بسم الله الرحمن الرحيم

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Determination of Haematological Changes in Ischemic Heart Disease Patients in Shendi Town

A thesis Submitted in partial fulfillment of the Msc Degree in Haematology

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الآيـة

Quran VERSE

بسم الله الرحمن الرحيم

قال تعالى:

﴿ وَقَضَى رَبُّكَ أَلاَّ تَعْبُدُواْ إِلاَّ إِيَّاهُ وَبِالْوَالِدَيْنِ إِحْسَاناً إِمَّا يَبْلُغَنَّ عِندَكَ الْكِبَرَ أَحَدُهُمَا أَوْ كِلاَهُمَا فَلاَ تَقُل لَّهُمَا أُفٍّ وَلاَ تَنْهَرْهُمَا وَقُل لَّهُمَا قَوْلاً كَرِيماً (23) وَاخْفِضْ لَهُمَا جَنَاحَ الذُّلِّ مِنَ الرَّحْمَةِ وَقُل رَّبِّ ارْحَمْهُمَا كَمَا رَبَّيَانِي صَغِيراً (24) ﴾

صدق الله العظيم

سوره الإسراء الآية (23–24)

Dedication

To those

Who give me the best of life without payment

To my mother for their patience and

Support

To my Brothers

my teachers

all my friends

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Abstract

Background: Ischaemic heart disease (IHD), is a group of diseases that includes: stable angina, unstable angina, myocardial infarction, and sudden cardiac death. It is within the group of cardiovascular diseases of which it is the most common type. The aim of the study is to determine the haematological changes in ischaemic heart disease patients.

Methods: This is a cross-sectional case control study conducted at El-Mek Nimir University Hospital in Shendi town to determine the haematological parameters and C- reactive protien in ischaemic heart disease patients in the period between (April 2018- August 2018). The study included (40) patients whom diagnosed as ischaemic heart disease and the study groups were compared with (10) healthy volunteers as a control group.

Blood samples were collected from the two groups. Complete blood count (CBC) and high sensitivity C-reactive protein (hsCRP), were measured. Data was collected using a structured face to face questionnaire and the (SPSS) version (11.5) program was used for data analysis.

Results: The study revealed that the ischaemic heart disease patients were; (28%) male and (72%) female, the age as (95%) have (40-80) years old and (5%) were less than 40 years old.

The study showed that the risk factors in ischaemic heart disease patients group (67.5%) as hypertensive, (32.5%) diabetic, (5%) smokers, (72.5) chronic disease , (70%) drug intake and (35%) as family history of patients group. The complete blood count (CBC) indicated the mean values of Hb, PCV, RBCs, MCV, MCH, MCHC, RDW were (12 g/dl), (40.9%), ($4.8x10^{12}$/l), (88.3 fl), (25.1 pg), (28.4 g/dl) and (16.5) respectively.

Also prevailed the mean of TWBCs, platelet count , MPV and C-reactive protein were (8.4 x 10^9 /l), (316.5 x 10^9 /l), (8.602) and (12.5 mg/l) respectively.

Conclusions: Ischaemic heart disease is responsible for significant changes in haemoglobin, packed cell volume, red blood cells count, total white blood cells count and high sensitivity c-reactive protein .

Key word: Ischaemic heart disease, CBC, hsCRP .

المستخلص

مدخل: مرض القلب الاحتشائي هو مجموعة من الأمراض تضم الذبحة الصدرية المستقرة وغير المستقرة واحتشاء عضلة القلب وتوقف القلب الفجائي.وهو من مجموعة أمراض القلب الوعائية الأكثر انتشارا. وتهدف الدراسة إلى تحديد التغيرات الدموية في مرضي القلب الاحتشائي.

منهجية الدراسة:أجريت هذه الدراسة المقطعية في مستشفي المك نمر الجامعي بمدينة شندي لتحديد مدى تاثير مرض القلب الاحتشائى علي الخلايا الدموية في الفترة ما بين (ابريل2018–اغسطس2018م). وكانت عينة الدراسة عبارة عن (40) مريض تم اختيارهم بصورة عشوائية. وقورنت نتائج الدراسة مع (10) متطوع سليم كمجموعة ضابطة.

تم جمع عينات الدم من جميع المرضي وتم تحليلها معمليا لإجراء فحص الدم الكامل وبروتين سيء. تم جمع المعلومات بواسطة الاستبيان ومن ثم استخدام برنامج الحزمة الإحصائية للعلوم الاجتماعية الذي يعرف ببرنامج (SPSS) لتحليل بيانات الدراسة.

النتائج: أظهرت الدراسة أن المرضي (28٪) منهم ذكور و (72٪) منهم إناث (95٪) منهم أعمارهم تتراوح ما بين (40–80) سنه و(5٪) أعمارهم اقل من 40 سنه

كما أظهرت هذه الدراسة أن المرضي يعانوا من عوامل خطر كانت (67.5%) ضغط دم و(32.5%) سكري و(5%) مدخنين و(72.5%) مصابون بأمراض مزمنة و(70%) يتناولون أدوية و(35%) لهم تاريخي عائلي للمرض.

تحليل الدم الكامل اظهر أن متوسط الهيموغلوبين، وتعداد كريات الدم الحمراء، الحجم الحشوي للدم ،متوسط حجم الخلية الحمراء ، متوسط الهيموغلوبين في الخلية الحمراء ،متوسط تركيز الهيموغلوبين في الخلية الحمراء ومعامل توزيع حجم الخلية الحمراء هم:

(12 g/dl, 40.9%, $4.8x10^{12}$/l, 88.3 fl, 25.1 pg, 28.4 g/dl,16.5)علي التوالي.

