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UNIVERSITÉ DE YAOUNDÉ I

FACULTÉ DE MÉDECINE ET DES SCIENCES BIOMÉDICALES

DEPARTMENT: OPHTHALMOLOGY, OTORHINOLARYNGOLOGY AND ODONTOSTOMATOLOGY

EPIDEMIOLOGICAL AND CLINICAL ASPECTS OF MACULAR OEDEMA IN DOUALA

Dissertation written and publicly defended in view of obtaining the specialist degree in ophthalmology

by:

Dr. ALUNGE-NNANGSOPE Chancelline Ntoh

Matricule number: 18M304

Supervisor

Prof. KOKI Godefroy
Associate Professor
Ophthalmology

Co-supervisor

Dr. NOMO Arlette
Assistant Lecturer
Ophthalmology

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DEDICATION

To

My lovely parents: Mr ALUNGE John Nnang (*of blessed memory*) and Mrs ALUNGE Comfort Mbulle

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SUMMARY

Background: Macular oedema is the accumulation of fluid and other substances in the macula of the retina leading to thickening of the retinal tissue and decrease in visual function. It is a sign and could occur in a wide variety of ocular pathologies including diabetes and retinal vein occlusion among others. We have not found studies on macular oedema globally irrespective of aetiology.

Research objective: To determine the epidemiological, clinical and therapeutical aspects of macular oedema in hospitals in Douala.

Methodology: We conducted a multicenter longitudinal analytic study at four hospitals in Douala over a period of 8 months. Consenting patients received for consultation who had macular oedema irrespective of aetiology confirmed on macular cross sectional OCT were included. Excel 2013, and Epi Info version 7.2.4.0 were used for data analysis. The Chi-square test was used to compare categorical variables and the calculation of the Odds ratio and the Pearson test for linear correlation. A significance threshold was set at 5% ($p<0.05$).

Results: A total of 14,261 patients were received during our study period, amongst which 116 had macular oedema (152 eyes) thus a prevalence of 0.81%. The mean age of patients with macular oedema was 54.87±1.57 years with a sex ratio of 0.9 and its prevalence among children less than 16 years was 0.05%. Diabetes was the most common comorbidity (73.68%).

Majority of eyes (57.24%) were visually impaired with most visual impairment moderate (25.66%). Most patients (68.97%) had unilateral eye involvement. Hard exsudates was the most common finding on fundoscopy (51.97%). The mean central macular thickness was 334.22 ± 10.4µm with extremities of 44 µm and 1074 µm. Majoriy of eyes (67.76%) had clinically significant MO. There was a negative correlation between visual acuity and central macular thickness (r= -0.434, p=0.001). The 3 common aetiologies of macular oedema were diabetes mellitus (57.24%), retinal vein occlusion (9.21%) and uveitis (6.58%).

Conclusion: Macular oedema is more common in older adults and usually leads to visual impairment. Diabetes is its most frequent aetiology.

RESUME

Contexte: L'œdème maculaire est l'accumulation de liquide et d'autres substances dans la macula de la rétine, entraînant un épaississement rétinien et une diminution de la fonction visuelle. C'est un signe et peut se produire dans une grande variété de pathologies oculaires. Nous n'avons pas trouvé d'études sur l'œdème maculaire dans son ensemble, indépendamment de son étiologie.

Objectif de la recherche: Déterminer les aspects épidémiologiques, cliniques et thérapeutiques de l'oedème maculaire dans les hôpitaux de Douala.

Méthodologie: Nous avons mené une étude analytique longitudinale dans quatre hôpitaux de Douala sur une période de 8 mois. Les patients consentants reçus en consultation présentant un œdème maculaire quelle que soit l'étiologie confirmée par l'OCT ont été inclus. Excel 2013, et Epi Info version 7.2.4.0 ont été utilisés pour l'analyse des données. Le test du Khi-carré a été utilisé pour comparer les variables catégorielles. Un seuil de signification a été fixé à 5 % ($p<0,05$).

Résultats: Un total de 14 261 patients ont été reçus, parmi lesquels 116 avaient un œdème maculaire (152 yeux), soit une prévalence de 0,81%. L'âge moyen des patients atteints d'œdème maculaire était de 54,87±1,57 ans avec un sex-ratio de 0,9 et sa prévalence chez les enfants de moins de 16 ans était de 0,05%. Le diabète était la comorbidité la plus fréquente (73,68 %). La majorité des yeux (57,24 %) présentaient une déficience visuelle dominée par une déficience visuelle modérée (25,66 %). La plupart des patients (68,97 %) avaient une atteinte unilatérale de l'œil. Des exsudats secs étaient le signe le plus fréquent à la fundoscopie (51,97 %). L'épaisseur maculaire centrale moyenne était de 334,22 ± 10,4 µm avec des extrémités de 44 µm et 1074 µm. La majorité des yeux (67,76 %) présentaient une MO cliniquement significative. Il y avait une corrélation négative entre l'acuité visuelle et l'épaisseur maculaire centrale ($r= -0,434$, $p=0,001$). Les 3 étiologies courantes de l'œdème maculaire étaient le diabète (57,24%), l'occlusion veineuse rétinienne (9,21%) et l'uvéite (6,58%).

Conclusion: L'œdème maculaire est plus fréquent chez les adultes âgés et entraîne généralement une déficience visuelle. Le diabète est son étiologie la plus fréquente.

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LIST OF ABREVIATIONS

ACIOL- Anterior chamber intraocular lens

ARMD – Age-related macular degeneration

BAB- Blood aqueous barrier

BRB- Blood-retinal barrier

BRVO – Branch retinal vein obstruction

CAI- Carbonic anhydrase inhibitors

CIMI- Central-involved macular oedema

CMO- Cystoid macular oedema

CMT- Central macular thickness

CRAO- Central retinal artery occlusion

CRVO- Central retinal vein occlusion

CSMO- Clinically-significant macular oedema

CSCR- Central serous chorioretinopathy

DGH- Douala General Hospital

DGOPH- Douala Gynaecological, Obstetric and Paediatric Hospital

DLH- Douala Laquintinie Hospital

DMO – Diabetic macular oedema

DR – Diabetic retinopathy

ECCE- Extracapsular cataract extraction

ELM- External limiting membrane

EMM- Epimacular membrane

ERM- Epiretinal membrane

EZ- Ellipsoid zone

FA- Fluorescein angiography

FVA- Far visual acuity

GCL- Ganglion cell layer

HBRVO – Hemi branch retinal vein obstruction

HRF- Hyperreflective foci

IG- Irvine Gass

INL- Inner nuclear layer

IPL- Inner plexiform layer

IS- Inner segment

IV- Intravitreal

IVTA- Intravitreal triamcinolone acetonide

IVB- Intravitreal bevacizumab

IVR- Intravitreal ranibuzimab

MO – Macular oedema

MH- Macular hole

NSAIDS- Nonsteroidal anti-inflammatory drugs

OCT- Optical coherence tomography

OD- Optic disc

ONH- Optic nerve head

ONL- Outer nuclear layer

OPL – Outer plexiform layer

OS- Outer segment

PCA- Posterior ciliary artery

PE- Phacoemulsification

PED- Pigment epithelial detachment

PFC- Parafoveal cyst

PG- Prostaglandin

PP- Posterior pole

PR- Photoreceptor

PRP- Panretinal photocoagulation

PVD- Posterior vitreous detachment

RGC- Retinal ganglion cell

RNFL- Retinal nerve fibre layer

RP- Retinitis pigmenstosa

RPE- Retinal pigmented epithelium

2RMH- 2nd Region Military Hospital

SCMO- Subclinical macular oedema

SLE- Slit lamp examination

SLO- Scanning laser ophthalmoscopy

SRF- Subretinal fluid

TRD- Tractional retinal detachment

VA- Visual acuity

VEGF- Vascular endothelial growth factor

VMT- Vitreomacular traction

VMTS- Vitreomacular traction syndrome

CHAPTER I: INTRODUCTION

I.1 BACKGROUND

Macular oedema (MO) is defined as an accumulation of fluid and other substances (lipids, proteins) in the macula of the retina leading to a thickening of the retinal tissue and a decrease in visual function [1]. MO may occur in a wide variety of ocular pathologies.The fluid accumulation in MO may be intracellular or extracellular. Extracellular MO which is more frequent and clinically more relevant, is directly associated with an alteration of the blood-retinal barrier (BRB) [2].

Worldwide, MO affects about 7 million and 3 million people due to diabetes and RVOs respectively [2,3]. It is also responsible for 40% of visual impairment (VI) in patients with uveitis [4].

The general prevalence of MO irrespective of its cause is hardly found from previous studies in Africa. It was however found to be responsible for 16.5% of consultations at a retinal clinic in Ibadan Nigeria in 2021 [5].

In Cameroon, a hospital-based study in Yaoundé in 2015 registered a prevalence of 8.5% of MO among diabetic patients, based solely on FA findings [6]. Some other values recorded are 8% in 2011 in the North West region among diabetic patients [7] and 36.8% in 2015 in Yaounde among patients with proliferative diabetic retinopathy [8].

Macular oedema patients usually present with decreased vision which is most common, or other symptoms including micropsia, metamorphopsia, positive central scotoma (macular syndrome). Fundus examination could reveal macular haemorrage, exsudates or absent foveolar reflex [9].

Fluid accumulation within and under the sensory retina can be confirmed and located by correlating results from fluorescein angiography (FA) and optical coherence tomography (OCT) [10]. Changes in macular thickness and identification of other elements useful for prognosis can be characterized by the spectral-domain (SD) OCT. The thickness of the macular from fluid or proteins is confirmed on OCT against a reference value. FA evaluates perfusion and identifies areas of leakage as a guide for treatment. Macular hyperfluorescence by leakage which increases with time into the late phase characterizes MO on FA [10]. The correlation of these imaging techniques is now primarily the basis of diagnosis and characterization of MO [11]. The OCT characterization of MO has evolved with time with evolving management modalities. Kim et al characterized diabetic MO into at least

five morphological patterns including diffuse, cystoid, subretinal fluid, posterior hyaloid traction with or without tractional retinal detachment [12]. With the advent of laser treatment MO was characterized into being clinically significant or not based on its distance from the centre of the macular and its size. Clinically-significant MO usually presents with decreased visual acuity and often requires treatment [13]. The introduction of anti vascular endothelial growth factors for management further led to a classification into central-involved MO or not depending on the involvement of the central subfield, still in a bid to guide management [14]. Macular oedema involving the centre is a recognized cause of visual impairment or blindness. Macular oedema could thus be a public health problem and its recognition is preliminary to tackling the disease burden it represents.

Studies in Cameroon concerning macular oedema have mainly focused on DMO since 2011 till date. Mainy studies have also been carried out in Cameroon on specific aetiologies of macular oedema. However, we have not found studies on macular oedema globally irrespective of aetiology. In a bid to help guide public health education, ensure overall optimal management of patients as well as set a baseline for continuity of care, we decided to determine the epidemiological, clinical and therapeutical apects of MO in hospitals in Douala.

I.2 RESEARCH QUESTION

What are the epidemiological and clinical characteristics of macular oedema in hospitals in Douala?

I.3 RESEARCH HYPOTHESIS

1.) Macular oedema mostly affects diabetic patients

2.) The mean age of patients with macular oedema is greater than 50 years

3.) Diffuse macular oedema is more common than focal macular oedema

1.3 RESEARCH OBJECTIVES

General objective:

To determine the epidemiological and clinical aspects of macular oedema in hospitals in Douala.

Specific objectives:

1.) To determine the hospital-based frequency of macular oedema in Douala

2.) To identify the clinical characteristics of macular oedema in hospitals in Douala

3.) To identify causes of macular oedema in hospitals in Douala

CHAPTER II: LITERATURE REVIEW

II.1 ANATOMY AND PHYSIOLOGY OF THE RETINA

II.1.1 ANATOMY OF THE EYEBALL

The human eye is a fluid-filled sphere enclosed by three layers of tissue which include; an outer fibrous (sclera), middle vascular (uvea) and inner neural (retina) coat [15–17]. Aqueous humour (AH) is the fluid that fills the front of the eye and vitreous humour (VH), a thick gelatinous substance occupies the space between the back of the lens and the retina surface (Figure 1) [18].

The retina contains photoreceptor (PR) cells which function in visual transduction, i.e., transforming light signals to nerve impulses transmitted from the optic nerve to the brain forming an image [19].

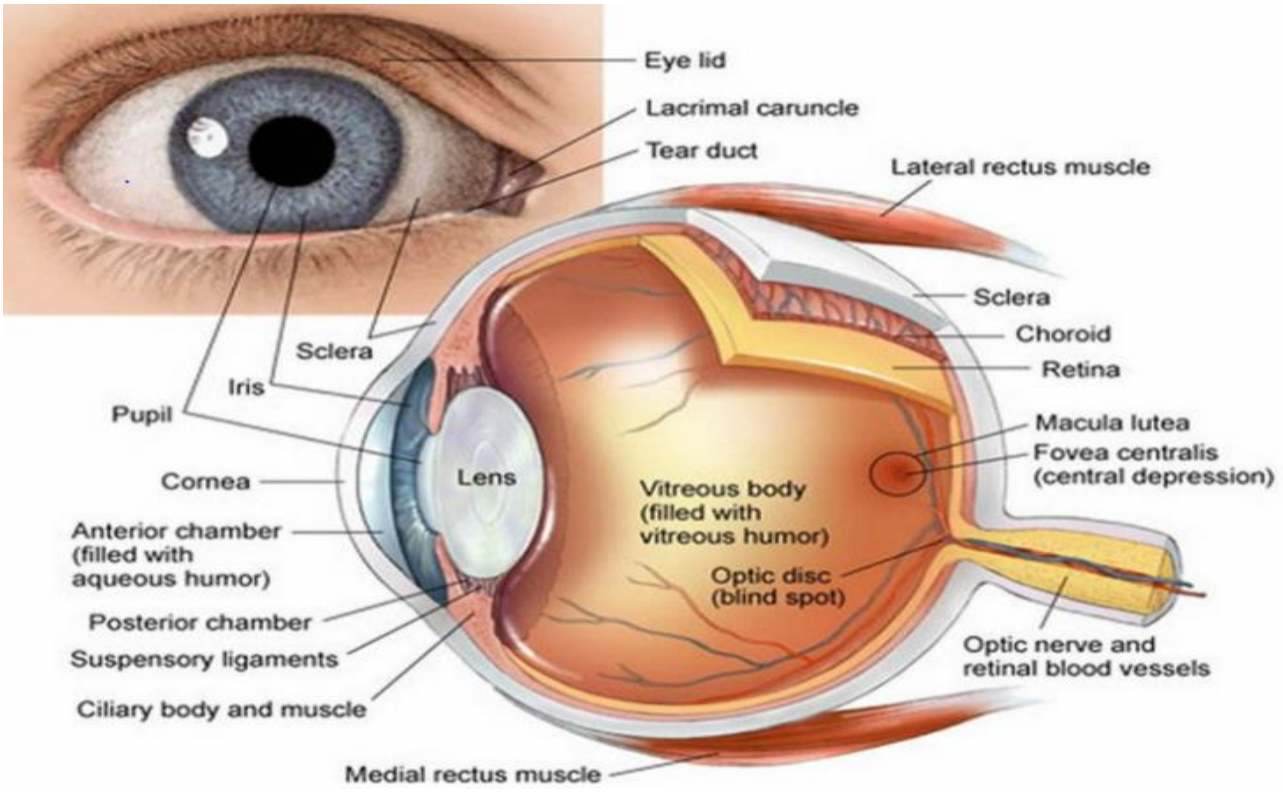

Figure 1. Anatomy of the eyeball (Source: www.healthjade.com, 2017) [18]

II.1.2 ANATOMY OF THE RETINA

The cross-sectional retina broadly consists of two primary layers: an inner neurosensory retina (NSR) and outer retinal pigment epithelium (RPE) with a potential space between them known as the subretinal space. The adhesion between neurosensory retina and RPE is relatively weak [20].

II.1.2.a Topography of the retina

Topographically, the human retina can grossly be divided into two distinct regions: posterior pole (PP) and peripheral retina.

The PP lies just beyond the optic disc (OD) and retinal arcades. It includes two distinct areas: the optic disc (OD) and macula lutea. The OD is a well-defined pink-coloured vertically oval area averagely measuring 1.76 mm horizontally to 1.88 mm vertically and placed 3.4 mm nasal to the fovea. It is the termination zone of all retinal layers except the nerve fibres (1-1.2 million) which run into the optic nerve (ON) through the lamina cribosa. The OD thus represents the beginning of the ON and so is also referred to as the optic nerve head (ONH). A depression seen in the disc is called the physiological cup. The central retinal artery (CRA) and vein emerge through the centre of this cup.

The macula lutea or the yellow spot is comparatively deeper red than the surrounding fundus and is situated at the PP temporal to the OD. It is about 5.5 mm in diameter. The fovea centralis is the central depressed 1.5mm diameter part of the macula and is the most sensitive part of the retina. A shining pit called foveola (0.35 mm diameter) in its centre has the lowest threshold for light and highest VA, because it contains only cones. It is situated about 2 disc diameters (DD) (3–4 mm) away from the temporal margin of the OD and about 1 mm below the horizontal meridian. A tiny depression in the centre of foveola called umbo is seen as a shining foveola reflex on fundus examination. An area about 0.8 mm in diameter (including foveola and some surrounding area) does not contain any retinal capillaries and is called the foveal avascular zone (FAZ). Surrounding the fovea are the parafoveal and perifoveal areas. The peripheral retina refers to the area bounded posteriorly by the retinal equator and anteriorly by the ora serrata. The ora serrata is the serrated peripheral margin where the retina ends [9].

The retinal surface can be divided into the following areas seen on the diagram below.

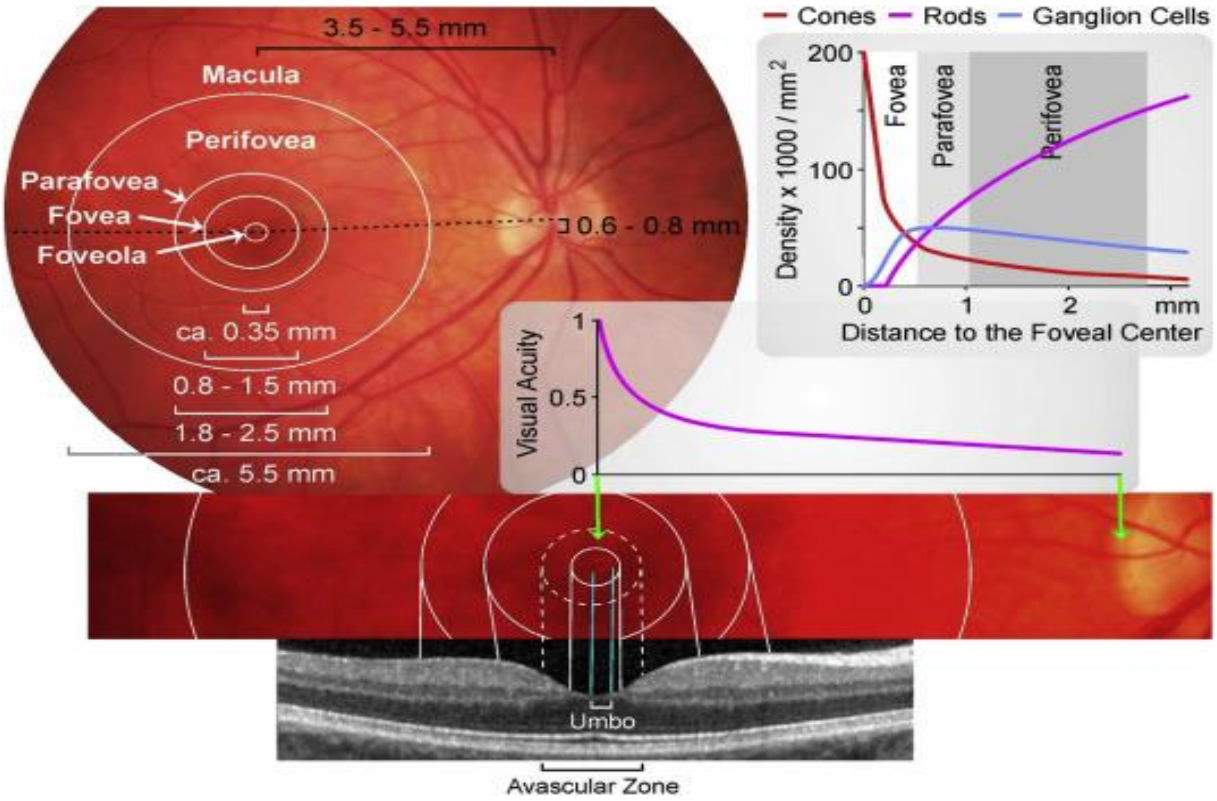

Figure 2. Topography of the retina with corresponding cross section of the retina at the macula (Source: Science direct, 2018) [21].

