association between type of detachment and RD, p-value (0.517 was greater than 0.05) indicates that these variables are independent of each other and that there was no statistically significant relationship between the type of detachment and RD.

Notes from the table (4.8), that there was no association between gender and RD, pvalue (0.131 was greater than 0.05) indicates that these variables are independent of each other and that there was no statistically significant relationship between the gender and RD.

Notes from the table (4.9), There was no association between age and RD, p-value (0.491 was greater than 0.05) indicates that these variables are independent of each other and that there was no statistically significant relationship between the age and RD.

Notes from the table (4.10), there was no association between DM and RD, p-value (0.083 was greater than 0.05) indicates that these variables are independent of each other and that there was no statistically significant relationship between the DM and RD.

Notes from the table (4.11), There was no association between DM control and RD, p-value (0.902 was greater than 0.05) indicates that these variables are independent of each other and that there was no statistically significant relationship between the DM control and RD.

Notes from the table (4.12), There was no association between Truma and RD, pvalue (0.406 was greater than 0.05) indicates that these variables are independent of each other and that there was no statistically significant relationship between the Truma and RD.

Notes from the table (4.13), There was no association between type of detachment and RD, p-value (0.517 was greater than 0.05) indicates that these variables are independent of each other and that there was no statistically significant relationship between the type of detachment and RD. This study results was agree with Ann Emerg Med. 2015 study in all parameters.

5.2 Conclusion

This study was carried out in al Faisal Eyes Center Khartoum state, the study objective was to study Retinal Detachment in Sudanese Patients Using Ultrasonography. The sample included 64% male and 36% female. The study variables included HT, DM, Truma and Age. The results showed that there was no statistically significant between the variable and RD.

5.3 Recommendations:

• In particular there is concern for the operator dependence of freehand screening for it to be documented.

• Closed eye technique should always be applied to avoid air noise in the image.

• The patient should be asked to move the eye back and forth with normal gain. Look for a flap that is tethered to the back wall. Along with being attached to the posterior aspect of the eye, a retinal detachment is a thick flap that will be easily visualized on low gain.

• The machine gain should be Increase slowly if patient rapidly moving the eye therefore. PVDs and VHs will not be tethered to the retina, and will float in the vitreous body.

• Full US report should always be made as incomplete report were observed in many report.

• Regular training on US technique should be made.

• Further studies using large sample is recommended.

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Appendices

Appendix (A)

Data Collection Sheet

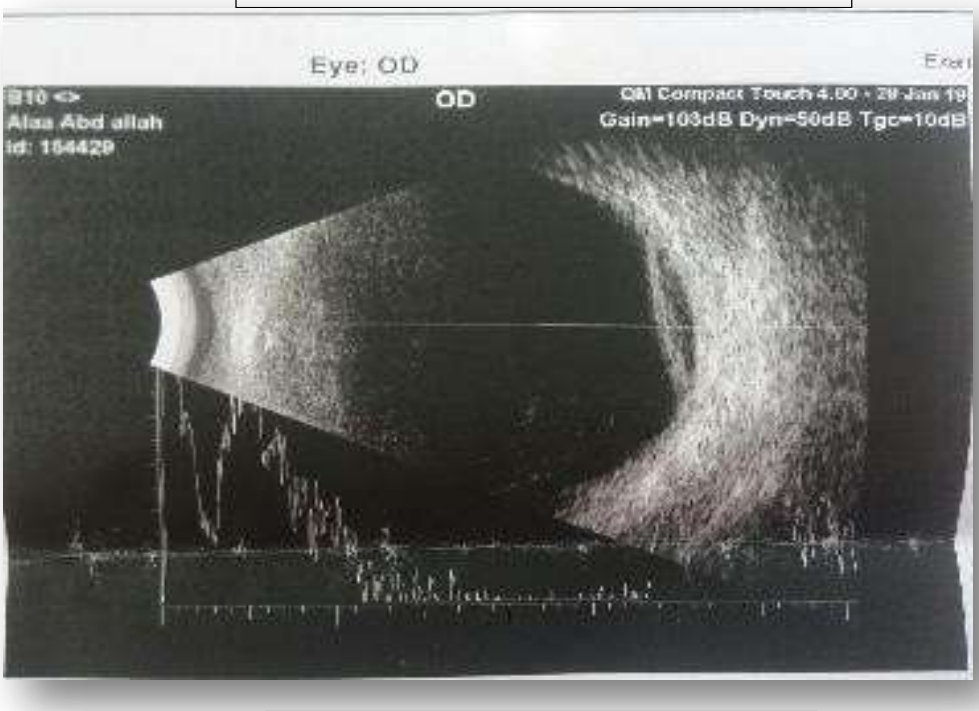
No.	Age	Six	Clinical history			Songraphic appearance	Type of RD	Resones
			Ht control	Dm control	Congenital			