كما أظهرت الدراسة أن متوسط تعداد كريات الدم البيضاء والصفائح الدموية ومتوسط حجم الصفائح الدموية وبروتين C هم :

على التوالي (8.4 x 10^9 /l), (316.5 x 10^9 /l), (8.6) and (12.5 mg/l)

الخلاصة: مرض القلب الاحتشائي مسئول عن تغيرات ذو دلالة مهمة التي تحدث في الهيموغلوبين وحجم الكرية الحمراء الحشوي وكريات الدم الحمراء وتعداد كريات الدم البيضاء وبروتين – C

الكلمات المفتاحية:مرض القلب الاحتشائي، فحص الدم الكامل ، بروتين- C المتفاعل عالي التحسس

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List of abbreviations

CAD	Coronary artery disease
CBC	Complete blood count
CHD	Coronary heart disease
CVD	Cardiovascular diseases
DM	Diabetes mellitus
HTN	Hypertension
Hb	Haemoglobin
hsCRP	High- sensitivity C.reactive protein
IHD	Ischaemic heart disease
MCH	Mean cell haemoglobin
MCHC	Mean cell haemoglobin concentration
MCV	Mean cell volume
Plt	Platelet
PCV	Packed cell volume
RBCs	Red blood cells
WBCs	White blood cells

Chapter one

Introduction

Rationale

Objectives

1.1. Introduction

Cardiovascular diseases are a class of diseases that involves the heart, the blood vessels (arteries, capillaries, and veins) or both. The causes of cardiovascular disaease sere diverse but atherosclerosis and/or hypertension are the most common. Additionally, when aging come a number of physiological and biochemical changes that alter cardiovascular function and lead to subsequently increased risk of cardiovascular diseases, even in healthy asymptomatic individuals.[1]

Most cardiovascular diseases can be prevented by addressing risk factors such as tobacco use, unhealthy diet and obesity, physical inactivity, high blood pressure, diabetes and raised lipids. Coronary heart disease (CHD) is the most common type of heart disease, [2]

Ischaemic heart disease (IHD) are accompanied by progressive mechanical obstruction, dynamic obstruction, and plaque inflammation, instability, and rupture, followed by superimposed thrombosis[3]

Complete blood count (CBC) is one of the most common blood tests. It's often done as part of a routine checkup. The CBC can help detect blood diseases and disorders.

White blood cells are part of the immune system, Abnormal WBC levels may be assign of infection, blood cancer, or an immune system disorder.

Platelets are blood cell fragment s that help in blood clot. They stick together to seal cuts or breaks on blood vessel walls and stop bleeding. Abnormal platelet levels may be a sign of a bleeding disorder or a thrombotic disorder.[4]

Hemoglobin is an iron rich protein in red blood cells (RBCs) that carries oxygen. Abnormal hemoglobin levels may b e a sign of anemia, , or other blood disorders.

Haematocrit is a measure of how much space (RBCs) take up in blood. Abnormal haematocrit levels also may be a sign of a blood or bone marrow disorder.

Mean corpuscular volume (MCV) is a measure of the average size of RBCs. Abnormal MCV levels may be a sign of anemia. [4]

The effect of leucocytosis o n ischemic heart disease can be explained by multiple mechanisms ; however, the inflammatory basis of atherosclerosis remain the cornerstone of this relation. Leucocytosis can be considered amarker of inflammatory changes in atherosclerotic lesions, An increased systemic and local inflammation plays a key role in the Path physiology of acute coronary syndrome.

High platelet count are clearly associated with an increased risk of thrombosis;. high platelet counts and a rapid platelet aggregation response are associated with increase long – term coronary death. It appears that the role of platelets in the pathogenesis of ischemic heart disease is due mainly to their functional properties and their interaction with plasma and tissue factors.

C-reactive protein (CRP) is a common inflammatory marker that has been found to be present in increased levels in patients at risk for cardiovascular diseases.

1.2. Rationale

Increasingly reliable estimates of the prevalence and incidence of IHD emphasize the importance of this disease as a contemporary health hazard.

Cardiovascular disease is now the leading cause of death, with CHD accounting for two-thirds of all heart disease deaths. The most recent data on the use of the WBC count and other components of the complete blood count (CBC) to predict CHD risk. An elevated (WBC) is a well-recognized indicator of inflammation. The total number of WBCs and each subtype (for example, neutrophils, monotypes, lymphocytes, and eosinophils) have been implicated as predictors of IHD. Nearly all of the cellular elements in the blood, including WBCs, RBCs, and platelets, are involved in the underlying pathogenesis of IHD .The study proposed to identify hematological changes in IHD factors related to the onset and course of IHD and designed to determine the importance of conventional risk factors, to identify new risk factors and extensive laboratory evaluations performed at baseline to identify the presence and severity of IHD and may help to establish secondary preventive medication in individual patients.

1.3. Objectives

1.3.1. General objective:

To determine of some hematological changes in patients with ischemic heart diseases.

1.3.2. Specific objectives:

- To determine red blood cells parameters: (Hb, PCV, RBC, RBCs indices, RDW) in patients with ischemic heart disease.
- To determine WBCs, platelet count and MPV in ischemic heart disease patients.
- To determine C - reactive protein in ischemic heart disease patients.

Chapter two

Literature Review

2. Literature Review

2-1: The heart

The human heart is a muscular which pumps blood through the blood vessels of the circulatory system [5] containing four chambers that is situated just to the left of the midline of the thoracic cavity [6]. It is approximately the size of man‘s closed fist. the upper two chambers (atria) are divided by a wall like structure called the inter a trial septum . the lower two chambers (ventricles) are divided by a similar structure called the inter ventricular septum. Between each atrium and ventricle, valves allow blood to flow in one direction, preventing backflow. [7]

The major function of the cardiovascular system is to circulate substances throughout the body. In other words, its organs function to supply cells and tissues with oxygen and nutrients and also to remove wastes, CO_2 and from cells and tissues.[7]

The heart is like any other muscle in body, it needs an adequate blood supply to provide oxygen so that the muscle can contract and pump blood to the rest of the body. Not only does the heart pump blood to the rest of the body, it also pumps blood to itself via the coronary arteries. These arteries originate from the base of the aorta (the major blood vessel that carries oxygenated blood from the heart) and then branch out along the surface of the heart. [8]

Coronary arteries are the heart's network of blood vessels. They exist on the surface of the heart, and they supply the heart muscle with oxygen. If the coronary arteries narrow, the supply of oxygen-rich blood to the heart may become too low, especially during physical activity. At first, this reduction in blood flow may not produce any symptoms, but as fatty deposits, or plaques, build up in the coronary arteries, signs and symptoms may emerge.[8]

ischemic heart disease (IHD) also known as coronary heart disease (CHD) , refers to a group of diseases which includes stable angina , unstable angina , myocardial infarction , and sudden cardiac death. [9]

2-2: Heart diseases:

Is a broad term used to describe a range of diseases that affect heart. Heart disease refers to various types of conditions that can affect heart function [10] . These types include:

- Coronary artery (atherosclerotic) heart disease that affects the arteries to the heart.
- Valvular heart disease that affects how the valves function to regulate blood flow in and out of the heart.
- Cardiomyopathy that affects how the heart muscle squeezes
- Heart rhythm disturbances (arrhythmias) that affect the electrical conduction
- Heart infections where the heart has structural problems that develop before birth[10]

2-2-1: Coronary artery disease:

Is the most common type of heart diseases .cholesterol plaque inside the artery walls. Over time, this buildup of plaque may partially block the artery and decrease blood flow through it.

coronary heart disease (CHD) also known as ischemic heart disease (IHD) refers to a group of diseases which includes stable angina, unstable angina, myocardial l infarction, and sudden cardiac death.[9]

A heart attack occurs when a plaque ruptures and forms a clot in the artery causing a complete blockage. That part of the heart muscle that is denied blood supply nstarts to die. Causes injury or damage to the inner layer of a coronary artery. This damage causes fatty plaque deposits to build up at the site of the injury. These

deposits consist of cholesterol and other cellular waste products. The accumulation is called atherosclerosis. [11]

If pieces break off or rupture, platelets will clump in the area, attempting to repair the blood vessel. This clump can block the artery, reducing or blocking blood flow, and leading to a heart attack.