It is worth noting that the retina literature is full of contradictory nomenclature. Clinicians use the term fovea to name the 1° diameter disk at the very center of the retina and the term macula to name the 5° diameter ring that surrounds it. Whereas, anatomists use the term fovea to name the 5° diameter disk at the center of the retina and the term macula to name the 20° diameter ring that surrounds it [22]. This can be seen on figure 3 below.

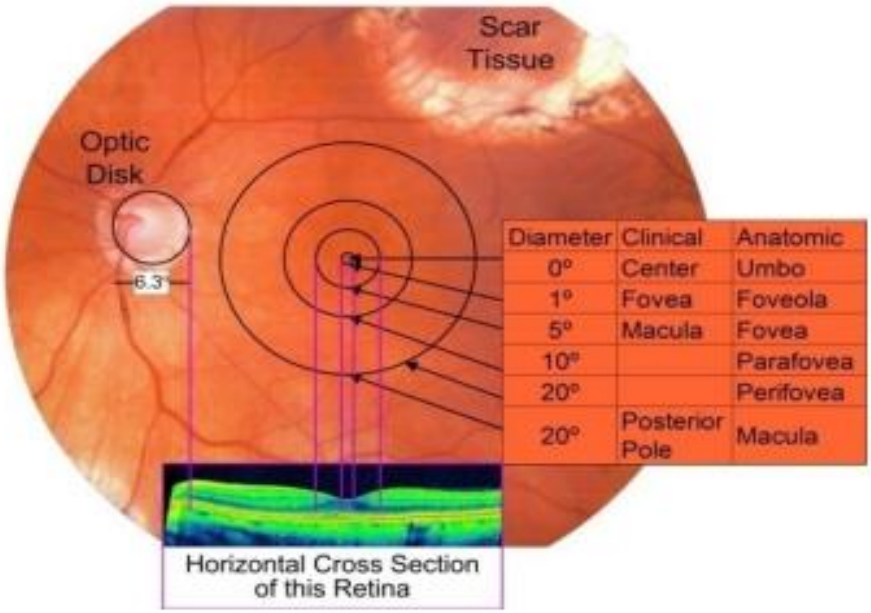

Figure 3. Multimodal views of the human retina (Source: Science domain, 2014) [22]

We used the 5.5mm diameter (20°) area definition by Comprehensive Ophthalmology [9] as the definition for the macular in our study.

II.1.2.b Histology (cross-section) of the retina:

The retina contains six major types of cells; five major neuronal cell classes and Müller glial cells providing metabolic and homeostatic support. These cells are: PRs (rods and cones), bipolar cells, horizontal cells, amacrine cells and retinal ganglion cells (RGC). In general, cell somas are grouped in three distinct nuclear layers, separated by two connecting layers plexiform layers, where synapses between cells are formed [23].

Layers of the Retina

The retina, more specifically, subdivides into ten distinct layers that are described in order from the innermost layers to the layers further towards the posterior and periphery of the eyeball (24)]:

- **Inner Limiting Membrane (ILM)** – the innermost layer of the retina that forms a smooth boundary against the VH which fills the vitreous chamber of the eye. The peripheral

boundary of this layer consists of Müller glial cells, which function to maintain retinal homeostasis by upholding retinal lamination and by supporting other cells.

- **Retinal Nerve Fiber Layer (RNFL)** – the layer composed of RGC axons mixed with astrocytes and the processes of the Muller cells. The ILM serves as the basal lamina for the cells of the RNFL.
- **Ganglion Cell Layer (GCL)** – the layer of ganglion cell bodies that project their axons, eventually to form the ON.
- **Inner Plexiform Layer (IPL) –** this layer is where the axons of bipolar cells synapse onto the ganglion cells. The dendrites of amacrine cells also synapse at this zone and function in modulating the electrical conduction between the bipolar cells and ganglion cells, preventing lateral potentiation.
- **Inner Nuclear Layer (INL)** – the layer composed of the cell bodies of bipolar cells, horizontal cells, and amacrine cells. Bipolar cells function as channels that transmit and encode various synaptic inputs from photoreceptor cells onto ganglion cells. Horizontal cells provide feedback modulation onto rod and cone cells.
- **Outer Plexiform Layer (OPL)** – the region where projections from PR cells synapse with the dendrites of the cells residing in the inner nuclear layer.
- **Outer Nuclear Layer (ONL)** – contains the cell bodies of both rods and cones.
- **External Limiting Membrane (ELM) –** composed of gap-junctions between PR and Muller cells; it separates the cell bodies of PRs from their inner segment (IS) and outer segment (OS) [25].
- **Photoreceptor (PR) Layer** – the region consisting of the ISs and OSs of PRs. The outer PR segments consist of membrane-bound discs that contain the light-sensitive pigments such as rhodopsin that are necessary for phototransduction. The inner segments house the abundance of mitochondria needed to meet the high metabolic demands of the PR cells.

- **Retinal Pigment Epithelium (RPE) –** the outermost retinal layer located between the neurosenrory retina (NSR) and the Bruch membrane, adjacent to the highly-vascularized choroid layer. It contributes to the BRB in conjunction with the endothelium of the retinal vessels and has many functions including ion and water transport and secretion of growth factors and cytokines. The RPE cells intermingle with the OSs of the PRs. This proximity allows for the recycling of visual pigment and its delivery back to the PRs to be used again for phototransduction. RPE cells are crucial in the support and maintenance of both PR cells and the underlying capillary endothelium.

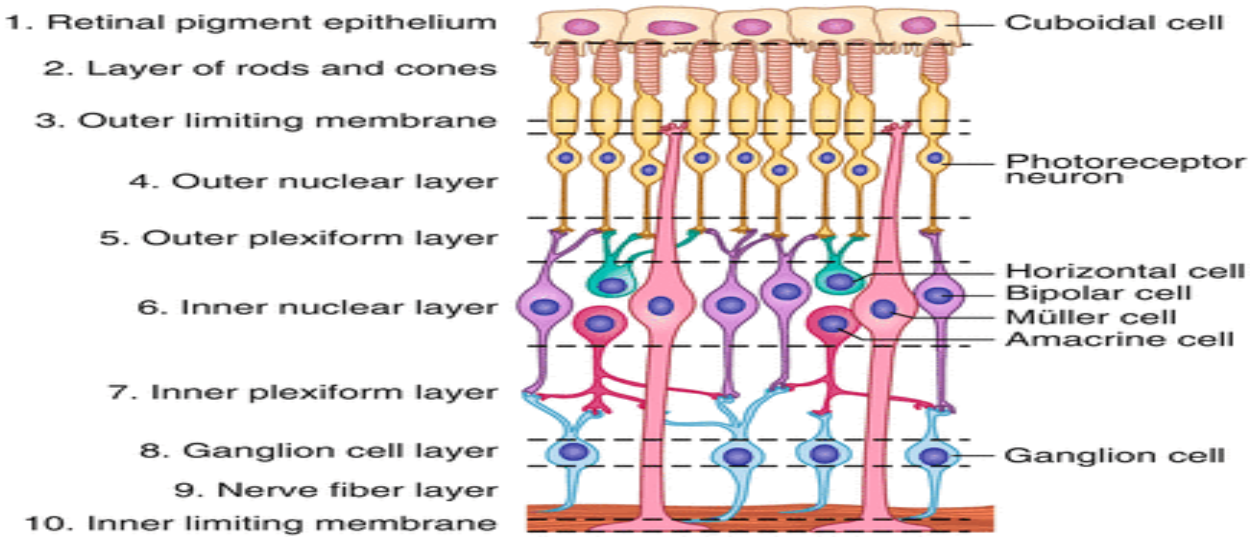

Figure 4. Cross-section of the retina (Source: The eye; Compendum of histology, 2017) [24]

II.1.2.c Blood Supply and Lymphatics

The retina has a double arterial supply. The outer four layers of the retina, viz, RPE, layer of rods and cones, ELM and ONL are avascular and get their nutrition from the choroidal and vascular system formed by contribution from anterior ciliary arteries (ACAs) and posterior ciliary arteries (PCAs). The inner six layers of retina are vascular and get their supply from the CRA, which is a branch of the ophthalmic artery (OA). In some individuals a cilioretinal artery (branch from PCA) is present as a congenital variation and it supplies the macular area [20].

Central Retinal Artery (CRA) – the major vessel that supplies the inner layers of the retina. It travels inside of the ON sheath and similarly penetrates the eye at the OD. The CRA divides into superior and inferior arcades that will form the BRB. It originates as a major branch of the OA.

Four unique vascular plexuses exist in the retina (Figure 5). The superficial vascular plexus (SVP) supplied by the CRA is composed of larger arteries, arterioles, capillaries, venules, and veins primarily in the GCL [26]. Two deeper capillary networks lie above and below the INL referred to as the 'intermediate' and 'deep capillary plexuses, or ICP and DCP, respectively, which are supplied by vertical anastomoses from the SVP. The fourth network is a regional layer called the radial peripapillary capillary plexus (RPCP). The capillaries here run in parallel with the NFL axons, as opposed to the deeper vascular plexuses, which have a lobular configuration. The functional significance of the RPCP has been recognized due to its role supplying the densely packed NFL bundles in this region [27]. The retina does not contain lymphatic vessels [28].

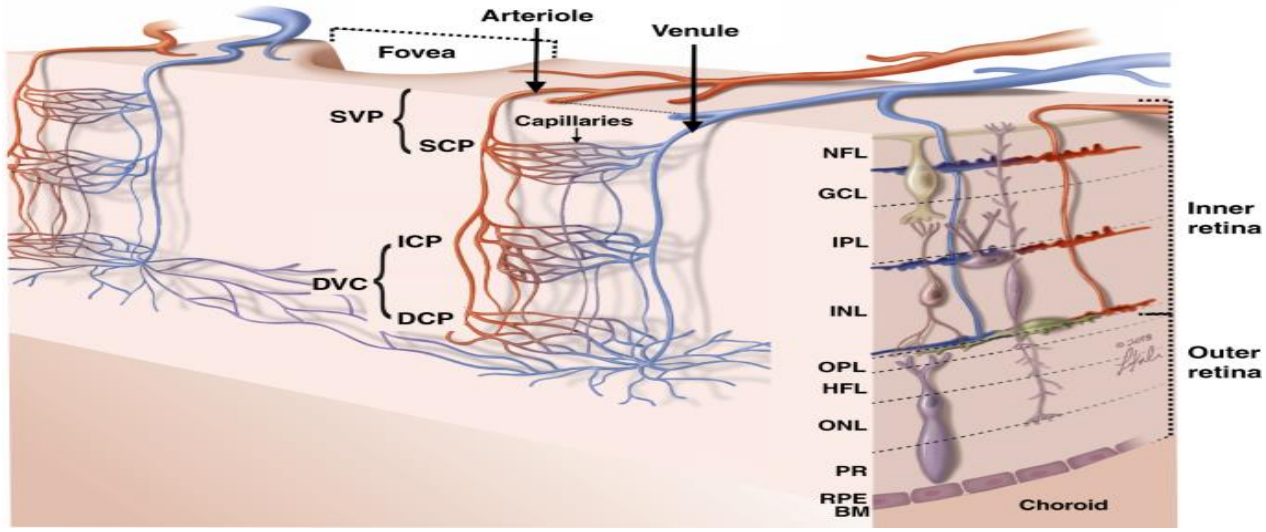

Figure 5. Anatomic localization of vascular plexuses in the retina (Source: nature.com) (29)]

SVP =superficial vascular plexus, SCP =superficial capillary plexus, DVC=deep vascular complex, ICP = intermediate capillary plexus, DCP=deep capillary plexus, NFL= nerve fiber layer. Not shown: in the peripapillary retina: RPCP (radial peripapillary capillary plexus). RPCP and SVP together are commonly known as the SVC (superficial vascular complex)

Central Retinal Vein (CRV) – the main drainage pathway of the retina and travels alongside the CRA within the sheath of the ON. It drains into the carvenous sinus.

Long Posterior Ciliary Arteries (LPCA) – these two vessels branch from the OA and pierce the sclera posteriorly near the entry zone of the ON. The LPCA supply the choroid in the medial and lateral horizontal planes and, eventually, the anterior structures of the eye.

Short Posterior Ciliary Arteries (SPCA) – these vessels arise as a few branches from the ophthalmic artery and subsequently branch into 10 to 20 smaller vessels that penetrate the posterior sclera in a ring around the ON. These branched vessels anastomose to form the circle of Zinn that encircles and supplies the area of the optic cup at the level of the choroid. Their perpendicular terminal arterioles also supply the Bruch membrane and the outer retina [25].

Choroid – the second major tunic, of the eye that vascularizes the outer layers of the retina. The Bruch membrane sits between the RPE layer and the choriocapillaries, forming the basement membrane of the choroid. The choriocapillaries layer is thickest behind the fovea (10 micrometers) and thins out towards the periphery (7 micrometers).The retinal veins follow the pattern of the arteries [30].

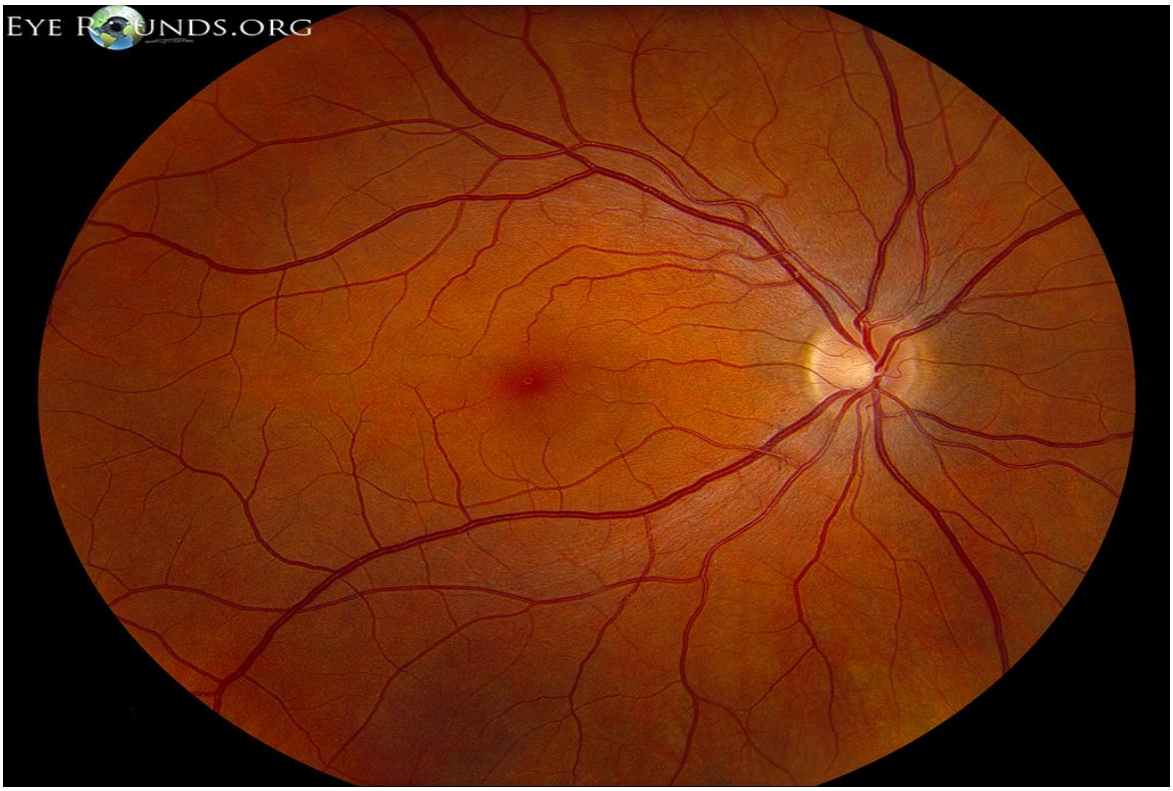

Figure 6. Retinal vessels on funduscopy (Source: eyerounds.org) [31]

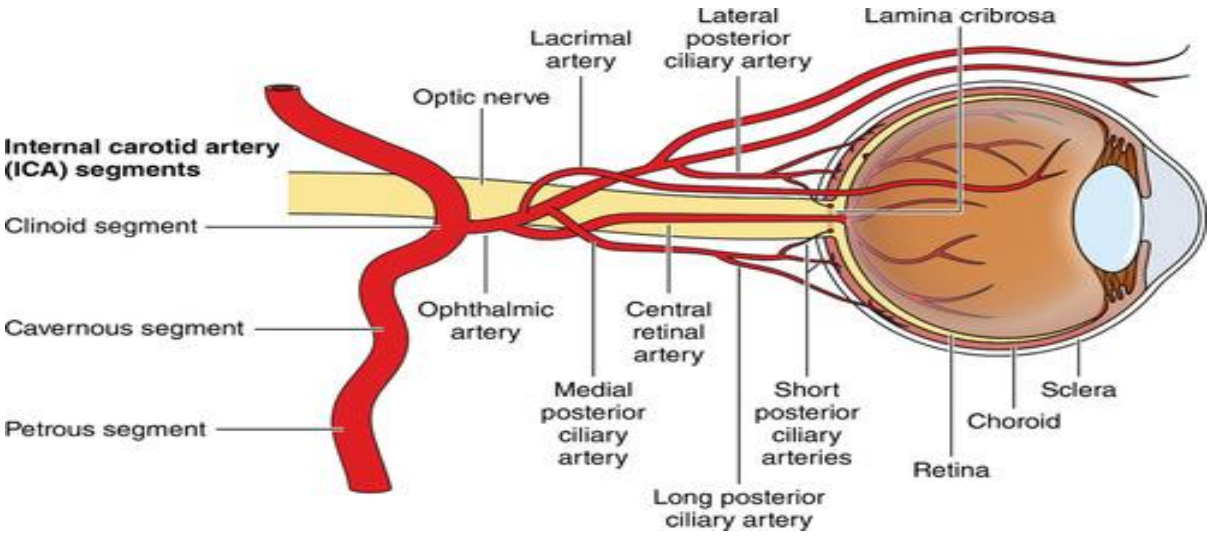

Figure 7. Arterial supply of the retina (Source: AHA journal) [32]

II.1.3 PHYSIOLOGY OF THE RETINA

The physiology of vision is a complex phenomenom. The main mechanisms involved here are: initiation of vision (phototransduction), processing and transmission of visual sensation, and visual perception by the brain. The cornea, iris, ciliary body, and lens play a role in transmitting and focusing light onto the sensory component of the eye, the retina.

The retina is responsible for phototransduction. The PRs serve as sensory nerve endings for visual sensation. The retina is comprised of two types of PR cells: rods and cones. Rods are responsible for scotopic vision and are the more abundant cell-type of the retina (90 million). They reach their maximum density approximately 15 to 20 degrees from the fovea [33]. The cones (6 million) confer color vision and high spatial acuity and are the cell-type most activated at higher light levels (photopic vision). The fovea has the highest density of cones and is free of rods [33].

II.1.3.a Blood retina barrier (BRB)

The blood-retina barrier (BRB) is composed of both an inner and an outer barrier. The outer BRB (oBRB) refers to the barrier formed at the RPE cell layer and functions, in part, to regulate the movement of solutes and nutrients from the choroid to the subretinal space.