Appendix (B)

Ultrasound Machine used (Al Faisal Eyes Center. 2019)

Eye Scan (US) (https://www.acep.org/sonoguide/smparts_ocular.html)

US image of PRD (Auther.2019)



US image of RRD (Auther.2019)

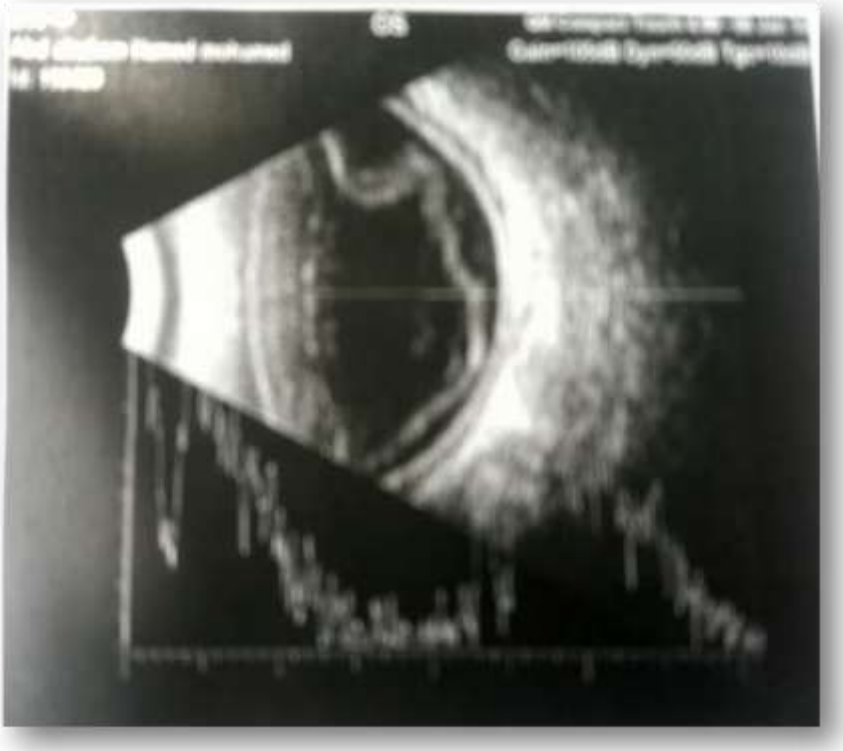
US image of PRD (Auther.2019)

US image of PRD (Auther.2019)