Classic signs and symptoms Chest pain (angina) - This pain may radiate or move to the arm, neck or back, Shortness of breath, Sweating, Nausea, Irregular heartbeat. [12]

2-2-1-1: Signs and symptoms:

Chest pain or discomfort which may travel into the shoulder, arm, back neck, or jaw. [13] Chest pain that occurs regularly with activity, after eating, or at other predictable times is termed stable.

- Occasionally it may feel like heartburn.
- Usually symptoms occur with exercise or emotional stress, last less than a few minutes, and improve with rest. [13]
- Shortness of breath may also occur and sometimes no symptoms are present. [13]
- Occasionally, the first sign is a heart attack.
- Other complications include heart failure or an abnormal heartbeat. [14]
- Angina and is associated with narrowings of the arteries of the heart.

-Angina that changes in intensity, character or frequency is termed unstable.

-Unstable angina may precede myocardial infarction.

In adults who go to the emergency department with an unclear cause of pain, about 30% have pain due to coronary artery disease. [15]

2-2-1-2: Risk factors

Include high blood pressure, smoking, diabetes, lack of exercise, obesity, high blood cholesterol, poor diet, depression, and excessive alcohol Blood fats Genetics About half of cases are linked to genetic. [16]

-Endometriosis in women under the age of 40. [17]

- Depression and hostility appear to be risks. [18]

- Haemostatic factors: High levels of fibrinogen and coagulation factor VII are associated with an increased risk of CAD. [19]

- Low hemoglobin. [20]

Both rheumatoid arthritis and systemic lupus erythematosus are independent risk factors as well. [21] The underlying mechanism involves reduction o f blood flow and oxygen to the heart muscle due to atherosclerosis of the arteries of the heart .[22]

2-2-1-3: Pathophysiology:

Micrograph of a coronary artery with the most common form of coronary artery disease (atherosclerosis) and marked luminal narrowing. Masson's trachoma. Limitation of blood flow to the heart causes ischemia (cell starvation secondary to a lack of oxygen) of the heart's muscle cells. The heart's muscle cells may die from lack of oxygen and this is called a myocardial infarction (commonly referred to as a heart attack). It leads to damage, death, and eventual scarring of the heart muscle without re growth of heart muscle cells. Chronic high-grade narrowing of the coronary arteries can induce transient ischemia which leads to the induction of a ventricular arrhythmia, which may terminate into a dangerous heart rhythm known as ventricular fibrillation, which often leads to death. Typically, coronary artery disease occurs when part of the smooth, elastic lining inside a coronary artery (the arteries that supply blood to the heart muscle) develops atherosclerosis. With atherosclerosis, the artery's lining becomes hardened, stiffened, and accumulates deposits of calcium, fatty lipids, and abnormal inflammatory cells to form a plaque. Calcium phosphate (hydroxyl apatite) deposits in the muscular layer of the blood vessels appear to play a significant role in stiffening the arteries and inducing the early phase of coronary arteriosclerosis. [23]

2-2-1-4: Diagnosis:

Physical examination, medical history and a number of tests can help to diagnose CHD including:

Blood tests. Halter monitor. Stress test electrocardiogram, cardiac stress testing, coronary computed topographic angiography, and coronary angiogram, among others.[23]

2-2-1-5: Prevention:

to reduce CAD risk include eating a healthy diet, regularly exercising, maintaining a healthy weight, and not smoking. [24]

Medications for diabetes, high cholesterol, or high blood pressure are sometimes used. [25] There is limited evidence for screening people who are at low risk and do not have symptoms. [26]

Treatment involves the same measures as prevention. [27]

2-2-1-6: Treatment:

There are a number of treatment options for coronary artery disease [28]

- Lifestyle changes
- Medical treatment – drugs (e.g.,
- cholesterol lowering medications ,
- beta- blockers, nitroglycerin, calcium channel blockers, etc.);
- Coronary interventions as angioplasty and coronary stent;

  Coronary artery bypasses grafting (CABG)

Statins , which reduce cholesterol, reduce the risk of coronary artery disease[29]

Nitroglycerin [30]

Calcium channel blockers and/or beta-blockers [31]

- Antiplatelet drugs such as aspirin [32]

2-3: Blood:

Blood is the life-maintaining fluid that circulates through: Heart; Arteries; Veins; Capillaries; Brain Rest of the body Blood carries the following to the body tissues: Nourishment; Electrolytes; Hormones; Vitamins; Antibodies; Heat; Oxygen Immune cells and carries the following away from the body tissues: Waste matter; Carbon dioxide [33]

2-3-1: Components of blood:

The components of human blood are:

- Plasma The liquid component of the blood in which the following blood cells are suspended:
- Red blood cells (erythrocytes) These carry oxygen from the lungs to the rest of the body
- White blood cells (leukocytes) these help fight infections and aid in the immune process. Types of white blood cells include:
- Lymphocytes ; Coenocytes ; Eosinophils; Basophiles Europhiles.
- Platelets (thrombocytes) these help in blood clotting.

Blood cells are made in the bone marrow. The bone marrow is the spongy material in the center of the bones that makes all types of blood cells.

There are other organs and systems in our bodies that help regulate blood cells. The lymph nodes, spleen, and liver help regulate the production, destruction, and differentiation (developing a specific function) of cells. The production and development of new cells in the bone marrow is a process called hematopoiesis. Blood cells formed in the bone marrow start out as a stem cell. [33]

2-3-2: Functions:

- Red blood cells, or erythrocytes carry oxygen from the lungs to the body tissues and carbon dioxide as a waste product, away from the tissues and back to the lungs. -

- Hemoglobin Hgb is an important protein in the red blood cells that carries oxygen from the lungs to all parts of our body.