In contrast, the inner BRB (iBRB), similar to the blood brain barrier (BBB) is located in the inner retinal microvasculature and comprises the microvascular endothelium which line these vessels. The tight junctions (zonulae occludentes) located between these capillary cells mediate highly selective diffusion of molecules from the blood to the retina and the barrier is essential in maintaining retinal homeostasis [34]. This continuous endothelial cell layer forms the main strutucture of the iBRB and rests on a basal lamina that is covered by the processes of astrocytes and Müller cells. Pericytes are also present, encased in the basal lamina, in close contact with the endothelial cells, but they do not contribute to the diffusional barrier. Astrocytes, Müller cells and pericytes are considered to influence the activity of retinal endothelial cells and of the iBRB.

The oBRB is established by the tight junctions (zonulae occludentes) between neighbouring RPE cells. The RPE is composed of a single layer of RPE cells that are joined laterally towards their apices by tight junctions between adjacent lateral cell walls. The RPE, resting on the underlying

Bruch's membrane, separates the NSR from the fenestrated choriocapillaries and plays a fundamental role in regulating access of nutrients from the blood to the PRs, as well as eliminating waste products and maintaining retinal adhesion. The metabolic relationship of the RPE apical villi and the PRs is considered critical for the maintenance of visual function [34].

Failures of these BRBs constitute the main pathophysiology of the development of MO.

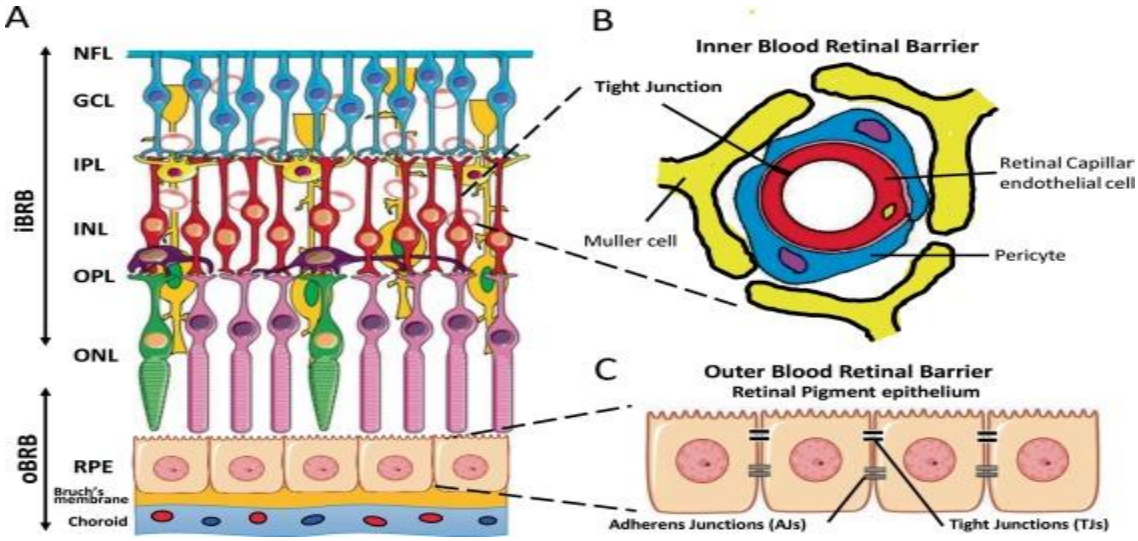

Figure 8. Blood-Retinal barrier (Source: Sciencedirect.com)[35]

II.2 EPIDEMIOLOGY OF MACULAR OEDEMA

II.2.1 WORLDWIDE

Macular oedema is an underestimated public health issue as it is a major cause of visual impairment (VI) in the course of metabolic, vascular and inflammatory retinal diseases [36]. Worldwide, it affects about 7 million and 3 million people due to diabetes and RVOs respectively [2,3]. Industrialized countries record MO from neovascular age-related macular degeneration (ARMD) in 5% of people 60 years of age and older [37]. It is also responsible for 40% of visual impairment (VI) in patients with uveitis[4].

II.2.2 AFRICA

The general prevalence of MO irrespective of its cause is hardly found from previous studies in Africa. We however note the prevalence from studies in diabetic patients from African countries. A study in Senegal recorded a prevalence of 9.8% in 2003 [38] .Macular oedema was found to be responsible for 16.5% of consultations at a retinal clinic in Ibadan Nigeria in 2021 [5]. A hospital-based study among diabetic patients in Kenya in 2018 demonstrated a prevalence of MO of 5.2%, observed from clinical fundus examination only. Diabetic MO was the most prevalent cause of MO from studies in Togo and Ivory Coast in 2016 and 2020 respectively, with RVO occupying third and second places respectively [39,40]. A study carried out in 2021 recorded 21% DMO amongst diabetic patients with 5.5 % clinically significant [41].

II.2.3 CAMEROON

A hospital-based study in Yaoundé in 2015 registered a prevalence of 8.5% of MO among diabetic patients. This diagnosis was based solely on FA findings [6]. This was similar to another hospital-based study in 2011 in another region, the North West region which recorded a prevalence of 8% of MO among diabetic patients [7]. In 2015, a higher prevalence (36.8%) was recorded in a study in patients with proliferative diabetic retinopathy in Yaoundé [8].

A hospital-based study in the Littoral region in 2016 recorded a significantly higher frequency of DMO among diabetic patients on insulin than in those on oral hypoglycaemic medication [42]. A

recent hospital based study in Yaoundé recorded a high prevalence of 32.2% DMO among diabetic patients with 13.8% clinically significant [43].

II.3 CHARACTERISTICS OF MACULAR OEDEMA

The predilection of oedema to the macular region is probably associated with the loose binding of inner connecting fibers in Henle's layer, allowing accumulation of fluid leaking from perifoveal capillaries. The absence of muller cells in the fovea region is also a contributing factor.

II.3.1. CLINICAL CHARACTERISTICS

II.3.1.1 POSITIVE DIAGNOSIS

Working pathology: Diabetic macular oedema

Circumstances of discovery:

- Accidental
- Referred by internist or diabetologist for fundoscopy
- In the presence of suggestive symptoms (defective vision, metamorphopsia)
- During complications(and may present with a red eye)

Patient interrogation:

- Age: > 50 years
- Symptoms:
    - Decreased far and near vision
    - Micropsia, metamorphopsia, positive central scotoma (macular syndrome).

Past History:

- Ocular: ocular surgery, trauma, ocular infection, ocular treatment, ocular degeneration
- General: diabetes, hypertension, exposure to radiotherapy

Ophthalmological examination:

- VA decreased
- Anterior segment: normal
- IOP normal
- Posterior segment:
    - Vitreous: normal
    - Retina: Slit lamp examination (SLE) may show loss of foveal reflection, hemorrhages, hard exudates (may also be in ring or circinate pattern), anterior bulging of the retina, as well as cystoid logettes which appear particularly in retro-illumination [1,44].

II.3.1.2 CLINICAL FORMS

i. With respect to symptoms (clinical)

Clinically-significant macular oedema (CSMO) is defined as one or more of the following on fundoscopy according to the Early Treatment Diabetic Retinopathy Study (ETDRS):

- retinal thickening at or within 500 μm of the center of the macula
- hard exudates at or within 500 μm of the center of the macula, if associated with adjacent retinal thickening
- or a zone or zones of retinal thickening one disc area in size, at least part of which is within one disc diameter of the center of the macula [13].

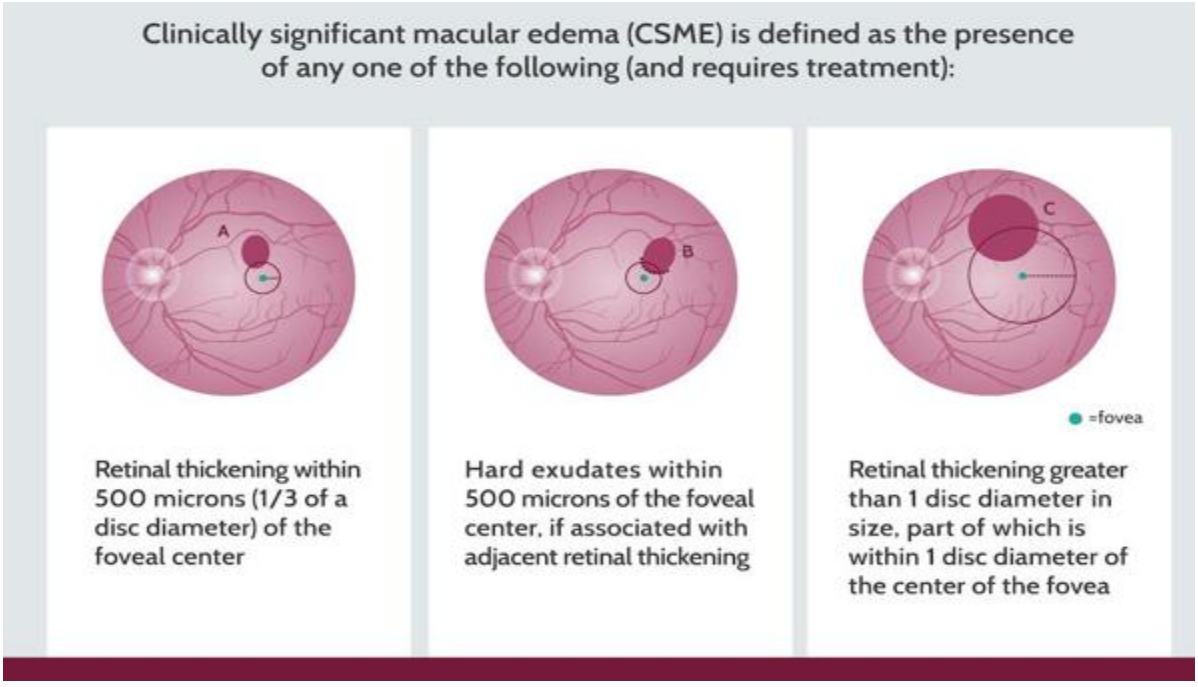

Figure 9. Clinically significant macular oedema (Source: Optoprep, 2021) [45]

This classification was meant to guide treatment with laser photocoagulation which was the mainstay of treatment.

Subclinical MO has also been described and refers to macular oedema between 250-300 μm on Cirrus OCT which usually is not yet apparent on fundus examination but which predisposes to clinical MO subsequently [46] .

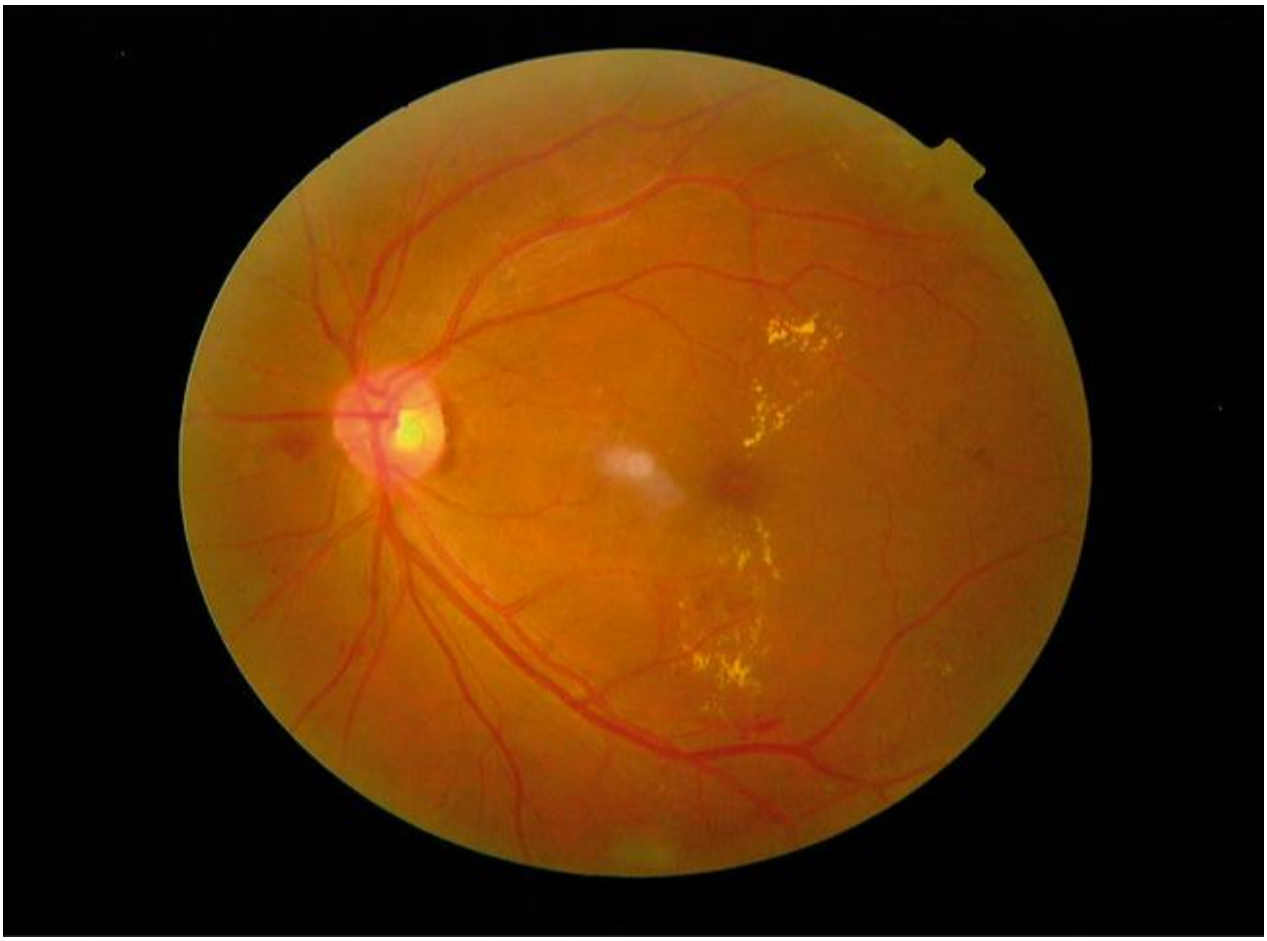

Figure 10. Clinically significant MO with hard exudates encroaching on the fovea (Source: CEH journal, 2008) [47]

ii. With respect to extent and pattern (OCT, FA)

With the advent of intravitreal anti-VEGF, promising results had been shown in the treatment of center-involved MO (CIMO).

Current guidelines from the International Council of Ophthalmology (ICO) thus recommend the classification of MO into center-involved and non–center-involved MO on OCT depending or whether or not the central 1mm subfield is involved [14].

Non-center involved MO is further classified into focal or diffuse for tailored laser treatment.

- Focal MO is characterized by localized leakage from microaneurysms (MA)**.**

- In diffuse MO, there is no definable demarcation around the areas of leakage, and the leakage involves the entire circumference of the fovea 48].

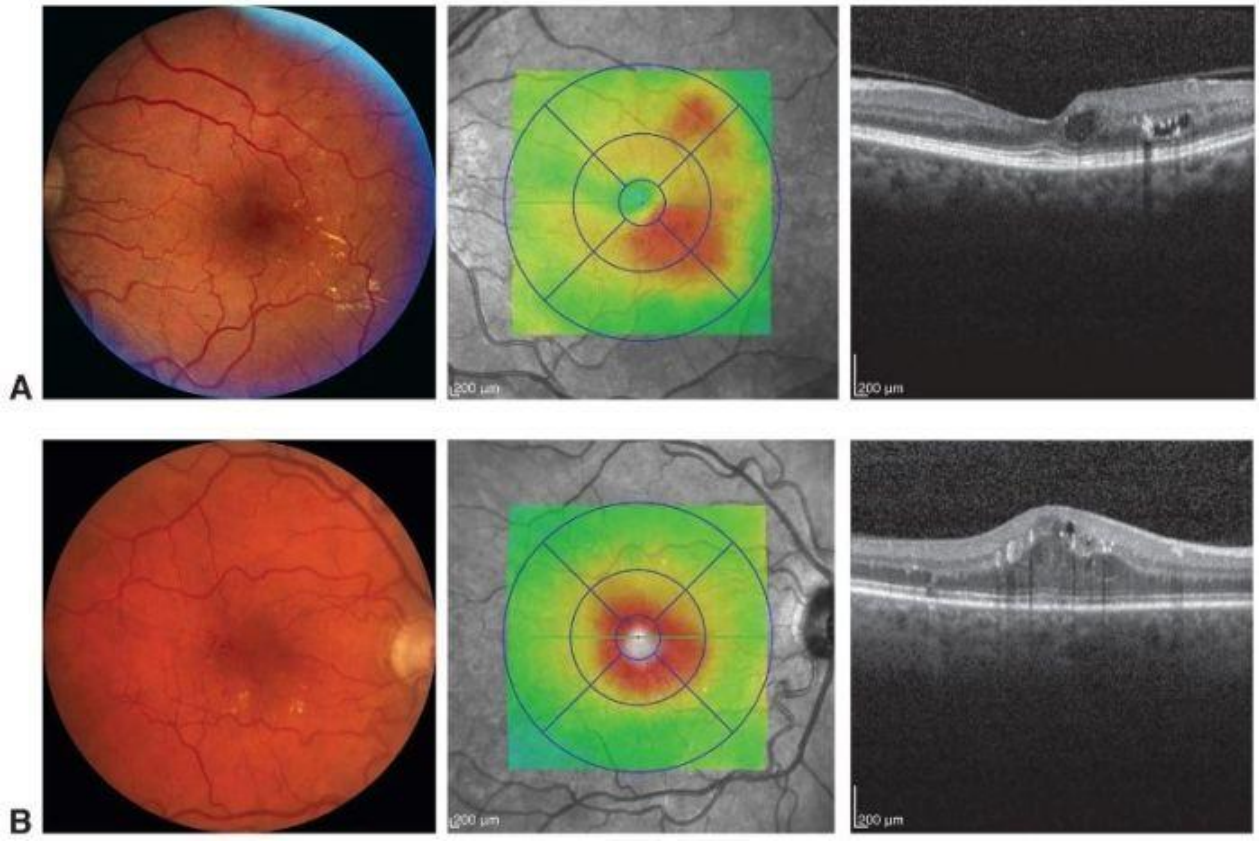

Figure 11. Extent of macular oedema. A) Non centre-invloved macular oedema B) Centre-involved macular oedema. (Source: eyewiki.aao.org, 2022) [49].

iii. With respect to morphology

A grading protocol termed SAVE was described recently to assist treatment decisions of CSMO. "S" for "subretinal fluid", "A" for "area of retinal thickening", "V" for "vitreoretinal interface abnormalities", and "E" for "etiology". It defines four aetiological types of CSMO which include focal leakage, diffuse leakage, macular ischaemea and retinal atrophy. It further analyses categories important in diagnosis and during follow-up [50]. These categories describe the individual state of morphological alteration and include: the presence or absence of subretinal fluid, the ETDRS grid fields showing retinal swelling (ie, a planimetric quantification, area) and the presence of vitreo-retinal abnormalities. These categories are assigned scores and individual central millimetre retinal

thickness value is added to describe the amount of oedema. The aim of developing this new grading protocol was to define the aetiology of an individual case of CSMO, in other words, the source of leakage. Apart from providing this comprehensive categorisation, it describes and defines an advanced atrophic stage of CSMO in a clinical grading protocol. This is of particular importance as a relevant alteration in retinal integrity may be a prognostic factor for the functional outcome of different therapeutic [50].

Furthermore morphological patterns of MO have been described and categorized into 3 subtypes: sponge-like diffuse retinal thickening (DRT), cystoid macular edema (CMO), and serous retinal detachment (SRD)

- In cystoid macular oedema, cystoid spaces are formed in the vicinity of the OPL caused by the anatomical structure of the plexiform layer. The arrangement of the cystoid cavities is determined by the müller cells, which are vertical. The anatomy is clearly delineated on OCT and also becomes very clear in late FA where one sees the typical petalloid leakage.

