PREVALENCE AND TYPES OF ECG ABNORMALITIES IN RHEUMATOID ARTHRITIS PATIENTS WITHOUT CLINICALLY EVIDENT CARDIOVASCULAR DISEASE AT KENYATTA NATIONAL HOSPITAL

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DECLARATION

I understand the nature of plagiarism and I am aware of the University policy on the same. I declare that this dissertation is my original work and has not been presented for the award of a degree in any other university.

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DEDICATION

I dedicate this work to my family-Without you I wouldn’t be where I am.

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LIST OF ABBREVIATIONS

ACCF: American College of Cardiology Foundation

ACR: American College of Rheumatology

ACS: Acute Coronary Syndrome

AHA: American Heart Association

AR: Aortic Regurgitation.

BMI: Body mass index

CAD: Coronary Artery Disease

CCF: Congestive Heart Failure.

CDAI -Clinical Disease Activity Index.

CVS: Cardiovascular system

DAS: Disease Activity Score

DAS 28 : Disease Activity Score 28

E/A: E wave/A wave ratio

ECG: Electrocardiogram

EULAR: European League against Rheumatism

ILAR: International League of Association against Rheumatism

KNH: Kenyatta National Hospital

LAE: left atrial enlargement

LBBB: Left Bundle Branch Block

LVEF: Left Ventricular Ejection Fraction.

LVH: Left Ventricular Hypertrophy

MI: Myocardial Infarction

MR: Mitral Regurgitation

MS: Mitral Stenosis.

RA: Rheumatoid Arthritis.

RAE: Right atrial enlargement

RBBB: Right Bundle Branch Block

RVH: Right ventricular Hypertrophy

SDAI: Simple Disease Activity Index

TR: Tricuspid Regurgitation

UON: University of Nairobi

WHO: World Health Organization

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ABSTRACT

Background: Cardiovascular disease (CVD) is one of the extra articular manifestations of RA and one of the leading cause of death in these patients. All layers of the heart may be involved in RA patients with pericarditis being the most common form of cardiac involvement. Routine electrocardiograms can help detect cardiac abnormalities earlier in RA patients leading to appropriate management being instituted early thus causing a reduction in adverse outcomes including mortality.

Objective: The primary objective of this study was to describe the prevalence and types of resting ECG abnormalities in RA patients attending KNH rheumatology clinic.

Study design and setting: A cross sectional descriptive study done at KNH rheumatology clinic over a period of 3 months from 9/8/2022 to31/10/2022. All adults 18 years and above attending KNH rheumatology clinic and fulfilling the ACR EULAR 2010 criteria were the study population.

Methods: A consecutive sampling technique was used to recruit 91 patients who satisfied the ACR /EULAR 2010 diagnostic criteria for RA. The Principal investigator performed ECGs on all cases and interpreted them as per ACC/AHA recommendations for standardization and interpretation of ECG. Data was collected via a printed questionnaire, and checked for completeness prior to entry into the Microsoft Excel 2017. Thereafter, the data was exported to the Statistical Package for Social Sciences (SPSS) version 24.0 for analysis.

Results: The study included 91 patients (71 females and 20males) with rheumatoid arthritis without evident cardiovascular disease. The mean age was 44.3 years. The mean disease duration was 10 years and majority of the study population had a moderate disease activity index at 45.6% and 3.3% being in remission. The total prevalence of abnormal of electrocardiographic abnormalities observed in our study population was 29.6%. Electrocardiographic abnormalities found were dominated by left ventricular hypertrophy encountered in 23 patients (25.6%), left atrial enlargement in 16.7% of cases, 8.9% of patients had left axis deviation. Atrial fibrillation was present in 4.4% of the study population with AV block being present in 4% of the participants. Premature atrial contractions were present in 3.3% of the participants and premature ventricular contractions were noted in 2.2% of the study population. Pathological Q waves were seen in 7.8% of the patients.