- White blood cells, or leukocytes, are to fight infection. There are several types of white blood cells and each has its own role in fighting bacterial, viral, fungal, and parasitic infections. Types of white blood cells that are most important for helping protect the body from infection and foreign ; Help heal wounds by ingesting matter, such as dead cells, tissue debris, and old red blood cells; Are our protection from foreign bodies that enter the blood stream, such as allergens; protection against mutated cells, such as cancer.
- Platelets, or thrombocytes, is blood clotting. Platelets are much smaller in size than the other blood cells. They group together to form clumps, or a plug, in the hole of a vessel to stop bleeding.[33]

2-3-3: Haemopoiesis:

Process of formation and development of the various types of blood cells and other formed elements.

Synonym (s): hematogenesis, hematopoiesis, hemogenesis, sanguification, Haemopoiesis.[34]

In humans, hematopoiesis begins in the yolk sac and transitions into the liver temporarily before finally establishing definitive hematopoiesis in the bone marrow and thymus. Experiments with human embryos confirm observations in the hemangioblast, a common precursor for endothelial and hematopoietic cells. In humans, HSCs are present in close proximity to endothelial cells.[35]

2-3-3-1: Erythropoiesis:

The formation of red blood cells (erythrocytes) from stem cells in the bone marrow. Regulated by the hormone erythropoietin from the kidneys, where increased secretion is stimulated by reduced oxygen tension in the blood; a recombinant human form is used therapeutically to treat some types of anemia. [36]

erythropoiesis is a succession of progressive differentiations from the initial hematopoietic stem cell to the erythrocyte. The multipotent cell first generates mixed colonies (or CFU: Colony Forming Unit), then erythroblast precursors initially called BFU-E (burst-forming unit-elytroid) then CFU-E. During this process, the cells progressively become sensitive to erythropoietin with the appearance of a specific receptor whilst losing their receptors to stimulation of the initial stem cell factor C-kit.

Maturation then produces pro-erythroblasts (P-E), basophile erythroblasts (E-B), polychromatophile erythroblasts (E-P), then reticulocytes (Ret) after the expulsion of the nucleus, and finally red blood cells (G-R).[37]

Diagram of the normal erythropoiesis and of the importance of growth factors Erythropoiesis is modulated by an endocrine mechanism mediated by erythropoietin (EPO). EPO protects against the permanent death signals sent by paracrine regulation of the erythroblast (red minus signs) which permanently controls cell multiplication and maturation.[38]

2.3.3.2: Leukopoiesis:

Leucopoiesis is the process of formation of leukocytes (white blood cells) from stem cells in hematopoietic organs. Leukocytes develop from either multipotential myeloid stem cells (CFU-GEMM) or multipotential lymphoid stem cells (CFU-L). Leukocytes developing from CFU-GEMM's are granulocytes (neutrophils, basophiles and eosinophils) or coenocytes. Leukocytes developing from CFU-Ls a re lymphocytes (T & B cells, dendritic and NK cells).[33]

2-3-3-2-1:Granulopoiesis:

All granulocytes develop from the CFU-GEMM cells, Under the stimulation of cytokines GM-CSF, G-CSF and IL-3 the CFU-GEMM differentiates into the CFU-GM, the common precursor for both neutrophils and monocytes. This then further differentiates into CFU-G.

2.3.3.2.1.1: Neutrophils:

Stages:

- Myeloblast

Large cell with a large nucleus and which demonstrates basophilic staining. This stage exists for all granulocytes.

- Promyelocyte

During this stage primary (azurophilic) granules are formed. This stage exists for all granulocytes.

- Neutrophilic myelocyte

The developing neutrophil can now be differentiated from basophils and eosinophils as neutrophil specific granules are now being formed.

- Neutrophilic metamyelocyte

At this stage mitosis can no longer occur. The nucleus elongates, becomes heterochromatic and has a kidney like shape. Differentiation is now much clearer from other granulocytes as the specific granules are in a far greater number than the primary granules formed in the promyelocyte stage.

- Band cell

Nucleus elongates further and represents a horse shoe. Nucleus starts to segment.

- Neutrophil

Mature neutrophil is formed and the nucleus is segmented and has 3 to 5 lobes. This lobular structure of the nucleus gives rise to the name polymorph nuclear neutrophil.

2.3.3.2.1.2: Basophiles:

Under the stimulation of GM-CSF and IL-3, the CFU-GEMM differentiates into CFU-Ba.

Stages:

- Myeloblast & Promyelocyte

These stages are common to all granulocytes and no distinction can be made between different cell lines.

- Basophilic myelocyte & metamyelocyte

Specific granules start to appear in the myelocyte stage, and as the cell develops into the metamyelocyte stage, mitosis ceases.

- Basophil

Final nuclear shape is masked by the high density of cytoplasmic granules.

2.3.3.2.1.3: Eosinophils:

Under the stimulation of GM-CSF, IL-3 and IL-5 the CFU-GEMM differentiates into the CFU-Eo.

Stages:

- Myeloblast & Promyelocyte

These stages are common to all granulocytes and no distinction can be made between different cell lines.

- Eosinophilic myelocyte & metamyelocyte

Specific granules start to appear in the myelocyte stage and once the cell has reached the metamyelocyte stage it cannot undergo further mitosis.

- Eosinophil

Mature cell has a bilobed nucleus. There are species specific variations in granule size once stained. [33]

2.3.3.2.2: Ungranulocytes:

2.3.3.2.2.1: Monocytes:

Monotypes develop from the same precursor as neutrophils - the CFU-GM. This then differentiates into the CFU-M under the influence of GM-CSF, IL-3 and M-CSF.

Stages:

- Monoblast

This is the first stage after cell has differentiated into the CFU-M.

- Promonocyte

Cell has a large nucleus and basophilic cytoplasm and consists of two populations:- One rapidly dividing and the other slowly dividing, which acts as a reservoir.

- Monocytes

Coenocytes are incapable of mitosis and enter the circulation. They have a large kidney shaped nucleus with a slightly basophilic cytoplasm, which is often vacuolated.

- Macrophage

Once the monotype has entered tissue it differentiates into a macrophage.

- Dendritic cells

These develop from the monoblast under the stimulation of GM-CSF and IL-4 into an immature dendritic cell. This then develops into the mature dendritic cell under stimulation of TNF-α. . [33]

2.3.3.2.2.2: Lymphopoiesis:

Lymphocytes develop from the CFU-L's. Those destined to become T cells leave the bone marrow and migrate to the thymus, and those destined to be B cells migrate to the spleen and gut-associated lymphoid tissue (GALT) or proliferate directly from the bone marrow.