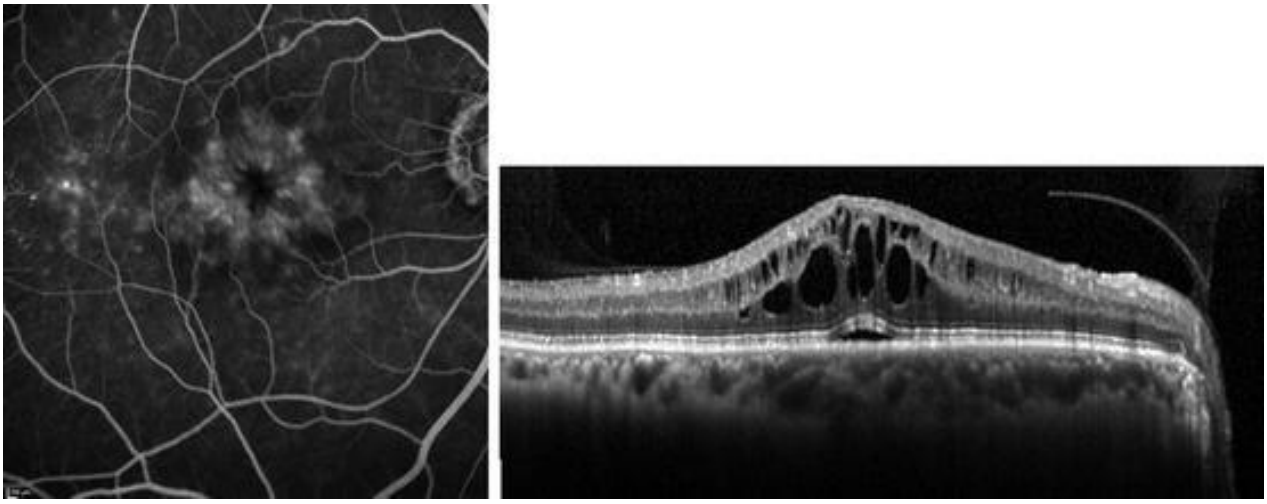

Figure 12. Cystoid macular oedema on fluorescein angiography (left) and opticl coherence tomography (right) (Source: entokey.com, 2017) [51]

- The DRT results from a diffuse accumulation of fluid from leakage through capillaries
- The movement of fluid from the edematous retina into the subretinal space with a breakdown of the oBRB in the RPE causes SRD [52].

II.3.1.3 AETIOLOGICAL DIAGNOSIS

i. Macular edema and retinal vascular diseases

a. Diabetes mellitus

Diabetic macular oedema (DMO) is seen in both type I and II diabetes mellitus and is the most common cause of visual loss in the latter [53]. It could be focal and diffuse. Systemic and ocular risk factors include cardiovascular or renal disease, severe systemic hypertension, advanced retinopathy, and vitreomacular traction [54].

b. Retinal vein occlusion

Retinal vein obstructions represent another common retinal vascular cause of MO and usually closely follows diabetic retinopathy in study prevalence. In these patients MO is a major cause of visual loss [40,55].

c. Sickle cell disease

Macular oedema has been described in sickle cell disease and this occurs in the case of proloferative sickcle cell retinopathy [56]. It is worth noting however that retinal involvement in sicklce cell disease is more frequently associated with the heterozygous (HbSC) than with the homozygous (HbSS) sickle cell disease [57].

d. Coats disease

In this disease the inner BRB is disrupted due to damage to the endothelium of the retinal vasculature and abnormal pericytes. These abnormalities lead to multiple telangiectasias, retinal ischaemia and macular oedema has been described to result from this pathology [58].

ii. Macular oedema and ocular inflammatory disease

Uveitis

Macular odema may complicate anterior, intermediate, and posterior uveitis, which may be because of various infectious, neoplastic or autoimmune etiologies.It is the main condition associated with vision loss in uveitis [59].

iii. Postoperative macular edema

a. Cataract surgery

Macular oedema following cataract surgery is known as the Irvine-Gass syndrome. Approximately 20% of the patients who undergo uncomplicated phacoemulsification (PE) or extra capsular extraction (ECCE) develop angiographically proven MO [60]. The risk factors most associated with MO include rupture of posterior capsule, vitreous loss, iris incarceration, use of iris fixated lenses, active uveitis and diabetes [61]. It usually peaks about 4-6 weeks following surgery [62].

b. Laser procedures

Macular oedema is a recognized complication following Nd:YAG capsulotomy with severity depending on amount of energy used during the procedure (63,64)] It occasionally occurs as a complication of panretinal photocoagulation (PRP) for diabetic retinopathy. When the clinical situation allows, preexisting MO should be treated prior to or concurrent with PRP. It is also helpful if the procedure can be divided into several sessions [64].

iv. Inherited dystrophies

Macular oedema is a well-described feature of certain hereditary retinal dystrophies, including retinitis pigmentosa (RP), juvenile X-linked retinoschisis (XLRS), enhanced S-cone syndrome (ESCS), choroideremia, and gyrate atrophy [65].

vi. Acquired macular dystrophies

Agr-related macular degeneration (ARMD) is one of the leading causes of blindness in the western world in people above 65 years [9]. It has two forms; the ‘dry’ form which is most common but less severe and the ‘wet’ form which is less common but more severe. Macular oedema has been described in the’wet’ form and plays a role in visual deteroriation [67].

v. Tumours

Macular oedema is an infrequent clinical feature in some of the intraocular tumors. Wolter [68] described three main types of MO, which have been seen to occur in association with choroidal melanomas:

1) direct involvement in cases where the neoplasm is located under the fovea
2) indirect involvement due to subfoveal exudate in choroidal melanomas distant to the fovea, and
3) indirect foveolar involvement without associated subfoveal tumor or exudates.

vi. Drug-induced macular edema

The use of some topical eye drops have been linked to macular oedema including epinephrine-like antiglaucoma drops, tamoxifen, latanoprost and timolol [69].

vii. Macular oedema and tractional disorders

a. Epiretinal membrane

Macular epiretinal membrane (ERM), whether idiopathic or secondary to vitreo-retinal pathology, may result in the development of MO. The disturbance of macular microcirculation in eyes with ERM has been proven by means of scanning laser ophthalmoscope (SLO) FA showing significantly reduced capillary blood flow velocity, which may lead to MO [70]. Spontaneous peeling of the ERM may occasionally occur, but if central VA declines to the 20/60 to 20/80 level, surgical intervention should be considered in order to prevent irreversible macular changes [71].

b. Vitreomacular traction (VMT) syndrome

The VMT syndrome is a rare entity in which partial posterior vitreous detachment (PVD) is combined with persistent macular adherence and macular traction (MT). In case vitreomacular adhesion is sufficiently dense, prolonged traction may cause MO, degeneration, and detachment of the macula. Complete vitreomacular separation, allows resolution of cystoid changes and improvement of VA [72].

viii. Trauma

Macular oedema from blunt eye trauma, known as Berlin's oedema has been described with characteristic OCT findings [72].

ix. Systemic infection

Macular oedem has also been described in malaria as part of the global diagnosis of malarial retinopathy [74].

II.3.2. PARACLINICAL EXAMINATIONS

Tests for MO may be grouped into three categories according to whether one is analyzing the underlying pathogenesis, the effect of the MO on the retina, or its impact on visual function.

a. Tests detecting disturbances in the BRB

Methods to detect disruption of the BRB in order to determine the presence and the extent of MO include fundus FA which is clinically the most widely available and useful. It permits study of the circulation of the retina and choroid in normal and diseased states and improves the accuracy of planning treatment for MO [61,74]. Vitreous fluorophotometry detects increased fluorescein leakage in vitreous with a slit lamp fluorophotometer. However, due to inconsistent results and the fact that vitreous fluorophotometry is abnormal in any instance of retinal vascular incompetence, the technique is not usually clinically helpful [68, 72].

Signs of MO of FA include: poor choroidal fluorescence in the early phase, retinal telengiectasis, capillary dilatation and leakage from perifoveal capillaires in the arterovenous phase, petalloid perifoveal leakage in CMO or diffuse irregular hyperfluorescence in the late phase [58].

b. Tests detecting retinal tissue thickness

Assessment of retinal thickness can be useful in the diagnosis, treatment and follow-up of MO. The two most commonly used techniques are the OCT and the retinal thickness analyzer (RTA).

Optical coherence tomography (OCT): The OCT is a non-invasive device that obtains cross-sectional, high-resolution images of the retina and vitreomacular interface [76]. Microstructural features are determined by measuring the 'echo' time it takes for the light to reflect from the different structures at varying distances, analogous to A-scan ultrasonography. As the OCT operates with a near-infrared wavelength (about 840 nm), the examination is of minimal discomfort for the patient. Optical coherence tomography examination is indicated in the early detection and follow-up of patients with MO. It has been shown to produce highly reproducible measurements and is as effective at detecting MO as FA, but is superior at demonstrating axial distribution of the fluid [77].

Types of OCT devices: OCT devices were first created in 1991 and have evolved since from time-domain (TD) to spectral domain (SD) to swept source (SS) to enhanced depth imaging (EDI) OCTs with progressively improving speed, sensitivity and resolution [78]. SD OCT is more common in Cameroon nowadays.

The most important advantage of SD-OCT compared with conventional time-domain OCT (TD-OCT) technique is the increased scanning speed. With SD-OCT imaging, acquisition of 25,000 to 100,000 scans/second is routinely possible. This is more than 100 times faster than the TD technique. The axial image resolution of OCT depends on the bandwidth of the low-coherence light source. Another important advantage of SD-OCT instrumentation is the possibility to obtain three-dimensional scans allowing for visualization of structural changes in the vitreoretinal interface and the retina in large areas [79].

Types of SD-OCTs include: Cirrus HD-OCT by Carl Zeiss Meditec, 3D OCT 1000 by TOPCON, RTVue-100 by Optovue, Spectral OCT/SLO by Ophthalmic Technologies, Spectralis HRA+OCT by Heidelberg Engineering and RS-3000 Advance OCT by NIDEK [80].

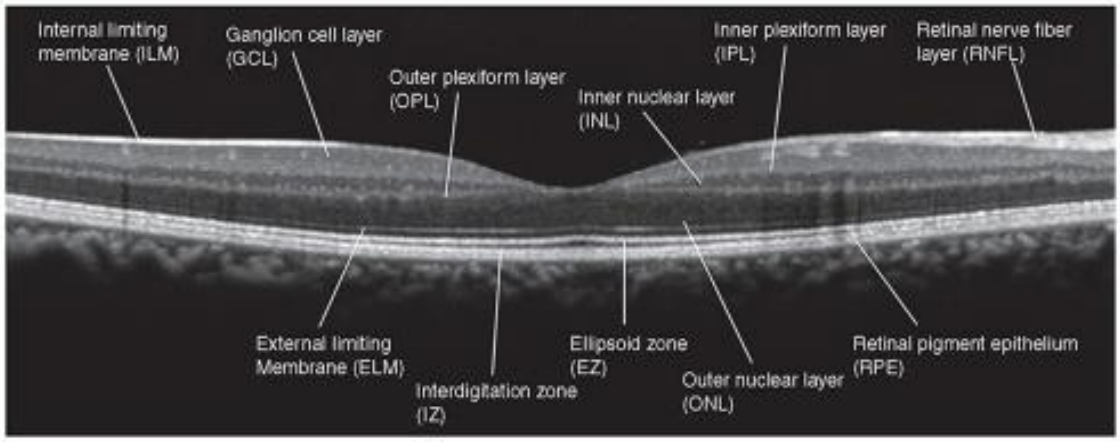

Figure 13. Normal retinal SD-OCT (Source: BioMed Eng OnLine, 2016) [81]

Signs of macular oedema on OCT include: retinal thickening (cystoid or not, diffuse or focal), PVD, VMT, TRD, flattening of the foveal depression, subretinal fluid, ERM, ellipsoid zone (EZ) disruption, hyperreflective foci [58]. EZ disruption grade 1 is defined as a normal and continuous structure, grade 2 as altered but continuous, grade 3 as interrupted and grade 4 as absent [82].

Retinal thickness analyzer (RTA): The RTA is a rapid screening instrument that generates a detailed map of retinal thickness. Multiple cross sectional imaging generates a 3D reconstruction of the retina. The major advantage of the RTA is the option to scan a relatively wide area of the retina in a short acquisition time [83]. The main sign of MO on RTA is macular thickening. However, RTA assessment of retinal thickening corresponds poorly on location of retinal thickening to the subjective assessment of retinal thickening by grading of stereo fundus photos. RTA is also poorly sensitive to subclinical MO [84].

Scanning laser ophthalmoscopy (SLO): The SLO has also been utilized in order to quantify retinal thickness by ophthalmoscopy and retinal topography. It is a rapid and non-invasive imaging method that provides quantitative analysis of macular cysts in addition to qualitative information not seen clinically. The chief advantage of the SLO is scanning a small focused spot to generate an image, (rather than illuminating a large area), which provides a high contrast image. Additional advantages include the ability to image through small pupils, retinal hyperpigmentation, blood, heavy exudation, or subretinal fluid [85].

Tests assessing retinal function

Tests assessing macular function may be used indirectly to detect the effects of MO and follow up its treatment. Contrast sensitivity charts and electroretinography (ERG) are both clinical and experimental tools [86]. Reduction in contrast sensitivity may account for persistent difficulties experienced by patients despite good Snellen acuity [87]. Electroretinography may also be utilized to follow up the treatment of MO. The foveal ERG provides objective information on the presence or absence of organic disease at the macula [88].

II.3.3 COMPLICATIONS OF MACULAR OEDEMA

Complications of MO could result from MO itself or from its management. The main organic complications of MO are changes in retinal architecture. These include inner retinal layers disorganization, intraretinal cystoid spaces indicating Muller cell dysfunction, hyperreflective foci deposition, ellipsoid zone disorganization and PR outer segment shortening.

These could all lead to the functional complication of progressive loss of vision which could eventually be irreversible.

Complications from laser photocoagulation include accidental foveal burn, subretinal fibrosis/ scarring, paracentral scotoma, and choroidal neovascular membranes. Complications from intravitreal injections include endophthalmitis, vitreous hemorrhage, cataract, central retinal artery occlusion and retinal tears [58].

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II.4 STATE OF THE MATTER

Global studies and studies in Africa on MO:

- A study by Yau et al in 2012 in the USA, Australia, Europe and Asia on the global prevalence and major risk factors of diabetic retinopathy revealed a DMO prevalence of 6.81% among diabetic patients [2].
-
- Kumar et al studied the diagnosis and management of DMO in India in 2019.They suggested that fundus fluorescein angiography is an important method used for evaluating patients with DMO, which assesses the severity of the characteristics of macular edema and shows the areas of retinal capillary leakage [89].
-
- A study in Togo in 2016 by Amedone et al on the aetiologies of MO, found diabetes to be the most common cause followed by age-related macular deneration (ARMD) and retinal venous occlusion respectively [39].
-
- Oluleye et al in Ibadan, Nigeria in 2021 found ARMD, MO and non ARMD atrophic maculopathy to be the major causes of macular disease at a retinal clinic of the University college there [5].
-
- The prevalence of MO among diabetic patients was 6% according to a study in 2018 in Ivory Coast by Kouassi et al [90].

CHAPTER III: METHODOLOGY

3.1- Study design:

We carried out a multicenter cross-sectional analytic study.

3.2 Study area and setting

Our hospital-based study was carried out at the ophthalmology services of four major hospitals i.e. Douala 2nd Region Military Hospital (2RMH), Douala General Hospital (DGH), Douala Gynaeco-Obstetric and Paediatric Hospital (DGOPH) and Douala Laquintinie Hospital (DLH). These units carry out advanced eye care services for the population of Douala, as well as referrals from other parts of the country.

3.2.1. Douala 2nd Region Military Hospital (2RMH)

It is located in Bonanjo, a busy part of Douala with inhabitants and workers of various ages and spheres of life. It is one of the reference hospitals with respect to retinal pathologies and its eye service is equipped with an adequate technical platform for ophthalmologic pathology management. It is the hospital at which macular OCT examination was carried out for this study.

Its structural organization comprises:

- A reception room for patients which doubles as the room for visual acuity testing, automatic refractometry/keratometry and jet air tonometry/pachymetry.
- Two consultation boxes with slit lamps
- One room for paraclinical tests and interventions including fluorescein angiography/retinal photography, optical coherence tomography, visual field, argon laser.
- One box with a bed for minor procedures doubling as a box for biometry measurement with A-scan ultrasound and keratometry.
- A patient waiting room doubling as a secretariat with a computer and printer as well as an archive room for patient files
- One office for the chief of service and one ophthalmologic theatre

Its personnel consists of 3 ophthalmologists including one retinal specialist, 2 senior ophthalmic technicians and 3 ophthalmic nurse assistants.

3.2.2 Douala General Hospital (DGH)

This is located in Makepe, a busy residential area. It is a reference hospital in Cameroon for all specialties as well as for ophthalmology with relatively better equipped service for diagnosis and management of more complicated ocular pathologies

Its structural organization comprises:

- A reception room for patients which doubles as the waiting room and archive for patient files.
- Four consultation boxes with consultation units comprising slit lamp with applanation tonometer, refractometer/keratometer, visual acuity/refraction projector
- Rooms for paraclinical tests and interventions including fluorescein angiography/retinal photography, optical coherence tomography, A and B mode ultrasound, visual field.
- A room for laser YAG
- Minor theatre with a bed for minor procedures
- An office for the chief of service
- An operating theatre

Its personnel consists of 5 ophthalmologists, 2 senior ophthalmic technicians, 3 ophthalmic nurse assistants

3.2.3 Douala Gynaecolo-Obstetric and Paediatric Hospital (DGOPH)

This hospital is strategically located in Yassa, not far from the highway on the way out of the city of Douala towards other major cities like Edéa and Yaoundé.

Its structural organization comprises:

- A reception room for patients which doubles as the room for visual acuity testing, automatic refractometry/keratometry and jet air tonometry/pachymetry.

- One room with two consultation units with slit lamps, A and B mode echography and a secretariat with a computer and printer.
- One room for fluorescein angiography/retinal photography
- One room for visual field testing doubling as the archive room for patient files
- One office for the ophthalmologists
- An ophthalmologic operating theatre

Its personnel consists of 3 ophthalmologists including the chief of service, 2 senior ophthalmic technicians and 2 ophthalmic nurse assistants

3.2.4 Douala Laquintinie Hospital (DLH)

The Douala Laquintinie hospital lies in the heart of Douala, in Akwa and the ophthalmology department shares the same space as the Dentistry and Ear, Nose and Throat (ENT) departments.

This department is equipped with:

- a large waiting room equipped with a TV for ophthalmology education videos while patients wait to be consulted in order of arrival
- A reception room doubling as an archive room
- A room with autorefraction/keratometry and tonometry/pachymetry
- A visual acuity and subjective correction room, a room for minor procedures
- Four consultation rooms
- A glass prescription room
- Two theatre rooms
- A changing room
- An office for the chief of service

Its human resource team includes 7 ophthalmologists, 8 specialized ophthalmic nurses, 1 ophthalmic nurse assistants, 1 refraction specialist and 1 glasses technician.

3.3 Study period and duration

The total study period from the research proposal drafting to final thesis lasted 13 months (October 1st 2021 – August 31st 2022) and the study duration from patient recruitment to final thesis was 8 months (January 1st 2022 – August 31st 2022).

3.4 Study population and sampling

3.4.1 Target study population

We targeted consenting patients diagnosed with macular oedema on fundoscopy or fluorescein angiography (FA) and confirmed with optical coherence tomography (OCT).

3.4.2 Inclusion criteria

- Patients of all ages diagnosed with macular oedema irrespective of aetiology, confirmed on OCT and who gave their consent

3.4.3 Exclusion criteria

- Poor OCT quality from unclear media
- Patients who refused to take part in the study

3.4.4 Sampling method

All patients with OCT-confirmed macular oedema were included in the study, whether followed up at any of the four hospitals or referred from some other hospital for macular OCT. A continuous sampling method was used.

3.4.5 Sample size

The minimum sample size (n) was determined using the Cochran's formula;

$\mathbf{n = z^2pq/d^2}$ where,

z – The standard normal variant at a 95% confidence level = 1.96

p – The prevalence of MO in diabetics. A previous hospital-based study carried out in Cameroon showed a prevalence of 10.6% [4]. We thus assumed p to be =10.6% = 0.106 = 0.11

q – Which is by definition 1-p = 0.894 = 0.89

d – The accuracy of the measurement = 0.05, then,

$n = (1.96)^2(0.11)\ (0.89)/\ (0.05)^2$

n = 150 eyes

We needed a sample size of at least 150 eyes for the study to be statistically significant. We thus assumed a sample size of **150 eyes**.