Conclusion: This study highlights the need for systematic electrocardiogram in patients with rheumatoid arthritis, even in the early stages of the disease when cardiovascular involvement is clinically silent because electrocardiographic abnormalities are prevalent in RA patients.

1.0 INTRODUCTION

RA is a chronic systemic inflammatory disease of unknown etiology. External triggers such as cigarette smoking, infection or trauma trigger an autoimmune reaction leading to synovial hypertrophy, chronic joint inflammation and extra articular manifestations .It is theorized to occur in genetically susceptible individuals(1). Rheumatoid arthritis is amongst the leading causes of chronic morbidity in the developed world with little information available about the disease burden in developing world, including Africa(2). The male to female ratio of rheumatoid arthritis in the younger population is 3:1 while in the older population it is 1:2(3). RA once a rare disease is now reported in large numbers from many parts of Africa due to an increase in population and increased modalities of diagnosis. Epidemiological surveys in Sub-Saharan Africa have shown an estimated prevalence of 0.25% which is similar to the global prevalence of rheumatoid arthritis that ranges from 0.24 to 1%(4).

RA and SLE are shown to be of increasing frequency in the indigenous population of East, Central and South Africa but remain rare in West Africa(5). 37.3% of patients attending rheumatology clinic at KNH were found to have rheumatoid arthritis(6).

Increased knowledge on rheumatoid arthritis coupled with better healthcare has contributed to a high number of people being diagnosed with rheumatoid arthritis.

The extra articular manifestations of RA occur at any age and point from onset of the disease. It is characterized by destructive poly arthritis and extra articular organ involvement including eye, skin ,lung, renal, nervous and gastrointestinal system(7). Extra articular manifestations develop in 47 % of patients with RA within a few years of diagnosis(8).

Survival in RA is markedly reduced compared to the general population with positive rheumatoid factor being a bad prognostic indicator(9). Heart disease is a major cause of death amongst RA patients with extra articular features(10). Extra articular manifestations of RA are associated with poor outcomes and patients presenting with them should be prioritized and given the best treatment and care possible(8). Extra articular disease is a major predictor of mortality in RA patients (9).In a study done in 2013 at the rheumatology clinic in KNH by Kirui et al, on the prevalence of hypertension among RA patients was 41.3%, diabetes mellitus 6.3%, dyslipidemia 71.3%,smoking 5%,obesity 22.5%,abnormal waist to hip ratio 33.8%,family history of sudden death 5%(10).

A study done in Senegal in 2015 by Mouhamadou et al to elicit the importance of ECG for detection of preclinical abnormalities in RA patients without cardiovascular events, 46.6% had Left Ventricular Hypertrophy, 32.9 % had Left Atrial Enlargement, 16.4% had Left axis deviation and 8.45% had ventricular premature beats found in patients with active RA(11). Echocardiogram studies done 2 years ago in 2017 on RA patients in KNH by Sayo et al on 104 patients showed prevalence of lesions unrelated to CDAI 62.5%,(pericardial effusion39.4%,TR 15.4%,pulmonary hypertension 5.5%)(12).Patients with RA have twice the risk for developing Congestive Heart Failure when compared with the rest of the normal population. This excess risk is not explained by traditional cardiovascular risk factors or clinical ischemic heart disease(13).

2.0 LITERATURE REVIEW

The precise cause of RA is unknown, and the prognosis is guarded, especially in those with high disease activity states. Better understanding of the pathogenesis of RA has stimulated the development of new biologic therapies, with better outcomes, all in pursuit of clinical remission. Joint erosions, rheumatoid nodules and other extra articular manifestations are seen primarily in patients with longstanding, poorly controlled disease but are frequently absent at initial presentation (8).

2.1 PATHOPHYSIOLOGY OF RHEUMATOID ARTHRITIS

The pathogenesis of RA is relatively unknown. However an external trigger e.g. cigarette smoking, infection or trauma sets off an autoimmune reaction leading to synovial hypertrophy and chronic joint inflammation along with extra articular manifestations theorized to occur in genetically susceptible individuals (1).