-Plasma & Memory cell

T Cell Helper Cytotoxic Regulatory NK cell Dendritic cell

T cell differentiation into helper, cytotoxic and T cells with regulator functions is induced by IL-10 & TNF-γ. ([39]

2.3.3.3:Thrombopoiesis:

Thrombopoiesis refers to the process of thrombocyte generation .Thromobocytes are ligations of the cytoplasm from megakaryocytes. A single megakaryocyte can give rise to thousands of thrombocytes.

The term "thrombocytopoiesis" is sometimes used to emphasize the cellular nature. Thrombopoietin stimulates megakaryopoiesis, the process of megakaryocyte maturation and differentiation. Thrombopoietin, upon release, binds to its receptor, c-mpl, found on megakaryocyte progenitor cells. Following binding, intracellular signaling leads to megakaryocyte growth, maturation, membrane stability, platelet granule formation and the demarcation of the cytoplasm into regions destined to fragment into mature platelets. These "pro platelet processes" further fragment into platelets. This last step of pro platelet process and platelet formation, in vitro, has been shown to be independent of thrombopoietin. [40,41]

2-3-4: Complete blood cell count (CBC):

The complete blood count (CBC) is one of the most commonly ordered blood tests. The complete blood count is the calculation of the cellular (formed elements) of blood. These calculations are generally determined by special machines that analyze the different components of blood in less than a minute. A major portion of the complete blood count is the measure of the concentration of white blood cells, red blood cells, and platelets in the blood.

CBC count is a measurement of size, number, and maturity of the different blood cells in a specific volume of blood. A CBC can be used to determine many abnormalities with either the production or destruction of blood cells. Variations from the normal number, size, or maturity of the blood cells can be used to indicate an infection or disease process. [42].

2.3.4.1: Components of the complete blood count:

- White blood cell count (WBC) is the number of white blood cells in a volume of blood. Normal range varies slightly between laboratories but is generally between 4.300 and 10.800 cells per cubic millimeter (cmm). This can also be referred to as the leukocyte count and can be expressed in international units as 4.3 to 10.8 x 109 cells per liter.

- White blood cell differential count. White blood count is comprised of several different types that are differentiated, or distinguished, based on their size and shape. The cells in a differential count are:

  Granulocytes, lymphocytes, monocytes, eosinophils, and basophils. A machine generated percentage of the different types of white blood cells is called the automated WBC differential. These components can also be counted under the microscope on a glass slide by a trained laboratory technician or a doctor and referred to as the manual WBC differential.
- Red cell count (RBC) signifies the number of red blood cells in a volume of blood. Normal range varies slightly between laboratories but is generally from 4.2 to 5.9million cells/cmm. This can also be referred to as the erythrocyte count and can be expressed in international units as 4.2 to 5.9 x 1012 cells per liter.

  Red blood cells are the most common cell type in blood and people have millions of them in their blood circulation. They are smaller than white blood cells, but larger than platelets.
- Hemoglobin (Hb). This is the amount of hemoglobin in a volume of blood. Hemoglobin is the protein molecule within red blood cells that carries oxygen and gives blood its red color. Normal range for hemoglobin is different between the sexes and is approximately 13 to 17.5 grams per deciliter for men and 12 to 15.5 for women (international units 8.1 to 11.2 mill moles/liter for men, 7.4 to 9.9 for women).
- Hematocrit (Hct). This is the ratio of the volume of red cells to the volume of whole blood. Normal range for hematocrit is different between the sexes and is approximately 45% to 50% for men and 37% to 45% for women. This is usually measured by spinning down a sample of blood in a test tube, which causes the red blood cells to pack at the bottom of the tube.

- Mean corpuscular volume (MCV) is the average volume of a red blood cell. This is a calculated value derived from the hematocrit and red cell count. Normal range may fall between80 to 100 femto liters (a fraction of one millionth of a liter).
- Mean Corpuscular Hemoglobin (MCH) is the average amount of hemoglobin in the average red cell. This is a calculated value derived from the measurement of hemoglobin and the red cell count. Normal range is 27 to 32 pico grams.
- Mean Corpuscular Hemoglobin Concentration (MCHC) is the average concentration of hemoglobin in a given volume of red cells. This is a calculated volume derived from the hemoglobin measurement and the hematocrit. Normal range is 32% to 36%.
- Red Cell Distribution Width (RDW) is a measurement of the variability of red cell size and shape. Higher numbers indicate greater variation in size. Normal range is 11 to 15.
- Platelet count. The number of platelets in a specified volume of blood. Platelets is not complete cells, but actually fragments of cytoplasm (part of a cell without its nucleus or the body of a cell) from a cell found in the bone marrow called a megakaryocyte. Platelets play a vital role in blood clotting. Normal range varies slightly between laboratories but is in the range of 150,000 to 400,000/ cmm (150 to 400 x 109/liter).

Mean Platelet Volume (MPV). The average size of platelets in a volume of blood[(43)]

2.3.5: C - reactive protein (CRP):

C-reactive protein (CRP) is a substance produced by the liver in response to inflammation. Other names for CRP are high-sensitivity C-reactive protein (hs-CRP) and ultra-sensitive C-reactive protein (us-CRP)

High level of CRP in the blood is a marker of inflammation. It can be inflammatory condition. Caused by a wide variety of conditions, from infection to cancer. High CRP levels can also indicate that there's inflammation in the arteries of the heart, which can mean a higher risk for heart attack. However, it's important to remember that the CRP test is an extremely nonspecific test. [44]

2.3.6: Haematological change in cardiovascular diseases:

Anemia is a known risk factor for ischemic heart disease and a frequent finding in patients with acute coronary syndrome. [45] Multiple factors related to red blood cells are associated with coronary heart disease, including hemoglobin, hematocrit, RDW, and erythrocyte sedimentation rate.[46] Several studies suggest a detrimental effect of anemia in patients with acute myocardial infarction[47] , related to reduced oxygen content in the blood, increased myocardial oxygen consumption due to elevated cardiac output to maintain appropriate tissue oxygenation, bleeding episodes during invasive procedures, anticoagulation, and inflammation.[48] A reduced oxygen transport capacity in anemia causes a compensatory increase of the heart rate, resulting in a shorter myocardial perfusion time in diastole.[49]A few studies in disease-free subjects and patients with vascular disease showed an association between increased hematocrit and increased risk of coronary heart disease, but low risk ratios were observed, and, therefore, the clinical usefulness of hematocrit alone is not clear.[50] Thrombotic events are important causes of morbidity and mortality in polycythemia vera . Recent studies showed a negative correlation between hematocrit to blood viscosity ratio and likelihood of cardiac death in coronary heart disease patients. [51]

The anemia of inflammation can reduce hemoglobin within 1-2 days, due to hemolysis of red blood cells and a suppression of the response to erythropoiesis mediated by tumor necrosis factor and acute changes in iron metabolism.[52] An increased uptake of iron in the reticuloendothelial system is responsible for the

lowered Fe level, iron saturation of transferrin, and total iron binding capacity.[53] .A reverse association was found between C-reactive protein and anemia, inflammation explaining the decline in hemoglobin.