3.5 Study Procedures

Step 1. Administrative aspects

To carry out our study we obtained;

- Firstly ethical clearance from the Faculty of Medicine and Biomedical Sciences Institutional Review Board (FMBSIRB) at the University of Yaoundé I
- Then research authorizations from the Directors of the 2RMH, DGH, DLH and DGOPH
- Any other administrative requirements at the hospitals concerned as needed. Hospitals were informed about the need for their support in the implementation of this piece of work.

Step 2. Data collection tool preparation

- After completing the administrative procedures, the data collection format was pre-tested and validated.
- The primary researcher deposited copies of the data collection form at the different hospitals

The data collection form contained; sociodemographic data, past relevant ophthalmologic and medical history, clinical and paraclinical parameters (OCT), therapeutical parameters (medical, physical or surgical) and follow up clinical and paraclinical parameters

Step 3. Recruitment of participants

- We visited the hospitals involved on Mondays and Thursdays initially, then on Tuesdays and Fridays of each week during our study period to recruit volunteer MO patients. OCT examinations when needed were done on any of those days.

- These patients were either presented to us directly upon consultation by the ophthalmologist while we were there or we identified them from the patient files of already consulted patients.

- We worked with ophthalologists in the various hospitals who called or texted us on phone each time they received patients with macular oedema on days we were not present.

- We met with the patients available immediately, introduced ourselves, explained our study, examine consenting patients when possible then scheduled appointments with to be received at the 2RMH for cross sectional macular OCT.

- Patients we identitified from files and those we were informed about in our absence were contacted on phone, briefed about our study and scheduled to be received at the 2RMH for better explanation, examination and OCT if they consented.

- Patients were received in the reception room of the 2RMH. After introducing ourselves, we introduced the study to eligible participants with details on thenOCT examination procedure for those who had to get one. We explained the purpose of our study, the modalities of OCT (how it is performed, its harmless nature, how free it is and its benefits) and some different possible findings.

Step 4: Data collection

Data collection was carried out by the principal investigator and supervisors after validation of the research protocol issue of research authorizations. It was organized as follows:

- Identification: Number, telephone number, age, sex, occupation, marital status, residence.
- Ophthalmological history: cataract surgery, trauma, glaucoma, infection.
- General history: hypertension, diabetes, type of diabetes, duration of evolution, controlled or not, treatment type and co-morbidities (renal insufficiency, pregnancy).
- Clinical findings: - distance corrected visual acuity by Monoyer or Snellen's E chart at a distance of 5m, anterior segment evaluation and intraocular pressure.
  - Visual acuity was classified according to the WHO international classification of diseases (ICD) [91] as seen below;

Table I: WHO-ICD classification of visual acuity

Visual acuity range	WHO-ICD classification
0.05	blindness
[0,05-0,1[	severe visual impairment
[0,1-0,3[	moderate visual impairment
[0,3-0,5[	mild visual impairment
≥0,5	no visual impairment

- Pupils were dilated by instillation of tropicamide 0.5% eye drops every five minutes until dilation. Then

- Funduscopy findings from fundus examination performed with a slit lamp and 90D Superfield Volk lens
- OCT findings from dilated OCT examination.

  We used the Cirrus Zeiss HD SD-OCTin our study, with an axial resolution of 5 μm.

The procedure for OCT acquisition was as follows;

- The patient was seated comfortably in front of the examination side of the machine, with the chin resting on the chin rest, the forehead leaning forward on the head rest and height of the examination table adjusted to suit the patient.
- After the patient settled in, the macular cross-sectional OCT was performed. The macular cube 518 × 200-scan pattern program was used and the software set to capture a 6 mm diameter macular retinal thickness map centered on the fovea to cover the nine Early Treatment Diabetic Retinopathy Study (ETDRS) areas. The areas are located in three rings of 1, 3, and 6 mm diameters. The 1 mm ring covers the central fovea and the para-foveal area. In contrast, the other rings are located 3 and 6 mm from the 1 mm diameter ring. Each ring is divided into four quadrants that are described as superior, inferior, temporal, and nasal.

- Macular thickness was measured using radial slices and quantitative analysis was performed using the macular mapping software, which automatically calculates the mean value of macular thickness in different sectors of the ETDRS macular grid.

The normal retinal tissue has different reflectivity patterns on OCT. The nerve fibres and the retinal pigment epithelium display high reflectivity. The plexiform and the nuclear layers display medium reflectivity. The photoreceptors display low reflectivity [92].

Macular oedema was suggested by:

- central 1mm macular thickness (CMT) higher than our reference value of 250μm [46]
- increased paracentral or pericentral thickness evidenced by its colour on OCT colour mapping

Definition of operational terms

We closely examined each OCT for other characteristics (CSMO or not, cystoid, diffuse or not, SRF or not, epimacular membrane or not) and fine details (layers involved, hyperreflective foci, vitreomacular traction, parafoveal cysts). We defined the different OCT characteristics as below.

Cystoid MO was characterized by cystoid spaces formed in the vicinity of the outer plexiform layer and diffuse oedema by a diffuse thickening. When both were present it was defined as mixed.

Center-involved MO: MO that involves the central subfield zone (1 mm in diameter)

Epimacular membrane (EMM): hyperreflective layer often irregular overretina inner surface [93].

Ellipsoid zone (EZ): formerly known as the inner/outer segment of PRs (IS/OS) and is the second hyper-reflective band from below on a retina optical coherence tomography (OCT) image (94)].

Hyperreflective foci (HRF): small, punctiform hyperreflective lesions, visible on linear OCT scans in the retina with similar relectivity to the retina nerve fibre layer and considered to correspond to extravasated lipoproteins and/or proteins [95].

Pigment epithelial detachment (PED): well-demarcated, abrupt elevations of the RPE with a homogenously hyporeflective sub-RPE space [96].

Parafoveal cyst (PFC): cystic spaces (hyporeflective enclosed spaces) directly underneath or just adjacent to the fovea

Posterior vitreous detachment (PVD): hyperreflective membrane of the posterior hyaloid observed overlying the internal limiting membrane part of which could or could not still be attached to the macula. It could cause elevation of the macular attached to it with resultant hyporeflective area in the subretinal space which we defined as tractional retinal detachment (TRD). Elevation from traction was termed posterior hyaloid traction (PHT) and characterized vitreomacular traction (VMT). We could thus have PHT with or without TRD.

Hyporeflectivity from fluid in the subretinal space was noted as subretinal fluid (SRF) and classified as serous retinal detachment (SRD) when there was no PHT.

The RPE integrity was considered conserved when its hyperreflective band had no discontinuity or distortions.

Macular oedema was broadly classified according to its morphological patterns on OCT into five categories namely; diffuse retinal thickening (DRT), cystoid macular oedema (CME), serous retinal detachment (SRD), posterior hyaloid traction (PHT) without tractional retinal detachment (TRD) and PHT with TRD [12].
A change in central macular thickness was considered to be clinically significant when this change was greater than or equal to 20% of its initial thickness based on a previous study of reference [97].

Clincally-significant MO (CSMO) was defined by any of the following:

- retinal thickening at or within 500 μm of the center of the macula
- hard exudates at or within 500 μm of the center of the macula, if associated with adjacent retinal thickening

- or a zone or zones of retinal thickening one disc area in size, at least part of which is within one disc diameter of the center of the macula [13].

Step 5. Dismissal of participants

The analysis and interpretation of the macular OCT were printed, handed to the patients and recorded on the patient's prefilled form.

3.5 Data management and analysis

Excel 2013 and Epi Info version 7 were used for data processing and analysis.

Categorical variables were expressed as frequency and number. Quantitative variables were expressed as mean ± standard deviation and median.

The Chi-square test was used to compare the categorical variables and the calculation of the Odds ratio with its confidence interval. P-values <0.05 were considered statistically significant

The linear correlation Pearson test was used to compare quantitative variables.

The p-value set at the 5% threshold allowed us to obtain the different significant associations.

Ethical Considerations:

- The tenets of the Declaration of Helsinki [98] were followed
- The study was carried out only after administrative and ethical clearances had been issued
- The data collection forms were anonymous with no use of participant’s names to ensure health confidentiality of the patient.

3.7 Expected outcome

The study is expected to provide information on the epidemiological, clinical and therapeutical characteristics of macular MO. We later look forward to;

- Its dissemination
- Public presentation at the Faculty of Medicine and Biomedical Sciences (FMBS)
- Its deposit at the library for archives after correction and its eventual publishing

CHAPTER IV: RESULTS

IV.1 STUDY POPULATION

IV. 1.1 General study population

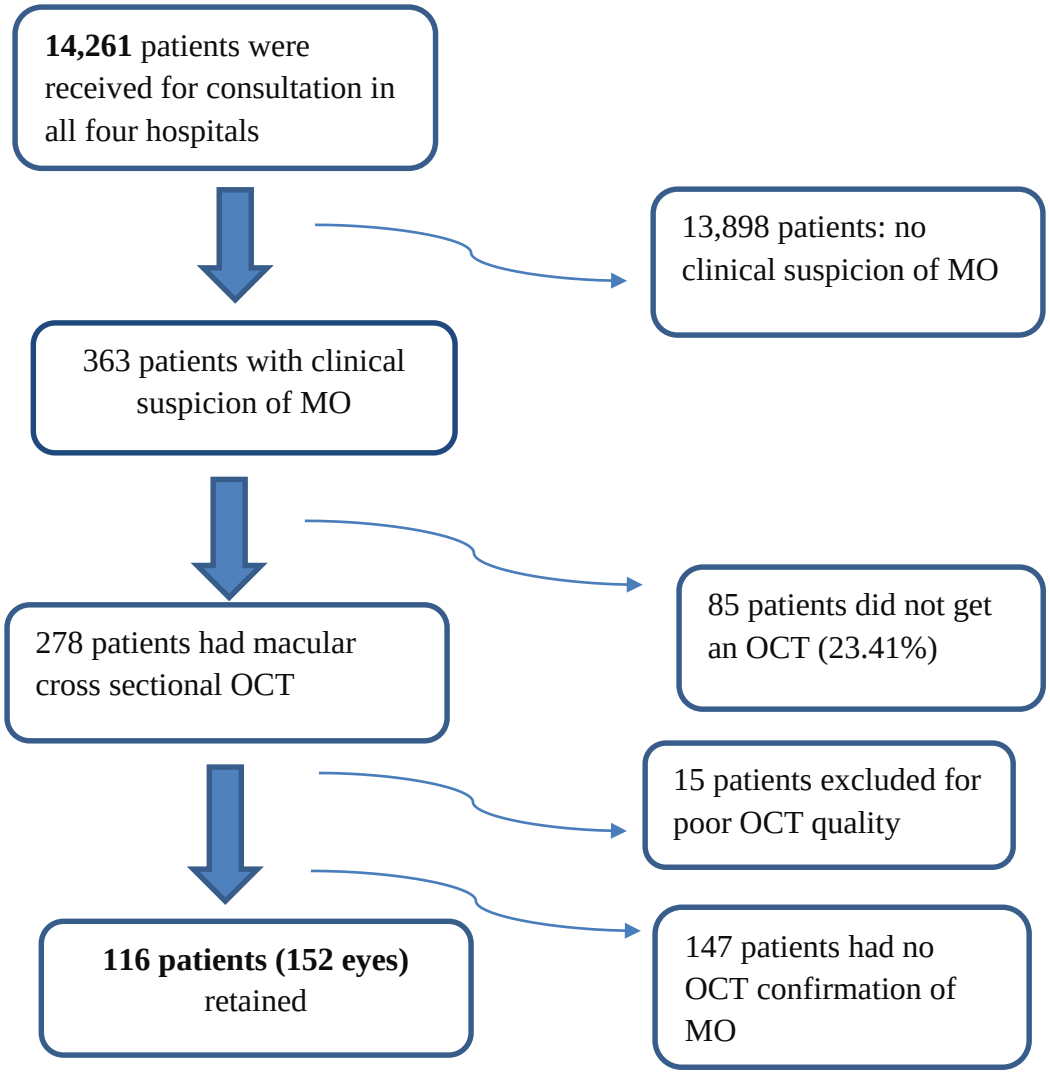


Figure 14. Patient flow

We retained 152 eyes from 116 patients for our study from the OCT examinations carried out during our study period. We eliminated 23 and 164 eyes for poor OCT quality and abscence of macular oedema respectively.

IV.1.2 Study population by hospital

We had varying number of consultations at the different hospitals as well as varying prevalences of suspected and confirmed MO rainging from 0.95%-5.38% and 0.20%-3.21% respectively.

Table II. Study population distribution by hospital

Hospital	Consultations	Clinical suspicion of macular oedema (patients)	Confirmed macular oedema (patients)
2RMH	1,653	89 (5.38%)	53 (3.21%)
DGH	3,022	92 (3.04%)	41 (1.36%)
DGOPH	1,238	18 (1.45%)	5 (0.40%)
DLH	8,348	79 (0.95%)	17 (0.20%)
Total	14,261	278 (1.95%)	116 (0.81%)

IV.2 DEMOGRAPHIC DATA FOR MACULAR OEDEMA PATIENTS

IV.2.1 Prevalence of macular oedema

We received a total of 14,261 patients amongst which 116 had confirmed macular oedema thus a prevalence of 0.81 %. Diabetic MO was recorded in 43 of 461 diabetic patients thus a prevalence of 9.33 %.

The total number of men, women and chidren below 16 years received was 3,207, 4,807 and 6,247 respectively.

The number of men, women and children below 16 years with MO was 52, 59 and 3 respectively.

The prevalence of MO among men, women and chidren below 18 was thus 1.62%, 1.23% and 0.05% respectively.

IV.2.2

Sex distribution of macular oedema patients

Our MO population had a majority of women with 52.59 % (n=61) against 47.41% (n=55) for men with a sex ratio of 0.90

Table III. Sex distribution of our study population

Sex	Frequency (n=patients)	Percentage (%)
F	61	**52.59**
M	55	47.41
Total	**116**	**100,00**

IV.2.3 Age

We had a mean age of 54.87 ± 1.57 years with extremities of 8 and 85 years. The most prevalent age ranges were those of ≥ 60 years at 51.72 % (n=60) followed by [41-60[years at 30.17 % (n = 35) respectively

Table IV. Age distribution of participants

Age (years)	Frequency (n=patients)	Percentage (%)
≤ 20	7	6.03
[21-40[	14	12.07
[41-60[	35	**30.17**
≥ 60	60	**51.72**
Total	116	100%

IV.3 CLINICAL AND PARACLINICAL CHARACTERISTICS

IV.3.1 Reasons for consultation

Most eyes with macular oedema (87.50 %) were seen at the ophthalmologic unit because they presented symptoms of decreased visual acuity while < 20% of eyes were diagnosed upon referral to ophthalmology by another specialty for fundus examination.

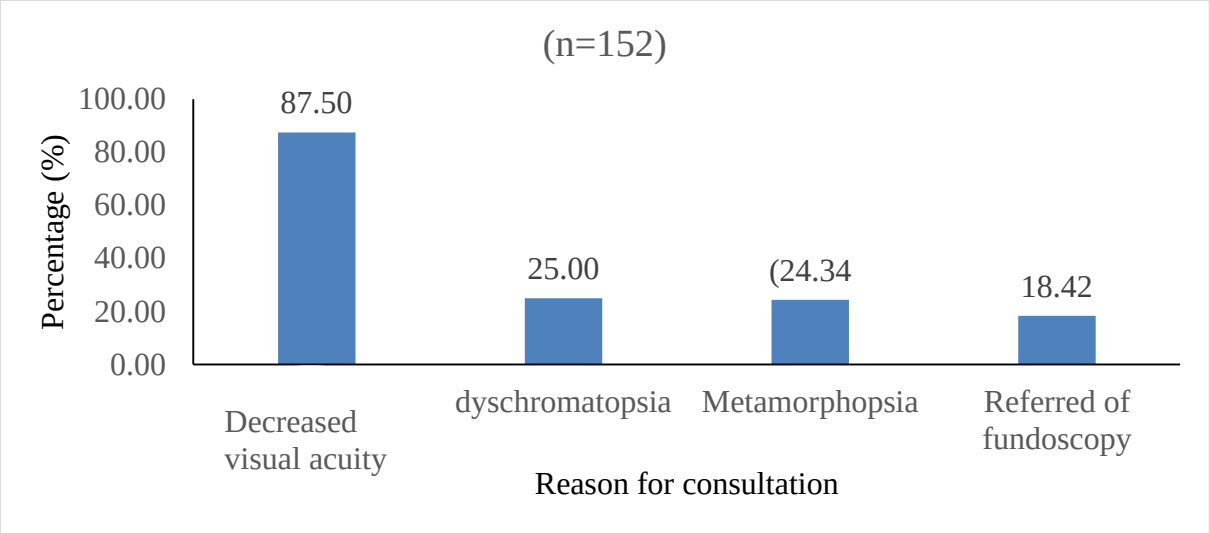


Figure 15. Reasons for ophthalmologic consultation

IV.3.2 Relevant past history

Over three quarters (87.50%) of participants had a contributory past history, most of which was general with diabetes mellitus being most prevalent (73.68 %). Hypertension was present in 39.10% and mostly moderate grade. A majority of all participants (72.93%) and almost all diabetic participants had type 2 diabetes. Most of the diabetic patients (84.69%) had poor glycaemic control. The most common ophthalmologic past history was that of surgery (5.26 %).

Table V. Relevant past history

Past history	Frequency (n=patients)	Percentage (%)
Ophthalmological	16	12.03
glaucoma	2	1.50
trauma	5	3.76
surgery	6	5.26
General		
Hypertension	37	39.10
Diabetes	**69**	**73.68**

IV.3.4 Number of eyes involved

Most participants (68.97%) had MO in just one of their eyes with fewer of them presenting with MO in both eyes.

Table VI. Laterality of eye involvement

Laterality	Frequency (n=patients)	Percentage (%)
Bilateral	36	31.03
Unilateral	80	68.97
Total	**116**	**100,00**

IV.3.5 Eyes (s) involved

The left eye was implicated more frequently (56.58%) than the right eye with respect to macular oedema

Table VII. Eye (s) involved

Eyes involved	Frequency (n=eyes)	Percentage (%)
LE	86	56.58
RE	66	43.42
Total	**152**	**100.00**

IV.3.6 Visual acuity measurement

Most eyes were visually impaired (57.24%) with the most common visual impairment visual acuity range of [0.1-0.3[with a 25.66% prevalence. Most eyes thus had moderate visual impairment according to the WHO International Classification of Disease (ICD) for visual impairment (see table VIII).

Table VIII. Visual acuity ranges

FVA	ICD	Frequency (n=eyes)	(%)
<0,05	blindness	11	7,24
[0,05-0,1[	severe VI	15	9,87
[0,1-0,3[	**moderate VI**	**39**	**25,66**
[0,3-0,5[	mild VI	33	21,71
≥0,5	no VI	54	35,53
Total		**152**	**100**

57.24

IV.3.4 Fundoscopy findings

Macular hard exsudates were the most common fundoscopic finding in eyes with MO, accounting for 51.97 % of fundoscopy findings.

Table IX. Fundus findings

Fundus findings	Frequency (n=eyes)	Percentage (%)
Macular hard exsudates	**79**	**51.97**
Elevated macular	54	35.53
Macular haemorrage	41	26.97
papilloedema	8	5.26

FINDINGS OF CROSS-SECTIONAL MACULAR OCT EXAMINATION

IV.3.5 Central macular thickness for all eyes

The mean CMT was 334.22 ± 10.40µm with extremities of 44 to 1074 µm and a median value of 303µm. Most eyes (78.95%) had CMT greater than our normal reference value of 250µm signifying centrally-involved MO that is, involving the central 500µm. The rest of the eyes thus had either paracentral or pericentral oedema. Most eyes had CSMO.

Table X. Central macular thichness distribution

CMT (µm)	Frequency (n=eyes)	Percentage (%)
≤ 250	32	21.05
> 250	120	78.95
Total	**152**	**100**

Table XI. Clinically significant macular oedema

Clinical significance of MO	Frequency (n=eyes)	Percentage (%)
CSMO	**103**	**67.76**
Non-CSMO	49	32.24
Total	**152**	**100**

IV.3.6 OCT classification of MO

The most common morphological pattern of MO observed on cross-sectional macular OCT was diffuse retinal thickening (48.68%) followed by cystoid macular oedema (38.16%). The least frequent pattern was that of posterior hyaloid traction with tractional retinal detachment (1.97%).