2.2 ENVIRONMENTAL AND GENETIC FACTORS

Those with genetic risk factors have up to 50% susceptibility of developing RA(14). Various immune regulatory factors underlie the disease. The alleles that contain a common amino acid motif (QKRAA) in the HLA-DRB1 region, called the shared epitope, confers an increased susceptibility for patients to develop RA(15). Gene interaction between HLA-DRB1, PTPN22 and TRAF5 confers increased risk for RA and predisposes individuals to poor outcomes(16).

Smoking, Obesity and blood transfusion are potential environmental triggers to rheumatoid arthritis(17). Smoking in the patients with HLA-DR SE genes has been postulated to trigger rheumatoid arthritis specific immune reactions to citrullinated proteins increasing the levels of anti-CCP in these patients(18). Citrullinated alpha enolase has been identified as a specific citrullinated autoantigen linking smoking to genetic risk factors in the development of rheumatoid arthritis(19).Infections e.g. EBV ,CMV E.coli etc. might produce heat shock proteins that are postulated to form immune complexes that can trigger rheumatoid arthritis via molecular mimicry (14). Rheumatoid factor and Anti citrullinated proteins are sometimes seen in some patients before development of arthritis, as the disease develops, the autoantibody levels have been shown to increase(20).

3.0 CARDIAC DISEASE IN RHEUMATOID ARTHRITIS

Patients with RA have a significantly higher risk of heart failure compared to non RA Patients. This was noted to begin soon after the onset of RA and continuing throughout the course of the disease (13). RA patients are less likely to report symptoms of angina and more likely to experience unrecognized myocardial infarction and sudden cardiac death(21).

Traditional risk factors for cardiovascular disease (CVD), such as smoking, hypertension, diabetes, and hyperlipidemia, do not fully account for the increased risk of CVD in patients with RA. In patients with RA, traditional and non-traditional risk factors play a role in the development and exacerbation of CVD (13).

All layers of the heart may be involved in RA patients. Pericarditis is the most common form of cardiac involvement in these patients; moreover, valvular disorders, coronary vasculitis, and ventricular diastolic dysfunction can be seen in RA. Myocardial edema and fibrosis typical for myocarditis may cause conduction defects and arrhythmias(22).

3.1 MYOCARDIAL AND PERICARDIAL DISEASE IN RHEUMATOID ARTHRITIS

Myocardial disease is normally silent and may occur as myocarditis, myocardial fibrosis and hypertrophic cardiomyopathy (21)**.** Various noninvasive modalities should be used to monitor and evaluate rheumatoid arthritis patients and institute treatment to those at greatest risk. Tissue Doppler ECHO is capable of identifying diastolic function that is impaired in rheumatoid arthritis that may not be detected by other conventional means like ECG(23).

In a cross sectional study on cardiac involvement in RA patients done in Iran involving 74 patients, ventricular dysfunction and pericardial involvement were the most common ECHO findings while ST segment and T wave changes were the most common ECG findings(24).Di Franco et al in Italy showed that 11.6% RA patients, had diastolic dysfunction characterized by impaired E/A and S/D ratio. The relationship between trans- mitral flow alteration and disease duration suggested a subclinical myocardial involvement(25). One third of rheumatoid arthritis patients had pericardial effusion in a study by William Macdonald et al and half of those patients exhibited features of chronic pericarditis (22).Four out of 32 patients followed up for 25 years in Dublin with serial ECHOS had constrictive pericarditis(26).

3.2 VALVULAR HEART DISEASE

Systemic inflammation from various connective tissue diseases has been to shown affects heart valves. In a study by Beckhauster et al 184 patients with RA without cardiac symptoms were studied using bi-dimensional echocardiography. Fifteen percent of the investigated patients had valvular heart disease. Valvular lesions were mainly detected in patients with more than a period of 15 years of rheumatoid arthritis disease with the aortic valve being the most affected(27) .Sayo et al found more than 15 % of the 104 patients he studied in KNH rheumatology clinic to have TR. Other risk factors e.g. cigarette smoking, gender, age and positive anti-inflammatory factors did not seem to affect valve involvement (12) .