The red cell distribution width (RDW), reflecting mean corpuscular volume heterogeneity, is an early parameter of iron deficiency, sideroblastic, vitamin B12, and folic acid deficiencies.[49] In patients with stable coronary artery disease, higher red cell distribution width (RDW), an index of anisocytosis, corresponds to higher comorbidity burdens (diabetes mellitus, heart failure, atrial fibrillation, peripheral vascular disease, and chronic kidney disease) and is an independent predictor of mortality . The mentioned comorbidities are associated with a proinflammatory state and oxidative stress. Oxidative stress impairs membrane fluidity of the erythrocytes, reducing the life span of the red blood cells, and inflammation is known to block iron metabolism and erythropoietin response. Increased RDW is associated with impaired micro vascular perfusion, causing hypoxia even in patients without anemia [47]. RDW was an independent predictor of death in patients with a previous myocardial infarction or stroke and of death secondary to cardiovascular diseases [50].

Components of the complete blood count, such as hematocrit, white blood cell count, and their subtypes, are associated with coronary heart disease and can improve our ability to predict coronary heart disease risk [48]. Several possible mechanisms of the role of red blood cells in coronary heart disease have been suggested, including viscosity, increased platelet aggregation associated with release of adenosine diphosphate, association with elevated serum cholesterol and triglycerides, deposition of cholesterol in the atherosclerotic plaque, stimulation of an excessive influx of macrophages, enlargement of the atherosclerotic necrotic core, and decreased fluidity of red blood cells [48].

An imbalance between oxygen demand and supply, bleeding episodes due to invasive procedures and anticoagulation, inflammation, hemodilution, and kidney failure are the main mechanisms linking anemia and coronary heart disease , Red blood cell count, hemoglobin, hematocrit, and RDW should be monitored in patients with coronary heart disease.[51]

2.4: Previous studies:

- -Study done by Toshio kobayashi, *et al*, relationship between haematological parameters (high PCV and Hb) incidence of ischaemic heart diseases among Japanese white-collar male workers .[52]
- In the study which conducted by shiyovich and gilutz, his colleagueat 2017 in texas, showed elevated WBC count was found to be a relevant death risk factor during the first 30 days and 6 months following the myocardial infarction among patients with ACS .[53]
- In the study which conducted by shiyovich benjamin D horne and jeffreyl anderson, his colleagueat 2005 in american, showed increased number of neutrophils and MPV in patients with a front wall myocardial infarction is strongly and independently connected to the development of microvascular reperfusion injury after recanalisation of infarct-related artery .[54]
- In the study which conducted by lippi, his colleagueat 2005 in american, . indicated a relationship between higher levels of RDW and the risk of death and adverse cardiovascular outcomes in people with prior myocardial infarction but without symptomatic heart failure .[55]
- In the study which conducted by Yuji and Eiji , his colleagueat 1995 in Japanese , relationship between haematological parameters (high PCV and Hb) incidence of ischaemic heart diseases among Japanese white-collar male workers. [56]

- In the study which conducted by moo-young kim and duk- chul lee, his colleagueat 2013 in korean, Assessed the association between hemoglobin or hematocrit level and cardio vascular disease these study show anemia and polycythemia are independent risk factors of cardio vascular disease in the general population as well as in patients with choronic kidney disease, type 2 diabetes, or polycythemia vera.[57]
- In the study which conducted by Onat A, his colleagueat in 2016 in western Turkey showed high CRP in CHD.[58]
- In the study which conducted by Buckley DI , his colleagueat in 2017, in U.S showed strong evidence indicates that high CRP (greater than 3.0 mg/dl) is associated with CHD. [59]
- In the study which conducted by Mohammad Madjid, and Omid Fatemi revealed high number of WBCs and sub type and other component of CBC were associated with CHD. [60]

Chapter three

Materials and methods

3. Materials and Methods

3.1. Study Design:

This is a descriptive cross-sectional aim to determine the haeamatological changes in ischaemic heart disease patients in Almek Nimir University Hospital during a period of (march 2018—august 2018).

3.2. Study Area:

The study was conducted at Almek Nimir University Hospital which located in Shendi town in Sudan. Shendi is a town in Northern Sudan, situated on the east bank of the Nile (150 km) Northeast of Khartoum. Shendi is also about (45 km) southwest of the ancient city of Meroe. Located in the River Nile state, Shendi is the centre of the Ja'aliin tribe and an important historic trading centre. Its principal suburb on the west bank is Al-Matamma. A major traditional trade route across the Bayuda desert connects Al-Matamma to Marawi and Napata, (250 km) to the Northwest. The majority of population profession is farming and trading beside other.Shendi their is Shendi university with various faculties and many hospitals such as :Almak Namer, Altalimy and other.

3.3. Study population:

A total of (40) samples collected of study group of ischaemic heart disease patients Diagnosis of ischemic and (10) samples collected of healthy individuals as control group.

3.4. Data collection tools:

Data was collected using self-administrated per-coded questionnaire which specifically designed to obtain information that helped in study.

3.5. Blood Sampling:

Venous blood collected using sterile disposable plastic syringe after cleaning the venipuncture area with (70%) ethanol, the blood added to the anticoagulant and gently mix.The sample centrifuge at (1300 rpm) for (15min) to obtain plasma.

3.6. Inclusion criteria:

Patients of both sexes with ischaemic heart disease (who take drugs or not take), irrespective of treatment patients with no other medical conditions were included in the study.

3.7. Exclusion criteria:

Patients with other severe diseases such as renal failure, liver disease, haematological diseases and other medical conditions or receiving certain treatment that affect the results were excluded from study.

3.8. Methods:

3.8.1. CBC was done by using mindray haematology analyzer (Mindray bc-3000):

3.8.1.1. Principle: blood cells can be broadly divided into three categories .red blood cells, White blood cells and platelets. The analyzer measures the number of cells and distinguishing between their types according to size using sheath flow DC detection. Electrical current is passed through a solution; this method measures the changes in electrical resistance that occurs when blood cells pass through detection aperture. This instrument performs haematology analyses according to the RF/DC detection method, Hydro Dynamic Focusing (DC Detection), and sodium lauryl sulphate (SLS) haemoglobin method. The radio frequencies and direct current (RF/DC detection method) detects the volume of blood cells by changes in direct- current resistance.