Table XII. Classification of macular oedema by OCT morphological pattern

Fundus findings	Frequency (n=eyes)	Percentage (%)
Diffuse retinal thickening	**74**	**48.8**
Cystoid macular oedema	58	38.16
Serous retinal detachment	53	34.87
PHT without TRD	21	13.82
PHT with TRD	3	1.97

PHT = posterior hyaloid traction TRD = tractional retinal detachment

IV.3.7 Associated signs on OCT

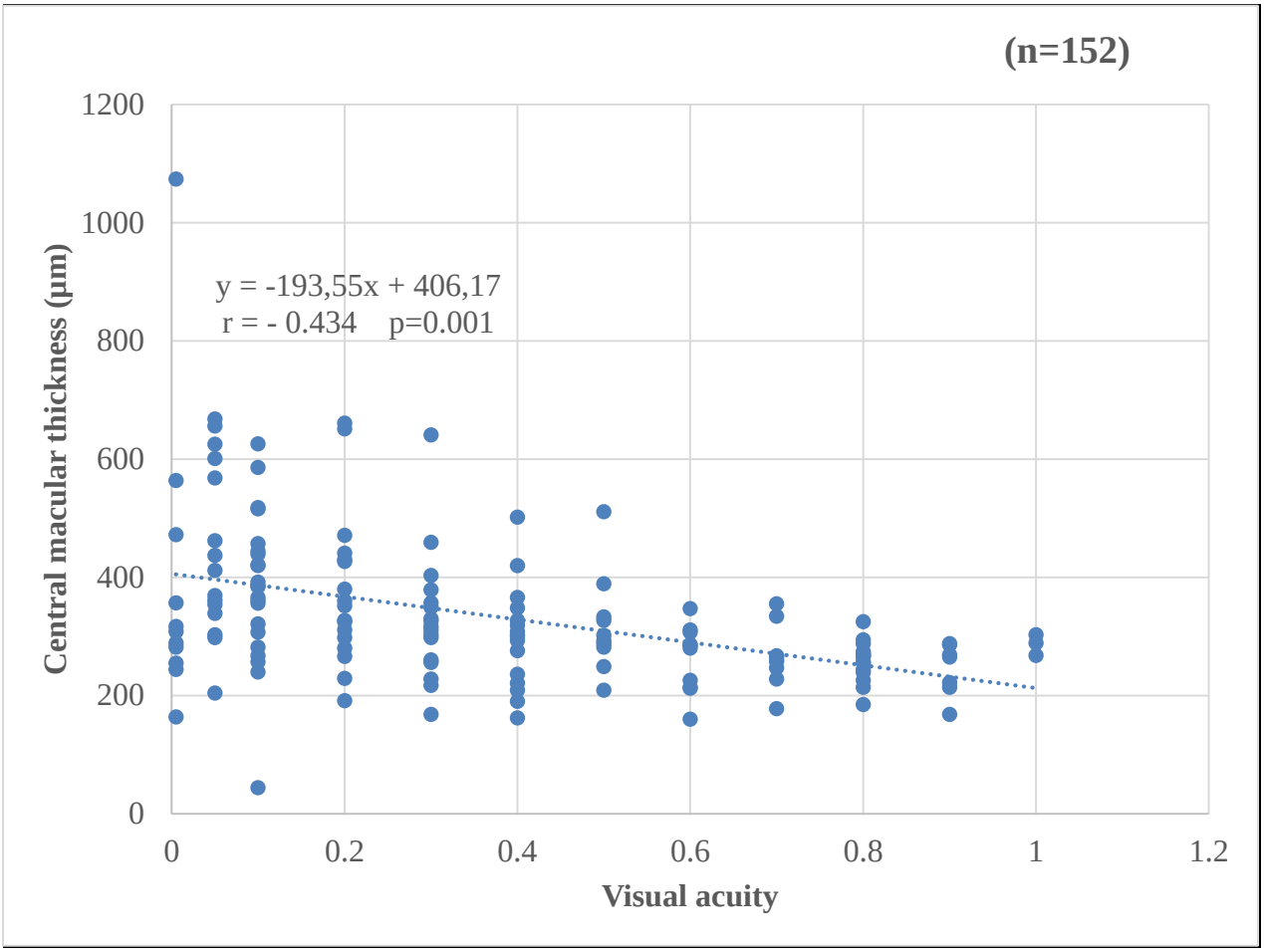
We noted a range of other signs associated with macular oedema on OCT, dominated by hyperreflective foci (HRF) (56.58%). The next 3 positions of most common signs in descending order were occupied by parafoveal cyst (PFC) (49.34%), epimacular membrane (EMM) (35.53%), and posterior vitreous detachment (PVD) in the fourth position (34.87%).

Table XIII. Associated signs on OCT

OCT sign	Frequency(n=eyes)	Percentage (%)
hyperreflective foci	**86**	**56,58**
parafoveal cyst	75	49,34
epimacular membrane	54	35,53
posterior vitreous detachment	53	34,87
Macular folds	30	19,74
RPE intergrity lost	14	9,21
pigment epithelial detachment	7	4,61

IV.3.8 Macular thickness and visual acuity

There was a statistically significant negative correlation between VA and CMT



IV.3.9 Aetiologies of MO

Diabetes was the leading cause of MO (57.24%) followed by RVO (9.21%) and uveitis (6.58%).

Table XIV. Pathologies associated with MO

Aetiologies	Frequency (n=eyes)	Percentage (%)
DMO	87	**57,24**
RVO	14	9,21
uveitis	10	6,58
MH	9	5,92
hypertensive maculopathy	8	5,26
VMTS	5	3,29
idiopathic	4	2,63
post-surgical (Irvine Gass syndrome)	4	2,63
CSCR	3	1,97
EMM	3	1,97
ARMD	2	1,32
Trauma (Berlin's oedema)	1	0,66
choroidal mass	1	0,66
retinitis Pigmentosa	1	0,66
Total	**152**	**100,00**

DMO=diabetic macular oedema RVO=retinal veinous occlusion MH=macular hole
VMTS=vitreomacuar traction syndrome IG=Irvine gass CSCR=central serouc chorioretinopathy
EMM=epimacular membrane ARMD=age-related macular degeneration

IV. 3.10 DMO, RVO, uveitis and OCT signs

In diabetic macular oedema hyperreflective foci, parafoveal cyst and posterior vitreous detachment were the most common OCT signs.
In retinal venous occlusion parafoveal cyst and epimacular membrane were most common
In uveitis hyperreflective foci, parafoveal cysts, subretinal fluid and epimacular membrane were most common.

Table XV. DMO, RVO, uveitis and OCT signs

OCT signs	DMO	%	RVO	%	Uveitis	%
EMM	20	22.99	**6**	**42.86**	**5**	**50.00**
Macular folds	10	11.49	4	28.57	2	20.00
Hyperreflective foci	**39**	**44.83**	5	35.71	**6**	**60.00**
PED	0	0.00	0	0.00	1	10.00
Parafoveal cyst	**25**	**28.74**	**11**	**78.57**	**6**	**60.00**
PVD	**25**	**28.74**	5	35.71	1	10.00
Subretinal fluid (SRD)	15	17.24	5	35.71	**5**	50.00

SRD = serous retinal detachment

CHAPTER V: DISCUSSION

We had as objectives of this study to describe the epidemiological aspects of MO, determine its presentation on clinical examination and describe its characteristics on OCT examination.

V.1. LIMITATIONS OF OUR STUDY

Almost a quarter (23.41%) of patients with clinical suspicion of MO did not show up too for OCT examination and thus could not have confirmation of MO. This could be the reason for the low prevalence of MO in this study.

V.2. SOCIODEMOGRAPHIC CHARACTERISTICS

Our study population had a female predominance of 52.59 %. Similar results were recorded in previous studies of MO in Cameroon [37]. However, male predominances were reported in studies in some neighbouring African countries including Togo and Ivory Coast [39,40]. The place of study and methodology can justify this difference.

The prevalence of MO in general was 0.81%. The total number of men, women and chidren below 16 received was 3,207, 4,807 and 6,247 respectively. The number of men, women and children below 16 years with MO was 52, 61 and 3 respectively.The prevalence of MO among men, women and chidren below 18 was thus 1.62%, 1.23% and 0.05% respectively.
The lowest prevalence in children is expected as they have fewer age-related risk factors. We found no previous studies of MO prevalence in general to compare with. These values however, serve as a basis for further studies and evaluations. The prevalence of MO varied between the different hospitals from 0.2% at the DLH which was the least, to 3.21% at the 2RMH which was the highest. This large variation could be explained by the fact that the OCT examaination was carried out at the 2RMH and it was easier for a patient already received at that hospital to accept to have it carried out, than for one from another hospital. This least prevalence in DLH could additionally be explained by the fact that consultations are cheapest there, and they have relatively many ophthalmologists thus they received the highest number of consultations.

Our participants' ages ranged from 8 to 85 years with a mean age of 54.87±1.57 years. The most prevalent age ranges were those of ≥ 60 years at 51.72 % followed by 41-60 years at

30.17 % .This result is similar to that recorded by Koki et al. in a study in 2015 on DMO where they recorded a mean age of 54.73±6.72 years and another study in Ethiopia with 54.71 ±13.66 years [36]. This can be explained by the fact that age ≥ 50 years is a risk factor for some general and ophthalmologic pathologies including hypertension, diabetes mellitus, dyslipidaemia, RVO and ARMD which all predispose to MO.

The prevalence of DMO among diabetic patients was 9.33 %. This value was a little lower than that recorded by Koki et al. in a study in 2010 where they had a 10.6% prevalence [99]. This difference could be explained firstly by the fact that their study was carried out only on diabetic patients. Our study on the other hand included all patients with MO irrespective of aetiology. Koki et al. in 2010 thus had a greater chance of diagnosing DMO amongst diabetic patients. In addition, their diagnosis of MO was done only by FA which could lead to over diagnosis of MO. This is explained by the fact that the OCT examination which is what we used for diagnosis in our study could eliminate cases of angiographic macular leakage which had no corresponding macular thickening fitting the definition of MO [1].
Our value was greater than the global prevalence of 6.8% [2] as well as the prevalence in the US [100]. These could be explained by differences in methodology. The global estimate was based on population studies and just for 40 years and above while the US study too considered a 20 -70 year age range, among other differences.

Considering aetiologies, we recorded a 57.24% prevalence of DMO among MO patients. This prevalence in our study is much higher than the prevalence of 25.60% recorded in Togo in 2016 and slightly higer than the 47.91% prevalence recorded in Ivory Coast in 2020. The lower values in these studies compared to ours may be due to the fact that we considered the whole 5.5mm diameter macular area in our study and had parafoveal and perifoveal cases while they studied just central-involving macular oedema. The Togo study also used a different type of OCT which could further contribute to the difference. This is because it uses an external limit a little shallower than the external limit used by Cirrus Zeiss OCT for measuring macular thickness [101].

The prevalence of retinal vein occlusion in our study population was 9.21%, lower than the 17.1% recorded by Amedome et al [39]. An explanation for this lower prevalence could be the relatively higher ages of participants in his study population demonstrated by a higher mean age

(61.9±10.6 years) as opposed to ours (54.87±17.05 years) . This is because the risk for retinal vein occlusion increases with age as there is a higher chance for the presence of cardiovascular risk factors [102].

V.3 CLINICAL DATA

Symptoms of defective vision were most common reasons for consulting ophthalmology in our study population (87.50 %) with < 20 % seen for referrals for fundoscopy from other specialties. Decreased vision has been the major presenting complain recorded in previous studies of patients with MO [39,40]. This is expected given that the macula is the most sensitive part of the retina, responsible for fine vision.

Diabetes mellitus was present in 73.68 % and hypertension in 39.10 % of participants most of which was of moderate grade. Similar findings on MO studies have been reported (39,40)]. This can be explained by the fact that these are risk factors for the development of MO, especially diabetes mellitus.

Most participants (68.97 %) had MO in just one of their eyes with the other eye spared. Coulibaly et al. in 2020 in Ivory Coast also had majority unilateral involvement with 58.33%. A study on the impact of unilateral and bilateral MO on the vision-related quality of life (VRQoL) in individuals with type 2 diabetes (T2D) was carried out in 2016 in Singapor. This study recorded significant decrements in VRQoL that occurred with unilateral DMO (11%), but which worsened when both eyes were affected (22%). They thus suggest that interventions to prevent the onset of MO in the second eye are strongly recommended to significantly reduce the bilateral impact of these conditions on VRQoL [103]. This information should indicate the need for eye practitioners all over to reinforce their approach to managing patients with unilateral MO in this regard.

The left eye was affected with MO more frequently than the right eye with a 56.58 % prevalence. Waheed et al. in a study in 2003 suggest that eye dominance may be an important determinant of the visual handicap suffered by patients with unilateral full thickness macular hole (FTMH) and macular holes have been described as one of the aetiologies of MO. However, we

are not aware of any previous studies relating symptomatic visual handicap to disease laterality and/or ocular dominance with respect to MO in general [104,105].

The most common fundus finding was hard exsudates (51.97%). This supports studies which show that hard exsudates are common in MO [107]. This value was however higher than the 20.6% recorded in the US [107], and could be due to the fact that the later study used retinal photography to detect hard exsudates and could under diagnose them.

The most prevalent VA range for visual impairment was the [0.1-0.3[with a 25.66% prevalence. Most eyes in our study were thus visually impaired with a total visual impairment prevalence of 57.24%. Amedone et al. had a range from 0.05-0.3 as most prevalent. This could be due to the fact that all their cases of MO were centrally invoving MO as opposed to ours where we considered even non centrally involing MO. The low VA in all these studies are in line with the fact the macular is responsible for fine vision so its pathologies likely would decrease VA.

V.4 PARACLINICAL DATA

The mean CMT was 334.22 ± 10.40 μm with extremities of 44 to 1074 μm. Our result for mean CMT was higher than that recorded in Togo [34] but higher than that in France [109]. The difference with the Togo study could be explained by the fact that they used the Topcon OCT which measures retinal thickness from the IML to the OS/RPE junction as opposed to our Cirrus OCT which measures from the ILM to the RPE itself [109]. Our Cirrus OCT thus records higher retinal thickness for corresponding points compared to the Topcon OCT.

We had 67.76 % of CSMO. Diffuse retinal thickening was present in majority (48.68%) of eyes and constituted the most frequent cross-sectional OCT morphological pattern of MO in our study population. The other patterns in descending order were cystoid macular oedema, serous retinal detachment, posterior hyaloid traction without tractional retinal detachment and posterior hyaloid traction with retinal detachment respectively. Our order of descending frequency of these five morphological patterns is exactly identical to our reference study with respect to this morphological classification carried out by Kim et al. [12]. This similarity could be explained by the fact that our study population had majority diabetic patients and the study by Kim et al. was

solely on diabetic MO. The MO patterns on OCT could thus be a reflection of what is expected in MO in diabetic patients. Central-involved MO (CIMO) was predominant with 66.45 %.

Other signs associated with macular odema on OCT were dominated by hyperreflective foci (HRF) at 56.58%. The next 3 common signs were parafoveal cyst (49.34%), epimacular membrane (35.53%) and PVD at 34.87%. These signs have been reported to contribute to the prediction of visual outcome in some studies [92,110].

V.5 AETIOLOGIES

Diabetes was the leading cause of MO (57.24%) followed by RVO (9.21%) and uveitis (6.58%). Our results are in line with many other studies with leading prevalence of DMO [2,39,40,100] A study in Togo recorded 25.6% prevalence and another in Ivory Coast, 47.91%. This is expected given that diabetes is one of the most common pathologies now with increasing sedentary lifestyle and an ageing population. Diabetes has also been known to be a frequent cause of macular oedema and we found it is a similar finding in our setting.

A large (84.69%) majority of the diabetic participants had poor glycaemic control according to their glycated haemoglobin values. Koki et al. had similar results with an 86.96% prevalence of poor glycaemic control. This factor has been proven to contribute to poor visual outcome of treatment in patients with DMO (41,100,111)].

These studies also had retinal vein occlusion among the top three causes of MO, still supporting our argument that the ages of our partcipants predispose to cardiovascular risk factors.

V.6 CORRELATIONS

There was a statistically significant negative correlation between VA and CMT (p=0.001) with a Pearson coefficient of -0.434. This was a similar finding to that recorded by Haller et al in 2006 [112]. Islam et al recorded similar findings in Pakistan as well. However, they noted from various other studies that a variable correlation exists between macular thickness and VA thus, many other factors need to be considered. These might range from unrecognized macular ischemia and macular microcirculation to duration of MO [113].

In diabetic macular oedema hyperreflective foci, parafoveal cyst and posterior vitreous detachment were the most common OCT signs.
In retinal venous occlusion parafoveal cyst and epimacular membrane were most common
In uveitis hyperreflective foci, parafoveal cysts, subretinal fluid and epimacular membrane were most common.

Catier et al. did not find any statistically significant difference in visual acuity when subretinal fluid was present in macular oedema. They also found subretinal fluid more common in retinal vein occlusion than in all other aetiologies as opposed to our study in which it was among the most common sign in uveitis [107]. Badaro et al. however had some findings similar to ours. These include a negative correlation between central macular thickness and visual acuity and high hyperreflective foci presence in diabetic macular oedema [79].
It is thus important to identify these signs to help our management and follow up decisions.

CONCLUSIONS

With respect to our specific objectives, which were; to determine the hospital-based prevalence of MO among patients in Douala, identify its clinical characteristics and determine its causes in our setting, we could draw the following conclusions:

- The hospital-based prevalence of MO in general in Douala is 0.81% and that of DMO among diabetic patients 9.33%.

- The mean age of patients with MO is 54.87±1.57 years and MO is slightly more common in females. The most common fundoscopy sign in MO is the presence of hard exsudates.
  The mean CMT in MO is 334.22 ± 10.40 μm. There is a negative correlation between CMT and visual acuity in MO. Some OCT findings like hyperreflective foci, subretinal fluid and parafoveal cysts are common depending on the aetiology of MO and may influence visual acuity.

- The main causes of MO are diabetes, RVO and uveitis with varying clinical and paraclinical presentations.

Our conclusion statement is that this study empowers us with objective information on the disease burden and the state of affairs with respect to the clinical aspects of macular oedema. This information should help us tailor our approach to diagnosing and managing these patients and serve as a basis for further research.

RECOMMENDATIONS

At the end of this study we make the following recommendations:

- To ophthalmologists

To have a very low threshold for performing macular OCT examination for diabetic patients especially those with poorly controlled diabetes.

To properly counsel patients and the community at large on the risk factors of MO.

To conduct further studies on the therapeutical aspects of macular oedema inorder to guide the management approach in our setting.

- To diabetologists / Internists / General practitioners

To systematically refer diabetic patients to the ophthalmology unit for follow up.

- To the patients

To actively take part in management of their own eye health and general health by adequately following the instructions and advice of their health care providers as well as doing regular check ups.

To avoid delays and consult their doctors immediately they experience abnormal symptoms.

To make it a routine to consult the ophthalmologist at least every year if they suffer from chronic diseases like diabetes or hypertentension.

REFERENCES

1. Creuzot-Garcher C, Société Française d'Ophtalmologie. Oedèmes Maculaires: rapport SFO 2016.

2. Yau JWY, Rogers SL, Kawasaki R, Lamoureux EL, Kowalski JW, Bek T, et al. Global Prevalence and Major Risk Factors of Diabetic Retinopathy. Diabetes Care. 2012; 35 (3):556–64.

3. Rogers S, McIntosh RL, Cheung N, Lim L, Wang JJ, Mitchell P, et al. The Prevalence of Retinal Vein Occlusion: Pooled Data from Population Studies from the United States, Europe, Asia, and Australia. Ophthalmol. 2010; 7(2):313-9.

4. Rothova A, Schulten MSS van, Treffers WF, Kijlstra A. Causes and Frequency of Blindness in Patients with Intraocular Inflammatory Disease. Br J Ophthalmol. 1996; 80 (4):332–6.