A study by Guedes et al involving 30 rheumatoid arthritis with no known cardiac anomalies had 80% of patients demonstrating Mitral regurgitation. Other valves (pulmonary and tricuspid) have also been involved in a few cases(28). However not all studies have linked valve involvement in RA patients with disease activity(29). Disease duration, activity, sex and inflammation severity have been reported as contributors to valvular heart disease in RA patients(30).

3.3 PULMONARY HYPERTENSION IN RHEUMATOID ARTHRITIS

The prevalence of PAH as studied by Udayakumar et al in unselected 45 patients with RA without cardiac disease and corresponding age and sex matched by controls by Doppler echo found the incidence of PA pressure of more than30mmhg suggesting pulmonary hypertension was higher in RA in comparison to the controls (26.7 % vs 4.5%)(31).

3.4 CONGESTIVE HEART FAILURE IN RHEUMATOID ARTHRITIS

CHF is more prevalent in rheumatoid arthritis patients in comparison to non RA patients. In a retrospective study done in USA, Minnesota by Gabriel et al involving 900 patients ,17% RA vs 11% Non RA had CHF(32). In RA patients, ECHO findings suggestive of subclinical contractile dysfunction and diastolic filling anomalies are both predictive of subsequent CHF (22). Various ECHO studies done in RA patients without clinically evident cardiac disease show that most have a diastolic dysfunction with a preserved ejection fraction and this finding is more in those with a longer duration of disease(33).

Chronic inflammation in RA possibly contributes to heart failure in addition to other traditional risk factors. An ECHO study done by Guedes et al involving 30 patients showed that the RA patients had significant cardiac anomalies (83% versus 53% in the control group) (28) .This compared favorably with one done at KNH, rheumatology clinic by Sayo et al involving 104 patients whose results were; 65 % had

cardiac anomalies (41% had pericardial effusion), 26% had valvular anomalies (TR-15.4%, AR-6%,MR-5.8%,MS-1.9%). Less than 3 % of the patients had an ejection fraction of less than 50% (12).

4.0 ELECTROCARDIOGRAPHY

A study done in Senegal in 2015 by Mohamadou et al on the importance of electrocardiogram for detection of preclinical anomalies in RA patients noted that the abnormalities found were dominated by LVH (46.57%), LAE(32.90%) and LAD (16.44%) which are all associated with increased cardiovascular risk in RA patients (11). An ECG study done in Iran to check on cardiac anomalies in RA, involving 100 patients, found out that the most common findings in the patients ECG were ST and T wave changes.
Sinus tachycardia was observed in 1, low voltage in 1, PVCs in 2, axis deviation in 3, poor R progression in 3, branch block in 4, and P pulmonale in 5 patients (24).

The prolongation of QTc interval is an established electrocardiographic predictor of the risk of arrhythmia and sudden death in the general population. In a study done in Poland it was reported, that a 50-ms increase of QTc was associated with doubling the risk of mortality. A significantly higher mean QTc interval was found in RA patients compared to the controls, without any relationship to the disease activity markers(34).RA was associated with an increased incidence of atrial fibrillation and stroke in a Danish cohort study.The overall incidence of atrial fibrillation was approximately 40% higher in rheumatoid arthritis patients than in the general population (age and sex matched event rates of 8.2 and 6.0 per 1000 person years)(37). P wave duration and P wave dispersion was found to be higher in RA patients than healthy control subjects. PWD is closely associated with disease duration and left ventricular (LV) diastolic dysfunction (12).

5.1 PROGNOSTIC SIGNIFICANCE OF RESTING ECG ANOMALIES

ECG anomalies have been linked with increased mortality in non-RA population with LVH, bundle branch block (LBBB and RBBB), ST depression, arrhythmias predominantly atrial fibrillation and features of ischemia being the most predictive. Their predictive value was found to be similar for both men and women(35).