3.8.1.2. Procedure:

RBCs count, Hct, Hb concentration, haematimetric indices (MCV, MCH, and MCHC), RDW, WBCs and platelets counts were measured by using an automatic blood cell counter (Mindray -3000 analyzers). The assay was performed according to the instructions provided by the manufacturer. The analyzer was controlled by normal control, abnormal high and abnormal low.

the EDTA blood samples were aspirated into analyzer through a sample probe, and the counting was started automatically, the results were displayed on the screen within (20) second, the print key was pressed to print out the results.

3.8.2: C. reactive protein:

3.8.2.1: Priniciple:

The test uses a sandwich immunodetection method, such that the detector antibody in buffer binds to CRP in sample and antigen-antibody complexes are captured to another CRP antibody that has been immobilized on test strip as sample mixture migrates nitrocellulose matrix. Thus the more CRP antigen in sample, the more antigen-antibody complexes accumulated on the test strip. Signal intensity of fluorescence on detector antibody reflects the amount of antigen captured and is processed by ichroma™ Reader to show CRP concentration in specimen. [162] [163]

Reference Range: < 10 mg/L

3.8.2.2. Components and reagents:

Ichroma™ CRP consists of a ‘Test cartridge’, an ‘ID chip’, a Blood Collecting Capillary, and a ‘Detection buffer tube’

- The test cartridge contains a test strip; on the membrane of which, murine antibodies against CRP and rabbit IgG have been immobilized at the test line and the control line respectively.

- Each test cartridge is individually sealed in an aluminum foil pouch containing a desiccant. (25) Sealed test cartridges are packed in a box which also contains an ID chip.
- The detection buffer pre-dispensed in a tube contains fluorochrome-labeled anti-CRP antibodies, fluorescent-labeled anti-rabbit IgG, bovine serum albumin (BSA) as a stabilizer and sodium azide in phosphate buffered saline (PBS) as a preservative.
- The detection buffer is dispensed in each detection buffer tube. (25) Detection buffer tubes are packed in a separate box which is further packed in a Styrofoam box provided with ice packs for the purpose of shipment.
- Blood collection capillary is used for picking up (10 μL) of whole blood, serum, plasma, or control solution.

3.8.2.3. Test procedure:

1. Puncture was made on the top of the detector tube by inserting an empty blood collection capillary.
2. Prick was made on a finger with a lancet. Draw whole blood with a blood collection capillary. (Serum or plasma or CRP control can be drawn with a blood collection capillary.)
3. The excess blood wipe out outside of the capillary with paper towel or Kimwipes.
4. Assembled the capillary and the tube into one.
5. The assembled tube was shaked (10 times) by inversion to take the blood out of capillary.
6. The cap off the top of tube was removed. Discard two drops of reagent onto the paper towel before applying to the cartridge.
7. Apply only two drops onto the sample well of a cartridge

8. To scan the sample-loaded test cartridge, insert it into the test cartridge holder of the ichroma™ Reader. Ensure proper orientation of the test cartridge before pushing it all the way inside the test cartridge holder. An arrow has been marked on the test cartridge especially for this purpose.

9. Press 'Select' button on the ichroma™ Reader to start the scanning process.

10. ichroma™ Reader will start scanning the sample-loaded test cartridge after 3 minutes.

11. The test result was read on the display screen of the ichroma™ reader. [166] [167]

3.9. Ethical consideration:

The consent of the selected individuals to the study was taken after being informed with all detailed objectives of the study and it is health emphasis in the future.

3.10. Data analysis:

The collected data code in master sheet and proceed for analysis using SPSS version 20 (mean, standard deviation, standard error mean, P.value).by using independent T test.

Chapter four

Results

4. Results

4.1: Demographic and clinical data:

A total of (40) blood samples collected from ischaemic heart disease patients and (10) samples collected as control from healthy individuals include:

Frequency of sex was 11 males (28%) and 29 females (72%) .

Table (4.1): Distribution of study population according to sex and age:

Characteristic		Frequency	Percent %
Study groups	Cases	40	80%
	Controls	10	20%
Sex	Male	11	28%
	Female	29	72%
Age	Less than 40	2	05%
	40-80	38	95%

In table(4-2) Participation to risk factors to ischaemic heart disease reflected that: 27 (67.5%) were HTN patients, while 13 (32.5%) were not , On the other hand, 13 (32.5%) were DM patients, while the remaining 27 (67.5%) were not , Furthermore 2 (5%) of the patients were smokers, while 38 (95%) of them were not, Regarding family history, most of the patients 26 (65%) with no family history of ischemic heart disease and 14 (35%) were family history.

Table (4.2): Distribution of Study Population According to Risk Factors:

Characteristic		Frequency	Percent %
HTN	Yes	27	67.5%
	No	13	32.5%
DM	Yes	13	32.5%
	No	27	67.5%
Smoking	Yes	2	05%
	No	38	95%
Family history	Yes	14	35%
	No	26	65%

Haematological Data:

In table (4-3) The mean values of Hb, PCV, RBCs, MCV, MCH, MCHC, RDW, TWBCs in case group were (12 g/dl), (40.9%), ($4.8x10^{12}$/l), (88.3 fl), (25.1 pg), (28.4 g/dl), (16.5) and ($8.4x10^{12}$/l) respectively and in control group the mean values of Hb, PCV, RBCs, MCV, MCH, MCHC, RDW,TWBCs were (12.8 g/dl), (42.8%), ($5.2x10^{12}$/l), (88.5 fl), (25.7 pg), (29.7 g/dl) , (16.4) and($6.1x10^{12}$/l), respectively. Table (4.3).

Table (4.3): Comparison between case and control in Hb, RBCs,PCV, RBCs indices RDW.

Groups		Number	Mean	SD	P.value
Hb g/dl	Cases	40	12.0	1.55	0.153
	Controls	10	12.8	1.53	
RBCsx10^9	Cases	40	4.8	.7637	0.229
	Controls	10	5.2	.7812	
PCV %	Cases	40	40.9	7.35	0.952
	Controls	10	42.8	6.37	
MCV fl	Cases	40	88.3	7.20	0.932
	Controls	10	88.5	4.72	
MCH pg	Cases	40	25.1	4.38	0.672
	Controls	10	25.7	3.96	
MCHC g/dl	Cases	40	28.4	4.50	0.425
	Controls	10	29.7	3.93	
RDW	Cases	40	16.5	2.35	0.907
	Controls	10	16.4	1.61	

In table (4-4) The mean of platelet count, MPV , hsCRP and TWBCs in IHD were (316.5 x 10^9 /l), (8.6) (12.5) (8.4 x 10^9 /l) respectively. the mean of, platelet count , MPV , hsCRP and TWBCs in control were (381.8 x 10^9 /l), (9.5) (2.5) (6.1) respectively.