5. Oluleye TS, Babalola YO, Majekodunmi OI, Ijaduola MA. Macular diseases in Ibadan, Nigeria. Niger J Clin Pract. 2021; 24(3):341–4.

6. Koki G, Billong Y, Epee E, Nga Ntouni N, Ella GP, Dohvoma VA, et al. Œdèmes Maculaires du Diabétique au Cameroun : Quelle Solution Thérapeutique Apporte L'injection Intra Vitréenne D'acétonide de Triamcinolone ? Rev SOAO. 2015; 12: 50–7.

7. Jivraj I, Ng M, Rudnisky CJ, Dimla B, Tambe E, Nathoo N, et al. Prevalence and Severity of Diabetic Retinopathy in Northwest Cameroon as Identified by Teleophthalmology. Telemed J E Health. 2011; 17(4):294–8.

8. Koki G, Bella AL, Nomo AF, Eballé AO, Epée E, Ella GP, et al. La Photocoagulation au Laser dans un Centre de Prévention et de Prise en Charge de la Rétinopathie Diabétique au Cameroun. Health Sci Dis. 2015; (16) 1

9. Khurana AK. Comprehensive Ophthalmology. 6th Ed. 2015.

10. Kozak I, Morrison VL, Clark TM, Bartsch DU, Lee BR, Falkenstein I, et al. Discrepancy between Fluorescein Angiography and Optical Coherence Tomography in Detection of Macular Disease. Retina. 2008; 28(4):538–44.

11. Cunha-Vaz J, Coscas G. Diagnosis of Macular Edema. Ophthalmologica. 2010; 224 (Suppl. 1):2–7. Doi: 10.1159/000315156

12. Kim BY, Smith SD, Kaiser PK. Optical Coherence Tomographic Patterns of Diabetic Macular Edema. Am J Ophthalmol 2006; 142(3):405-412.e1.

13. Photocoagulation for Diabetic Macular Edema. Early Treatment Diabetic Retinopathy Study Report Number 1. Arch Ophthalmol. 1985; 103(12):1796–806.

14. Wong TY, Sun J, Kawasaki R, et al. Guidelines on Diabetic Eye Care: The International Council of Ophthalmology Recommendations for Screening, Follow-up, Referral, and Treatment Based on Resource Settings. Ophthalmology. 2018; 125(10):1608-1622.

15. Bekerman I, Gottlieb P, Vaiman M. Variations in Eyeball Diameters of the Healthy Adults. J Ophthalmol. 2014; 2014:503645.

16. Board PATE. Anatomy of the eye. [Internet] National Cancer Institute (US); 2021

17. Pradeep T, Mehra D, Le PH. Histology, Eye. [Internet] StatPearls Publishing; 2021

18. Team HJ. Human Eye Anatomy - Parts of the Eye and Structure of the Human Eye. [Internet] Health Jade. 2017

19. Stone WL, Patel BC, Basit H, Salini B. Retinopathy. [Internet] StatPearls Publishing; 2021

20. Parthopratim DM. eOphtha. Anatomy of Retina. [Internet] 2021

21. Bringmann A, Syrbe S, Görner K, Kacza J, Francke M, Wiedemann P, et al. The Primate Fovea: Structure, Function and Development. Prog Retin Eye Res.2018; 66:49–84.

22. Bahill A. Multimodal Views of the Human Retina. Ophthalmology Research: An International Journal2014; 2(3):121–36.

23. Germain F, Pérez-Rico C, Vicente J. Functional Histology of the Retina. 2010; 12.

24. Rehfeld A, Nylander M, Karnov K. The Eye. In: Rehfeld A, Nylander M, Karnov K, editors. Compendium of Histology: A Theoretical and Practical Guide: Springer International Publishing; 2017. p. 603–38.

25. Nguyen KH, Patel BC, Tadi P. Anatomy, Head and Neck, Eye Retina. In StatPearls. StatPearls Publishing; 2021.

26. Campbell JP, Zhang M, Hwang TS, Bailey ST, Wilson DJ, Jia Y, et al. Detailed Vascular Anatomy of the Human Retina by Projection-Resolved Optical Coherence Tomography Angiography. Sci Rep. 2017; 7(1):42201.

27. Park JJ, Soetikno BT, Fawzi AA. Characterization of the Middle Capillary Plexus Using Optical Coherence Tomography Angiography in Healthy and Diabetic Eyes. Retina. 2016; 36 (11):2039–50.

28. Chen L. Ocular Lymphatics: State-Of-The-Art Review. Lymphol. 2009; 42 (2):66–76.

29. Sampson DM, Dubis AM, Chen FK, Zawadzki RJ, Sampson DD. Towards Standardizing Retinal Optical Coherence Tomography Angiography: A Review. Light Sci Appl. 2022; 11 (1):63.

30. Nickla DL, Wallman J. The Multifunctional Choroid. Prog Retin Eye Res. 2010; 29 (2):144–68.

31. EyeRounds.org. Atlas Entry - Normal fundus - adult. [Internet] 2019.

32. Mac Grory B, Schrag M, Biousse V, Furie KL, Gerhard-Herman M, Lavin PJ, et al. Management of Central Retinal Artery Occlusion: A Scientific Statement from the American Heart Association. Stroke. 2021; 52(6):e282–94.

33. Ludwig PE, Jessu R, Czyz CN. Physiology, Eye. InStatPearls. StatPearls Publishing. 2021.

34. Cunha-Vaz J. The Blood–Retinal Barrier in Retinal Disease. Euro Ophthalmic Rev; 2009; 3(2):105-8

35. Madhuri Rudraraju, S. Priya Narayanan, Payaningal R. Somanath. Regulation of Blood-Retinal Barrier Cell-Junctions in Diabetic Retinopathy. [Internet] 2020. doi:10.1016/j.phrs.2020.105115

36. Daruich A, Matet A, Moulin A, Kowalczuk L, Nicolas M, Sellam A, et al. Mechanisms of macular edema: Beyond the surface. Progress Retinal Eye Res. 2018; 63:20–68.

37. Pennington KL, DeAngelis MM. Epidemiology of Age-Related Macular Degeneration (AMD): Associations with Cardiovascular Disease Phenotypes and Lipid Factors. Eye and Vis. 2016; 3(1):34.

38. Masson E. Aspects Épidémiologiques et Angiofluorographiques de la Rétinopathie Diabétique Au Sénégal. EM-Consulte. [Internet] 2021.

39. Amedome KM, Tete Y, Nonon S KB, Vonor K, Maneh N, Dzidzinyo K, et al. Etiologies des Oedemes Maculaires A Lome. Rev SOAO. 2016; 02: 14-19

40. Coulibaly F, Kouassi L, Noussi EN, N'Zi EG, Boni S, Fanny A. Profil Epidemiologique et Tomographique Des Oedemes Maculaires : Etude Portant Sur 96 Yeux De Patients A Abidjan. Rev SOAO. 2020; 01: 38-42

41. Kabtu E, Tsegaw A. Prevalence of Diabetic Macular Edema and Risk Factors among Diabetic Patients at the University of Gondar Tertiary Eye Care and Training Center, North West Ethiopia. 2021; 28(2):71-80**.**

42. Jingi AM, Noubiap JJN, Essouma M, Bigna JJR, Nansseu JRN, Ellong A, et al. Association of Insulin Treatment Versus Oral Hypoglycaemic Agents with Diabetic Retinopathy and Its Severity nn Type 2 Diabetes Patients in Cameroon, Sub-Saharan Africa. Ann Transl Med 2016; 4(20):395.

43. Kagmeni G, Ngoune CN, Mvilongo CT, Ngo Nsala S, Donmgang N. Macular Thickness Measurement in Diabetic Patients Using Optical Coherence Tomography in Yaounde. J. Ophthalmol Clin Res. 2022; 9(1):1–5.

44. Gundogan FC, Yolcu U, Akay F, Ilhan A, Ozge G, Uzun S. Diabetic Macular Edema. Pak J Med Sci. 2016; 32(2):505–10.

45. OptoPrep. [Internet]. 2017

46. Kitchens JW, Network DRCR. Observational Study of Subclinical Diabetic Macular Edema. Invest Ophthalmol Vis Sci. 2010; 51(13):4246.

47. Sandeep N, Walker M, Walker J, Using Basic Technology to Screen for Diabetic Retinopathy in Fiji. Community Eye Health. 2008; 21(66):33.

48. Hang P, Levent A. Treatment of Focal vs Diffuse Diabetic Macular Edema. [Internet] 2017. Vol 14: 19-23

49. AAO. Diabetic Macular Edema - EyeWiki [Internet]. 2022

50. Bolz M, Lammer J, Deak G, Pollreisz A, Mitsch C, Scholda C, et al. SAVE: A Grading Protocol For Clinically Significant Diabetic Macular Oedema Based On Optical Coherence Tomography And Fluorescein Angiography. Br J Ophthalmol. 2014; 98(12):1612-7

51. Themes UFO. Diagnosis of Cystoid Macular Edema: Imaging [Internet]. Ento Key. OPH. 2017

52. Hui VWK, Szeto SKH, Tang F, Yang D, Chen H, Lai TYY, et al. Optical Coherence Tomography Classification Systems for Diabetic Macular Edema and Their Associations With Visual Outcome and Treatment Responses – An Updated Review. Asia-Pacific J Ophthalmol. 2022; 11(3):247–57.

53. Matuszewski W, Baranowska-Jurkun A, Stefanowicz-Rutkowska MM, Modzelewski R, Pieczyński J, Bandurska-Stankiewicz E. Prevalence of Diabetic Retinopathy in Type 1 and Type 2 Diabetes Mellitus Patients in North-East Poland. Medicina. 2020; 56(4):164.

54. Lopes de Faria JM, Jalkh AE, Trempe CL, McMeel JW. Diabetic Macular Edema: Risk Factors and Concomitants. Acta Ophthalmol Scand. 1999; 77(2):170–5.

55. Channa R, Smith M, Campochiaro PA. Treatment of Macular Edema Due To Retinal Vein Occlusions. Clin Ophthalmol. 2011; 5:705–13.

56. Vagelos College of Physicians and Surgeons. Sickle Cell Proliferative Retinopathy [Internet]. 2022.

57. Retinal Physician. Clinical Presentation, Management, and Advances in Treatment of Sickle Cell Retinopathy. Retinal Phys. 2020, (17): 18-23.

58. Kohli P, Patel BC. Macular Edema. StatPearls Publishing; 2022.

59. Lardenoye CWTA, van Kooij B, Rothova A. Impact of Macular Edema on Visual Acuity in Uveitis. Ophthalmol. 2006; 113(8):1446–9.

60. Subramanian ML, Devaiah AK, Warren KA. Incidence of Postoperative Cystoid Macular Oedema by a single surgeon. Digit J Ophthalmol. 2009 Nov 28; 15 (4):37–41.

61. Ray S, D'Amico DJ. Pseudophakic Cystoid Macular Edema. Semin Ophthalmol. 2002; 17(3–4):167–80.

62. Jaffe NS, Luscombe SM, Clayman HM, Gass JD. A Fluorescein Angiographic Study of Cystoid Macular Edema. Am J Ophthalmol. 1981; 92(6):775–7.

63. Giocanti A, Tilleul J, Rohart C, Fajnkuchen F, Touati M, Buffet S, et al. Cystoid Macular Edema and Nd-yag Capsulotomy: Prospective Study of 30 Cases | IOVS | ARVO J. 2009;505: 184

64. Parajuli A, Joshi P, Subedi P, Pradhan C. Effect of Nd: YAG laser posterior capsulotomy on intraocular pressure, refraction, anterior chamber depth, and macular thickness. Clin Ophthalmol. 2019; 13:945–52.

65. Reddy SV, Husain D. Panretinal Photocoagulation: A Review of Complications. Semin Ophthalmol. 2018; 33(1):83-88.

66. Salvatore S, Fishman GA, Genead MA. Treatment of Cystic Macular Lesions in Hereditary Retinal Dystrophies. Surv Ophthalmol. 2013; 58(6):560–84.

67. Chopdar A, Chakravarthy U, Verma D. Age Related Macular Degeneration. BMJ. 2003; 326 (7387):485–8.

68. Wolter JR. Three Basic Types of Foveal Involvement in Choroidal Melanomas. Graefes Arch Clin Exp Ophthalmol. 1982; 218(5):237–43.

69. Makri OE, Georgalas I, Georgakopoulos CD. Drug-Induced Macular Edema. Drugs. 2013; 73(8):789–802.

70. Kadonosono K, Itoh N, Nomura E, Ohno S. Capillary Blood Flow Velocity In Patients With Idiopathic Epiretinal Membranes. Retina. 1999; 19(6):536–9.

71. Tranos PG, Wickremasinghe SS, Stangos NT, Topouzis F, Tsinopoulos I, Pavesio CE. Macular Edema. Surv Ophthalmol. 2004; 49(5):470–90.

72. Hikichi T, Yoshida A, Trempe CL. Course of Vitreomacular Traction Syndrome. Am J Ophthalmol. 1995; 119(1):55–61.

73. Oladiwura D, Lim LT, Ah-kee EY, Scott JA. Macular Optical Coherence Tomography Findings Following Blunt Ocular Trauma. Clin Ophthalmol. 2014; 8:989–92.

74. White VA, Lewallen S, Beare NAV, Molyneux ME, Taylor TE. Retinal Pathology of Pediatric Cerebral Malaria in Malawi. PLOS ONE. 2009; 4(1):e4317.

75. Kylstra JA, Brown JC, Jaffe GJ, Cox TA, Gallemore R, Greven CM, et al. The Importance of Fluorescein Angiography in Planning Laser Treatment of Diabetic Macular Edema. Ophthalmol. 1999; 106(11):2068–73.

76. Huang D, Swanson EA, Lin CP, Schuman JS, Stinson WG, Chang W, et al. Optical Coherence Tomography. Sci. 1991; 254 (5035):1178–81.

77. Hee MR, Puliafito CA, Duker JS, Reichel E, Coker JG, Wilkins JR, et al. Topography of Diabetic Macular Edema with Optical Coherence Tomography. Ophthalmol. 1998; 105(2):360–

78. Gabriele ML, Wollstein G, Ishikawa H, Kagemann L, Xu J, Folio LS, et al. Optical Coherence Tomography: History, Current Status, and Laboratory Work. Invest Ophthalmol Vis Sci. 2011; 52(5):2425–36.

79. Badaró E, Novais E, Prodocimo LM, Sallum JMF. Spectral-Domain Optical Coherence Tomography for Macular Edema. Scientific World J. 2014. (2014): 191847.

80. Elias R, Ho J, Duker JS. OCT Units: Which One Is Right for Me? [Internet] 2009.

81. Fu D, Tong H, Zheng S, Luo L, Gao F, Minar J. Retinal Status Analysis Method Based On Feature Extraction And Quantitative Grading In OCT Images. BioMed Eng OnLine. 2016; 15: 87.

82. Filho MB, Witkin AJ. Outer Retinal Layers as Predictors of Vision Loss. Rev Ophthalmol. 2015

83. Zeimer RC, Shahidi M, Mori MT, Benhamou E. In Vivo Evaluation Of A Noninvasive Method To Measure The Retinal Thickness In Primates. Arch Ophthalmol. 1989; 107(7):1006–9.

84. Strøm C, Sander B. Comparison of Objective Retinal Thickness Analysis and Subjective Stereo Fundus Photography in Diabetic Macular Edema. Invest Ophthalmol Vis Sci. 2004; 45(5):1450–5.

85. Culham L, Fitzke F, Marshall JG. Clinical Uses of the Scanning Laser Ophthalmoscope. Ophthalmic and Physiological Optics. 1995; 15(4):346–346.

86. Ghafour IM, Foulds WS, Allan D, McClure E. Contrast Sensitivity in Diabetic Subjects with and Without Retinopathy. Br J Ophthalmol. 1982; 66(8):492–5.

87. Ibanez HE, Lesher MP, Singerman LJ, Rice TA, Keep GF. Prospective Evaluation of the Effect of Pseudophakic Cystoid Macula Edema on Contrast Sensitivity. Arch Ophthalmol 1993; 111(12):1635–9.

88. Rotsos TG, Moschos MM. Cystoid Macular Edema. Clin Ophthalmol. 2008; 2(4):919–30.

89. Jitendra K. Diagnosis and Management of Diabetic Macular Edema Based On Optical Cohrence Tomography (Oct) Finding. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 18, no. 4, 2019, pp 14-22.

90. Kouassi FX, Koman CE, Kra ANS, Soumahoro M, Sowagnon TYC, N'dohi R. Epidemiological Features of Diabetic Retinopathy in Abidjan (Côte d'Ivoire): A Study about 448 Patients. Open J Ophthalmol. 2018; 8(3):140–9.

91. World Health Organization, ICD-11 for Mortality and Morbidity Statistics, 2018.

92. Trichonas G, Kaiser PK. Optical Coherence Tomography Imaging of Macular Oedema. Br J Ophthalmol. 2014; 98 (Suppl 2):ii24–9.

93. Kanukollu VM, Agarwal P. Epiretinal Membrane. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022.

94. Fujita A, Aoyama Y, Tsuneyoshi S, Sugiura A, Azuma K, Asano-Shimizu K, et al. Association Between Visual Function and the Integrity of Residual Ellipsoid Zone in Resolved Central Serous Chorioretinopathy. Sci Rep. 2019; 9(1):12433.

95. Midena E, Torresin T, Velotta E, Pilotto E, Parrozzani R, Frizziero L. OCT Hyperreflective Retinal Foci in Diabetic Retinopathy: A Semi-Automatic Detection Comparative Study. Front Immunol. 2021; 12:613051.

96. AAO, Pigment Epithelial Detachment – EyeWiki, 2022.

97. Sugar EA, Jabs DA, Altaweel MM, Lightman S, Acharya N, Vitale AT, et al. Identifying a Clinically Meaningful Threshold for Change in Uveitic Macular Edema Evaluated by Optical Coherence Tomography. Am J Ophthalmol. 2011; 152(6):1044-1052.e5.

98. wma.net. The World Medical Association-WMA Declaration of Helsinki. Ethical Principles for Medical Research Involving Human Subjects. [Internet] 2022.

99. Koki G, Bella AL, Omgbwa EA, Epee E, Sobngwi E, Kouanang KA, et al. Rétinopathie Diabétique du Noir Africain : Étude Angiographique. Cahiers d'Etudes et de Recherches Francophones / Santé. 2010; 20 (3):127–32.

100. Varma R, Bressler NM, Doan QV, Gleeson M, Danese M, Bower JK, et al. Prevalence of and Risk Factors for Diabetic Macular Edema in the United States. JAMA Ophthalmol. 2014; 132(11):1334–40

101. Kakinoki M, Sawada O, Sawada T, Kawamura H, Ohji M. Comparison of Macular Thickness Between Cirrus HD-OCT and Stratus OCT. Ophthalmic Surg Lasers Imaging Retina. 2009; 40(2):135–40.

102. Koki G, Aboubakar H, Biangoup Nyamsi P, Teperesna P, Nomo A, Epée E, et al. Occlusions Veineuses Rétiniennes Traitées par Injections Intra-Vitréennes de Bévacizumab À l'Hôpital

d'Instruction, d'Application et de Référence des Armées de Yaoundé. J Fr Ophtalmol. 2020; 43(1):51-58.

103. Man REK, Fenwick EK, Sabanayagam C, Li LJ, Tey CS, Soon HJT, et al. Differential Impact of Unilateral and Bilateral Classifications of Diabetic Retinopathy and Diabetic Macular Edema on Vision-Related Quality of Life. ARVO. 2016; 57(11):4655–60.

104. Waheed K, Laidlaw D. Disease Laterality, Eye Dominance, and Visual Handicap in Patients with Unilateral Full Thickness Macular Holes. Br J Ophthalmol. 2003; 87(5):626–8.