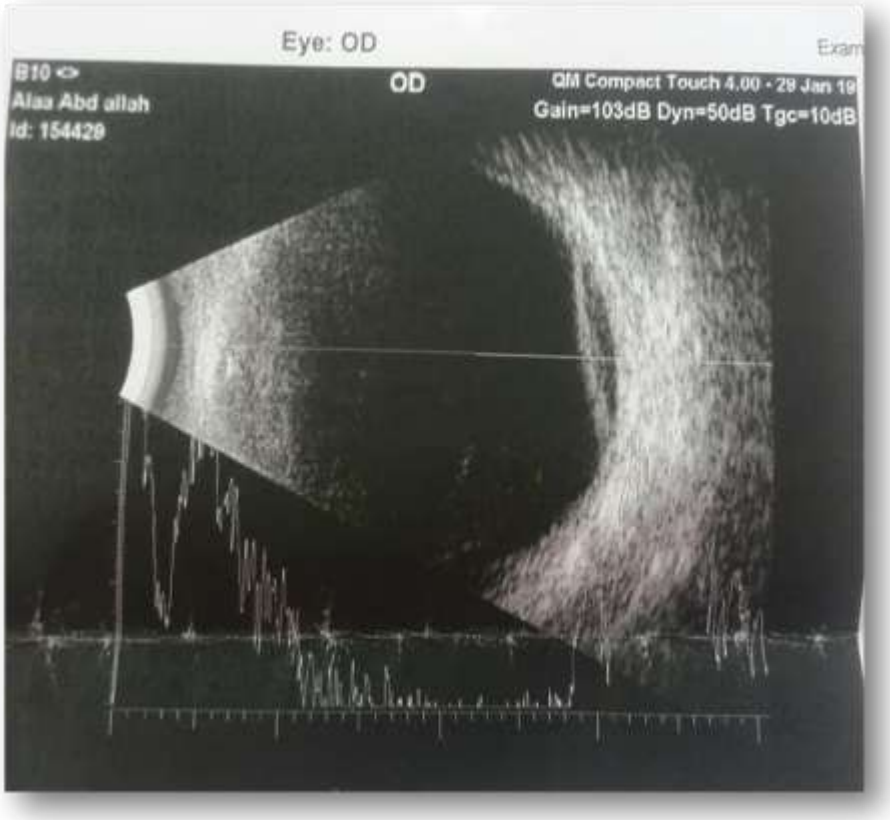
US image of PRD (Auther.2019)

US image of PRD (Auther.2019)

US image of PRD (Auther.2019)



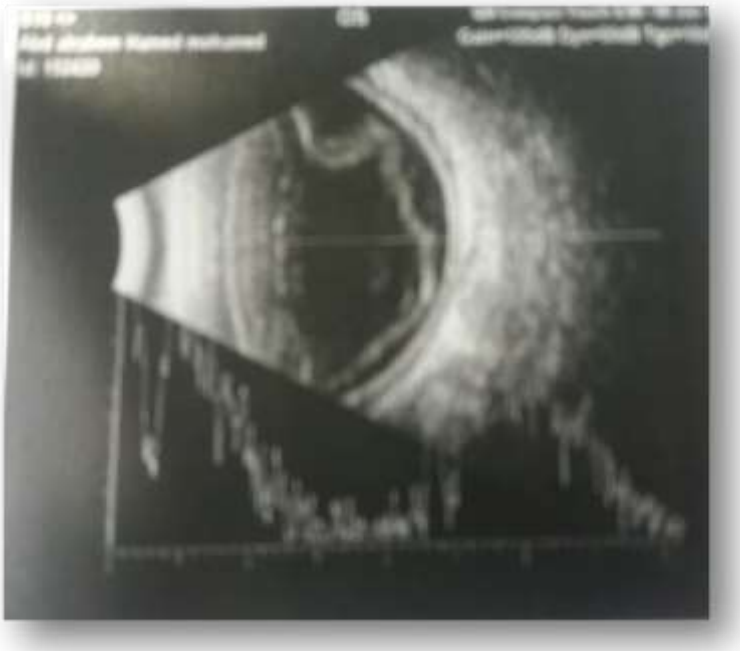
US image of CRD (Auther.2019)



US image of VH+PRD (Auther.2019)

US image of HEMORGE+PRD (Auther.2019)

US image of PRD (Auther.2019)



US image of CRD (Auther.2019)