In table 4,4 there was statistical difference in the mean of MPV and CRP between cases and control with P.value (o.oo2 and 0.009) respectively .

Table (4.4): Relationship between case and control in platelet, MPV, HsC-reactive protein and TWBCs:

Group		Number	Mean	SD	P.value
Platelet $x10^9$	Cases	40	316.57	123.27	0.155
	Controls	10	381.80	145.57	
MPV	Case s	40	8.602	.76443	0.002
	Controls	10	9.500	.74536	
hsCRP mg/dl	Cases	40	12.507	22.612	0.009
	Controls	10	2.5200	2.2265	
TWBCs	Cases	40	8.4	5.52	0.207
	Controls	10	6.1	1.58	

Chapter five

Discussion

conclusion

Recommendations

5.1. Discussion

Ischaemic heart disease (IHD), is a group of diseases that includes stable angina, unstable angina, myocardial infarction, and sudden cardiac death .[61]

The results of this study denoted that the hypertensive patients were in high risk to IHD and showed an increased prevalence, followed by DM as shown in many studies. [62]

The results of this study obtained demonstrated that there was insignificant decrease in Hb, RBCs count and PCV compared to control. (P value >0.05)

Several factors related to RBCs are associated with IHD including Hb levels, PCV but there are not enough data to suggest an association between the RBCs count and cardiovascular disease [63]

This study prevailed that there was no significant diffences in RBCs indices (MCV, MCH & MCHC)between cases and control (p value <0.05).

The RDW, a numerical measure of the variability of the size of circulating erythrocytes, is significantly associated with an increased risk of all-cause death, and specifically with death secondary to CVD in cross-sectional studies of the population of the U.S. In addition, the RDW is an independent predictor of death in patients who have had previous MI or stroke and in men referred for coronary angiography.

Finding of the parameters examined in this study, reflected an increase in the mean of RDW compared to control group and there was no significant statistical value depicted among study population; (P.value 0.907). This result disagreed with the study conducted by (Patel KV et al, 2009), that showed a significant association between RDW and IHD [64].

The results of this research confirmed an increase in the mean of WBCs. There was insignificant statistical relationship found among study population; (P.value 0.207).

Results of the present study were in disagreement with a previous study done by (Mohammad Madjid, and Omid Fatemi.2013), whom suggested that: leucocytosis can be considered as a marker of inflammatory changes in atherosclerotic lesions, because leucocytes play a role in initiation and progression of the disease. Leucocyte release cytokines, bringing about further macrophage recruitment and the proliferation of smooth muscle cells within the vascular wall[65,66].

The laboratory investigations done indicated a decrease in the mean of platelet compared to controls . There was no significant difference in platelets count between cases and controls group (P = 0.155). It appears that the role of platelets in the pathogenesis of IHD is due mainly to their functional properties and their interaction with plasma and tissue factors.[67]

The study estimated a decrease in MPV mean compared to controls. There was strong significant statistical value demonstrated among study population; (P.value 0.002).

The results of the tests conducted showed an increase in the mean of hs-CRP compared to control group. There was strong significant statistical difference appeared among study population; (P = 0.009). The recent study showed strong association between hs-CRP and IHD[69]. The results were in agreement with multiple other studies that presented an increase in CRP of IHD patients. One study denoted that: an increase in hs-CRP was associated with increased incidence of recurrent angina,coronary revascularization and cardiovascular death (Onat A, et al, 2001). It has recently been suggested that hs-CRP is a marker of inflammation, along with serum cholesterol, may be critical component in the development and progression of atherosclerosis. hs-CRP is emerging as the strongest and most independent predictive risk factor for CVD.[70]

5.2. Conclusion

- Hb, PCV, red cells indices were lower in IHD patients and there was insignificant difference compared to controls. (P value >0.05)
- Platelets were lower in IHD patients and there was insignificant compared to controls. (P value >0.05)
- TWBCs were higher in IHD patients and there was insignificant compared to controls. (P value >0.05)
- Serum hsC-reative protein was higher in IHD patients and there was significant compared to controls. (P value <.05)
- MPV were lower in IHD patients and there was significant compared to controls. (P value <0.05)

5.3. Recommendations

1-Haematological tests should be checked regularly in ischaemic heart disease patients.

2-Health education, diet control and exercise are important factors in lowering the body weight especially in obese patients so as to achieve good control of ischaemic heart disease.

3-More investigations should be done for ischaemic heart disease patients, to determine which risk factors and thrombotic markers are important predictors of bleeding and thrombotic risk among ischaemic heart disease patients.

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Appendices

Appendix I

Questionnaire

Determination of Haematological and Biochemical Changes in Ischaemic Heart Disease Patients

- *Age* ☐

- *Gender:*

Female ☐ *Male* ☐

- *Smoker*

Yes ☐ *no* ☐

- *duration of smoking……*

- *family history of cardiac disease:*

Yes ☐ *no* ☐

- *chronic disease :*

Yes ☐ *no* ☐

determine ……

- *Drugs :*

yes ☐ *no* ☐

- *type of food :*

vegetable ☐ *animal* ☐

Results

- *CBC finding*

Hb g/dl ☐

RBCS count ☐

TWBCS ☐

PCV ☐

MCV ☐

MCH ☐

MCHC ☐

RDW ☐

Platelet count ☐

MPV ☐

Differential WBCs :

N ☐ *L* ☐ *M* ☐ *E* ☐ *B* ☐

CRP ☐

Appendix II

إقـــرار بالموافقـــة

الاسم :----------

العمر :---------- العنوان :----------

أوافق بمحض إرادتي بالمشاركة في البحث العلمي المتعلق بدراسة التغييرات الدموية لدي مرضي أمراض القلب الإحتشائية في مستشفى المك نمر الجامعي .

نسرين عوض الأمين سالم

بعد أن شرح لي بأنه لا يترتب عليه أي أذى جسدي أو نفسي واعلم أن المشاركة في هذا البحث لن تؤثر بأي حال من الأحوال في الرعاية الطبية التي أتلقاها كما أنه يحق لي بدون إبداء أسباب الانسحاب من هذا البحث في أي مرحلة من مراحله.

البحث بإشراف :

أ:. د.حمزه احمد حسن محمد.د.

التوقيع : ---------- التاريخ :----------