105. Lecleire-Collet A, Offret O, Gaucher D, Audren F, Haouchine B, Massin P. Full-thickness Macular Hole in a Patient with Diabetic Cystoid Macular Oedema Treated by Intravitreal Triamcinolone Injections. Acta Ophthalmol Scand. 2007; 85(7):795–8

106. Kohner EM. The Evolution and Natural History of Diabetic Retinopathy. Int Ophthalmol Clin. 1978; 18(4):1–16.

107. Roy MS, Klein R. Macular Edema and Retinal Hard Exudates in African Americans with Type 1 Diabetes: the New Jersey 725. Arch Ophthalmol. 2001; 119(2):251

108. Catier A, Tadayoni R, Paques M, Erginay A, Haouchine B, Gaudric A, et al. Characterization of Macular Oedema From Various Aetiologies by Optical Coherence Tomography. Am J Ophthalmol. 2005; 140(2):200–6.

109. Chaglasian M, Fingeret M, Davey PG, Huang WC, Leung D, Ng E, et al. The Development of a Reference Database with the Topcon 3D OCT-1 Maestro. Clin Ophthalmol. 2018; 12:849–57.

110. Huang C, Yang C, Hsieh Y, Yang C, Ho T, Lai T. Hyperreflective Foci in Predicting the Treatment Outcomes of Diabetic Macular Oedema After Anti-vascular Endothelial Growth Factor Therapy. Sci Rep. 2021; 11:5103.

111. Graue-Hernandez EO, Rivera-De-La-Parra D, Hernandez-Jimenez S, Aguilar-Salinas CA, Kershenobich-Stalnikowitz D, Jimenez-Corona A. Prevalence and Associated Risk Factors of

Diabetic Retinopathy and Macular Oedema in Patients Recently Diagnosed with Type 2 diabetes. BMJ Open Ophthalmology. 2020; 5(1).

112. Haller JA, Weinberg D, Chou C, Ip M, Davis M, Whitcup SM. Correlation of Macular Thickness and Visual Acuity in Patients with Persistent Macular Edema. Invest Ophthalmol & Vis Sci. 2006; 47(13):5908.

113. Islam F, Ashraf M, Zafar S, Masood H, Qureshi N. Retinal Thickness and Visual Acuity in Diabetic Macular Edema: An Optical Coherence Tomography-Based Study. 2016; 26:4.

ANNEXES

ANNEX 1: ETHICAL CLEARANCE FMBS-UYI

UNIVERSITÉ DE YAOUNDÉ I

FACULTÉ DE MÉDECINE ET DES SCIENCES BIOMÉDICALES

COMITÉ INSTITUTIONNEL D'ÉTHIQUE DE LA RECHERCHE

Tel/ fax : 22 31-05-86 22 311224

Email: decanatfmsb@hotmail.com

THE UNIVERSITY OF YAOUNDE I

FACULTY OF MEDICINE AND BIOMEDICAL SCIENCES

INSTITUTIONAL ETHICAL REVIEW BOARD

Ref. : N° 560 /UY1/FMSB/VDRC/DAASR/CED

CLAIRANCE ÉTHIQUE

Le COMITÉ INSTITUTIONNEL D'ÉTHIQUE DE LA RECHERCHE (CIER) de la FMSB a examiné

La demande de la clairance éthique soumise par :

M.Mme : Dr ALUNGE-NNANGSOPE Chancelline NTOH Matricule: 18M304

Travaillant sous la direction de :
- Pr KOKI GODEFROY
- Dr NOMO ARLETTE

Concernant le projet de recherche intitulé : EPIDEMIOLOCAL, CLINICAL AND THERAPEUTICAL ASPECTS OF MACULAR OEDEMA IN DOUALA

Les principales observations sont les suivantes

Evaluation scientifique	
Evaluation de la convenance institutionnelle/valeur sociale	
Equilibre des risques et des bénéfices	
Respect du consentement libre et éclairé	
Respect de la vie privée et des renseignements personnels (confidentialité) :	
Respect de la justice dans le choix des sujets	
Respect des personnes vulnérables :	
Réduction des inconvénients/optimalisation des avantages	
Gestion des compensations financières des sujets	
Gestion des conflits d'intérêt impliquant le chercheur	

Pour toutes ces raisons, le **CIER** émet un avis **favorable** sous réserve des modifications recommandées dans la grille d'évaluation scientifique.

L'équipe de recherche est responsable du respect du protocole approuvé et ne devra pas y apporter d'amendement sans avis favorable du **CIER**. Elle devra collaborer avec le **CIER** lorsque nécessaire, pour le suivi de la mise en œuvre dudit protocole.

La clairance éthique peut être retirée en cas de non - respect de la réglementation ou des recommandations sus évoquées.

En foi de quoi la présente clairance éthique est délivrée pour servir et valoir ce que de droit

LE PRESIDENT DU COMITE ETHIQUE

PROFESSEUR

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ANNEX 2: AUTHORISATION OF RESEARCH/ETHICAL CLEARANCE 2RMH

REPUBLIQUE DU CAMEROUN
Paix – Travail - Patrie
PRESIDENCE DE LA REPUBLIQUE
MINISTERE DE LA DEFENSE
DIRECTION DE LA SANTE MILITAIRE
DEUXIEME REGION DE SANTE MILITAIRE
HOPITAL MILITAIRE DE REGION N°2

REPUBLIC OF CAMEROON
Peace – Work – Fatherland
PRESIDENCY OF REPUBLIC
MINISTRY OF DEFENCE
DEPARTMENT OF MILITARY HEALTH
SECOND MILITARY HEALTH REGION
SECOND REGION MILITARY HOSPITAL

SECOND REGION MILITARY HOSPITAL ETHICS COMMITTEE

N° 01221121 SRMHEC

Douala, November 22nd, 2021

ETHICAL CLEARANCE

The Second Region Military Hospital Ethics Committee (SRMHEC) for the **2021 / 11 / 22** evaluation session, has examined the research project entitled « **Epidemiological, clinical and therapeutical aspects of macular oedema in Douala**» submitted by **ALUNGE-NNANGSOPE Chancelline Ntoh**, a final year resident in ophtalmology at the **Faculty of Medicine and Biomedical Sciences** under the supervision of **Pr. KOKI Godefroy**.

The present research project has a clear scientific interest and presents no risk for its participants. The objectives and methodology of this research project are clearly described. The principle of data confidentiality is respected. The required expertise for the supervision of the research is present. Based on the comments above, the SRMHEC approves this version of the project for a period of **(06) six months non-renewable**.

However, **ALUNGE-NNANGSOPE Chancelline Ntoh** is responsible of the scrupulous respect of the methodology and ethical consideration, and should not amend it without approval of the SRMHEC. Researchers are expected to collaborate with the SRMHEC for a follow-up of the ethical aspects of the approved project. **A copy of the thesis should be given to SRMHEC for archival purposes.**

The researchers are informed that they are bound by the obligation of reserve in relation to any sensitive information of which he may be aware during his work and the strict observation of the security measures in force within the military barracks.

The present ethical clearance is delivered to serve the purpose for which it is presented. It can be cancelled in case of non-respect of the above recommendations.

The President

Colonel Doctor **SEPO SEPO David**

Dr. Sepo S. David
Colonel - Médecin - Interniste
Hépato - Gastroentérologue
Chef de Service HGE - HMR II

Colonel Doctor **KOKI Godefroy**

Chief Doctor of the Second Region Military Hospital

Colonel - Médecin
ABKH Joseph Pierre
Interniste - Cardiologue
Chef Service Cardio... - HMR2 - Douala
ONMC N° 3902 / 97

ANNEX 3: AUTHORISATION OF RESEARCH DGH

REPUBLIQUE DU CAMEROUN
Paix – Travail – Patrie
****
MINISTERE DE LA SANTE PUBLIQUE
****
HOPITAL GENERAL DE DOUALA
DIRECTION MEDICALE
BP: 4856 Douala Tél. 233 50 01 01
Fax : 233.37.01.46 **E-mail** : hgd@hgdcam.com

REPUBLIC OF CAMEROON
Peace – Work – Fatherland
****
MINISTRY OF PUBLIC HEALTH
****
DOUALA GENERAL HOSPITAL
MEDICAL DIRECTORATE
PO Box: 4856 Douala Phone 233 50 01 01
Fax : 233.37.01.46 **E-mail** : hgd@hgdcam.com

N°__ AR /MINSANTE/HGD/DM/01/22

Douala, le 25 Janvier 2022

AUTORISATION DE RECHERCHE

Je soussigné Dr BARLA MATHIO Esther, Directeur Médical de l'Hôpital Général de Douala,

Autorise **ALUNGE-NNANGSOPE CHANCELLINE NTOH**, Résident en Ophtalmologie, à la Faculté de Médecine et des Sciences Biomédicales de l'Université de Yaoundé I, à effectuer ses travaux de recherche dans notre Formation Sanitaire pour la rédaction de sa thèse intitulée : **« Epidémiological, Clinical and Thérapeutical Aspects of Macular Oedema in Douala. »** sous la supervision du Dr NDJOCK NYOUMA Jasmine, Ophtalmologue.

Période de recherche : Janvier – Juin 2022

L'étudiant(e) devra se conformer au règlement intérieur en vigueur dans l'établissement et déposer obligatoirement une copie finale de sa thèse à la Direction Médicale de l'hôpital. Le matériel nécessaire aux manipulations sera totalement fourni par l'étudiant(e).

La présente Autorisation est délivrée à l'intéressé(e) pour servir et valoir ce que de droit.

Le Directeur Médical,

Dr BARLA Mathio Esther

ANNEX 4: AUTHORISATION OF RESEARCH DGOPH

REPUBLIQUE DU CAMEROUN
Paix - Travail - Patrie
MINISTERE DE LA SANTE PUBLIQUE
HOPITAL GYNECO-OBSTETRIQUE ET PEDIATRIQUE DE DOUALA

REPUBLIC OF CAMEROON
Peace - Work - Fatherland
MINISTRY OF PUBLIC HEALTH
DOUALA GYNAECO-OBSTETRIC AND PEDIATRIC HOSPITAL

N°2021/0758/L/HGOPED/DG/DFRI

Douala le 15 DEC 2021

AU
DR ALUNGE-NNANGSOPE CHANCELINE NTOH.
ETUDIANTE EN 4EME ANNEE DE SPECIALISATION
A L'UNIVERSITÉ DE DOUALA
675 93 04 76

-YAOUNDE-

Objet : Votre demande d'autorisation de recherche.

Monsieur,

Comme suite à votre demande d'autorisation de recherche à l'Hôpital Gynéco-Obstétrique et Pédiatrique de Douala,

J'ai l'honneur de vous informer que, je marque mon accord pour une période de six (06) mois à compter du **01 Janvier 2022 jusqu'au 30 Juin 2022**.

Vous voudrez bien prendre attache avec la Direction de la Formation, de la Recherche et de l'Innovation pour les modalités pratiques.

Veuillez agréer, Monsieur, l'expression de ma considération distinguée. /-

Le Directeur Général

Pr Emile T. MBOUDOU
Professeur Titulaire Agrégé des Universités

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- Direction Générale : +237 233 504 302
- DAAF : +237 233 504 309

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ANNEX 5: AUTHORISATION OF RESEARCH DLH

REPUBLIQUE DU CAMEROUN
PAIX – TRAVAIL – PATRIE
MINISTERE DE LA SANTE PUBLIQUE
DIRECTION HOPITAL LAQUINTINIE
BP 4035 – DOUALA CAMEROUN
TEL/FAX. : (237) 33 42 15 40
Email : hopital_laquintinie@yahoo.fr

REPUBLIC OF CAMEROON
PEACE – WORK – FATHERLAND
MINISTRY OF PUBLIC HEALTH
HEAD OFFICE OF THE
LAQUINTINIE HOSPITAL
BOX 4035 – DOUALA CAMEROON
TEL/FAX. : (237) 33 42 15 40
Email : hopital_laquintinie@yahoo.fr

N°0807/5/AR/MINSANTE/DHL

AUTORISATION DE RECHERCHE

Madame ALUNGE-NNANGSOPE Chancelline N., Résidente de fin de cycle en Ophtalmologie à la Faculté de Médecine et des Sciences Biomédicales de l'Université de Yaoundé I, est autorisée à effectuer une recherche de (08) mois allant de **janvier** à **août 2022** au sein de l'Hôpital Laquintinie de Douala, sur le thème : **«Epidemiological, clinical and paraclinical aspects of mascular oedema in Douala»**.

Les travaux s'effectueront sous la supervision du **Dr MAYOUEGO KOUAM Jeanne épse ENYAMA,** Ophtalmologue, dans le respect du code d'éthique et de déontologie en vigueur à l'Hôpital Laquintinie de Douala.

Toute publication de ce travail devra préserver les intérêts de l'Hôpital et des personnels y ayant participé. Une copie sera transmise au Centre de Documentation pour archivage.

En foi de quoi la présente Autorisation de Recherche est délivrée pour servir et valoir ce que de droit.

Ampliation :
- DHL

Copie :
- SG/Coordo Secteur
- CSP
- C.DPTE/Chef Sce
- SUPERVISEUR(S)
- INTERESSE(E)
- CHRONO/ARCHIVES

Fait à Douala, le 12 JAN 2022
Le Directeur de l'Hôpital Laquintinie de Douala,
et par délégation le Conseiller Médical

Dr Marie Solange NDOM -EBONGUE

ANNEX 6: INFORMATION SHEET AND CONSENT/ASSENT FORM

INTRODUCTION: My name is Alunge-Nnangsope Chancelline Ntoh. I am fourth year resident at the Faculty of Medicine and Bomedical Sciences of the University of Yaounde I. I am carrying out a research entitled "**EPIDEMIOLOGICAL AND CLINICAL ASPECTS OF MACULAR OEDEMA IN DOUALA."**

INVITATION TO STUDY: You are kindly invited to participate in this study which I will proceed to describe. It is a study to enable us determine the epidemiological and clinical profile of macular oedema at the Douala 2nd Region Military Hospital, Douala General Hospital, Douala Gynaecological Obstetric and Paediatric Hospital and Douala Laquintinie Hospital. The results of this study will enable us propose measures to improve eye care in these hospitals.

VOLUNTARY PARTICIPATION: If you decide to participate you will benefit from a free paraclinical examination of your retina, known as optical coherence tomography which is otherwise relatively expensive. It is a painless simple examination which require dilating eye drops instilled in your eyes prior to the exam. You are free to decide to participate or not. It is not compulsory.

RISKS/BENEFITS: You will benefit freely from the OCT exam and help your eye health professional better manage any eye pathologies. There are no major risks of the exam but for some stinging while instilling the dilatation eye drops and temporal blurring of near vision for few hours.

CONFIDENTIALITY: All information obtained from a participant will be kept very confidential and will be used solely for the intended purpose. Each participant will be given a code number, and will not be identified during the publication of the results

CONTACT: If you have any questions regarding this study, please feel free to contact any of the following people listed below

1) Supervisor: Prof. Koki Godefroy. Tel. 694 23 34 15 email: kok2002g@yahoo.fr
2) Co- supervisor: Dr. Nomo Arlette Tel. 675 12 27 80 email: nomoarlette2011@yahoo.fr
3) Principal Investigator: Alunge-Nnangsope Chancelline Ntoh, 4th year ophthalmology resident. Tel 675 93 04 76 email: celinealunge@yahoo.com

CONSENT

I

……

…… having understood the study 'epidemiological and clincal aspects of macular oedema in Douala', after having the consent / study form thoroughly explained to me, given the opportunity to ask questions and time to consider my participation in the study, I agree to participate in the study.

…… ……

Date/signature of participant Date/signature of investigator

ASSENT

I

…… …… having understood the study 'epidemiological and clinical aspects om macular oedema in Douala', after having the consent / study form thoroughly explained to me, given the opportunity to ask questions and time to consider participation of my child in the study, I agree he/she participates in the study.

…… ……

Date/signature of participant Date/signature of investigator

ANNEX 7: DATA COLLECTION SHEET

Epidemiological and clinical aspects of macular oedema in Douala

❖ **IDENTIFICATION :**

Serial No :… Age :…….. Sex : M/F Residence :……. Marital status : S/M

Level of Education …… Occupation :…… Tel : …… Eye : RE /LE

❖ **PAST HISTORY**

Ophthalmologic :

Infection: Yes/No Type:…..... Timing:…… Treatment:……. Trauma: Yes/No Type:….. Timing……. Treatment:…….. Surgery: Yes /No Type:…… Complication: Yes /No Type :….

General :

HTA**:** Yes / No Grade: mild / moderate / severe Duration: (yrs)……Treatment: Yes /No Controlled : Yes/No

Diabetes: Yes/No Type: 1/2 Duration:…… Treatment type: OAD/Insulin…… Glycemia controlled: Yes/No Dyslipidemia : Yes/Non Pregnancy : Yes/No

Systemic review: Decreased far visual acuity: Yes /No……. Metamorphopsia: Yes /No Micropsia Yes/No Macropsia: Yes/ No Central scotoma: Yes/No Floaters: Yes / No

❖ **Ophthalmologic examination:**

- Visual acuity

Far : RE……/ LE…….	Near : RE……/ LE…….

- Slit lamp examination RE LE

- Intraocular pressure RE :……. LE :……..

- Posterior segment

	RE	LE
Optic disc		
Macular		
Vessels		
Retina		

Absence of DR : RE - LE	NPDR : o Min RE - LE o Mod RE - LE o Sév RE - LE	PDR : o Min RE- LE o Mod RE - LE o Sév RE - LE	CSMO : o Yes RE - LE o No RE – LE
DME : -Yes/ No RE - Yes /No LE Hard exudates : - Present RE-LE	Involvement : - centre RE/LE - paracentral RE/LE - pericentral RE - LE	Mean thickness : RE : ≤250 >250 LE : ≤250 >250	VR interface abnormalities : - RE/LE -ERM: RE/LE - VR traction: RE/LE - PVD: RE/LE
Hard exsudates: - Yes/No RE - Yes/No LE	Hemorrage: -Yes/No RE - Yes/No LE	Macular swelling - Yes/No RE - Yes/No LE	Absent foveal reflex - Yes/No RE - Yes/No LE
RVO: Yes/No	CRVO: RE/LE	HRVO: RE/LE	BRVO: RE/RE
ARMD : Yes/No	Early: RE/LE	Intermediate: RE/LE	Advanced: Geographic atrophy : RE/LE CNV : RE /LE
RP: Yes/No	Early stage	Mid stage	Late stage
Macular hole (MH): - Yes/No RE - Yes/No LE	MH grade: - RE 1/2/3/4 - LE 1/2/3/4		

❖ **Paraclinical aspects**

- Macular OCT

eye / OCT	RE Central/ Paracentral/ Pericentral	LE Central/ Paracentral/ Pericentral
ETDRS:central macular thickness	…….µm	…….µm
shape	Cone / doughnut	Cone / doughnut
Image analysis : if oedema ; characteristics	- cystoid - sponge-like - SRF - diffuse -focal - ERM – hyperreflective foci - VR traction - ERM - folds - layer(s) involved -TRD - PVD - ellipsoid zone grade - RPE intergrity parafoveal cyst	- cystoid - sponge-like - SRF - diffuse -focal - ERM – hyperreflective foci - VR traction - ERM - folds - layer(s) involved -TRD - PVD - ellipsoid zone grade - RPE intergrity parafoveal cyst

ANNEX 8: STUDY TIMELINE

DATE \ ACTIVITY	SEPTEMBER-DECEMBER 2021	JANUARY-AUGUST 2021	AUGUST-SEPTEMBER 2022	SEPTEMBER OR OCTOBER 2022
Protocol writing, submission and defense	XXXXX			
Acquisition of administrative clearance and ethical approval	XXXXXX			
Recruitment and data collection		XXXXXXX		
Data analysis and thesis writing			XXXXXX	
Submission of thesis/Defense				XXXXXXX

ANNEX 9: BUDGET

ITEM	UNIT PRICE	TOTAL PRICE
Documentation		
Protocol printing (5copies)	5,000	25,000
Production of data collection sheet (300 copies)	100	30,000
OCT	5000	750,000
Draft of thesis report (5copies)	10,000	50,000
Final thesis report (5 copies)	10,000	50,000
Letters and envelops to authorities	5,000	5,000
Writing material	5,000	5,000
Internet charges (50 hours)	20,000	200,000
Transportation		
Interurban and intraurban	75,000	700,000
Miscellaneous		100,000
GRAND TOTAL		**1,910,000**
Budget		

ANNEX 10: IMAGES

Cirrus Zeiss OCT used in our study

ANNEX 10: IMAGES

OCT report of one of our diabetic patients with central involving macular oedema