Patients with RA are at higher risk of clinical AF recurrence, and are more likely to be taking antiarrhythmic drugs and require repeated ablation(36). A 50-ms increase in QTc interval associates with a doubling of the hazard for all-cause mortality in patients with RA (34). Cardioversion rates were also noted to lower in patients with RA who have AF and high inflammatory burden with persistently increased serum inflammatory indices (44).

6.0 JUSTIFICATION OF THE STUDY

RA is increasingly being diagnosed in our set up. Extra articular manifestations, cardiac included, contribute to mortality and morbidity. ECHO studies on the same done locally have shown more than 60% cardiac involvement (12). In Africa we have a single study on ECG anomalies in RA patients (11) and none done locally. ECG is a non- invasive, affordable and widely available screening tool .Early detection of cardiac involvement using ECG may reduce the morbidity and mortality due to cardiovascular causes in these patients There's a higher incidence of conduction defects and arrhythmias in RA patients as compared to the general population(37).Hence this study was aimed at getting us that information and hopefully that data will help us incorporate ECG studies in managing RA patients ,institute preventive measures and do appropriate management.

7.0 RESEARCH QUESTION

What are the resting electrocardiographic findings in rheumatoid arthritis patients attending a rheumatology clinic at a referral hospital without clinically evident cardiovascular disease?

8.0 OBJECTIVES.

8.1 BROAD OBJECTIVE

To determine the prevalence and types of resting ECG changes in rheumatoid arthritis patients attending Kenyatta National Hospital rheumatology clinic.

8.1.1 PRIMARY OBJECTIVES

1 To determine the prevalence of resting ECG abnormalities in RA patients attending KNH rheumatology clinic.

2. To describe the type(s) of resting ECG abnormalities in RA patients attending KNH rheumatology clinic.

9.0 STUDY DESIGN AND METHODOLOGY

9.1 Study design

A cross sectional descriptive study

9.2 Study site

The study was conducted at KNH rheumatology clinic. KNH is a teaching and referral hospital located in the capital city, Nairobi. It is also a primary care center for The University of Nairobi residents. It has an 1800 bed capacity and runs the largest rheumatology clinic in the country. The catchment is largely from the surrounding metropolis with many referrals from almost all parts of the country. Rheumatology clinic runs every Tuesday and Thursday from 2pm to 5pm, an average of 100 patients are reviewed in every clinic.

9.3 Study population:

All adult patients more than 18 years at KNH rheumatology clinic fulfilling the ACR criteria without any clinically evident cardiovascular disease were consecutively sampled over 3 months.

10.0 Case definition

Patients more than 18 years who presented in the KNH Rheumatology clinic with a documented diagnosis of RA by a rheumatologist and meeting the revised 2010 ACR-EULAR criteria for RA.

10.1 Inclusion criteria:

- Adults 18 years and above with RA
- Patients who consented to participate in the study

10.2 Exclusion criteria

- Patients with RA who were pregnant.
- Patients who were on follow up for a cardiovascular disease
- Patients with mixed arthritides

11.0 Sample size estimation:

The following formula was used to determine the sample size from an estimated population of 130 RA patients attending the RA clinic at KNH;(38).

Sample size was calculated using the Fischer's formula;

$$n = \frac{Z^2 x\ P(1-P)}{d^2}$$

Where,

n = Desired sample size

Z = value from standard normal distribution corresponding to desired confidence level (Z=1.96 for 95% CI)

P = expected true proportion (estimated at 46.7%, from a cross sectional descriptive study conducted by Mouhamadounazirou Dodo et al (2015) which included prospectively 73 RA patients of both sexes at the University Hospital Center Aristide Le Dantec in Dakar, Senegal.

d = desired precision (0.05),

$$n_0 = \frac{1.96^2 x\ 0.467(1-0.467)}{0.05^2} = 382$$

Currently in Kenyatta national hospital approximately 130 RA patients are seen in the Rheumatology clinic. Adjusting the sample size for finite populations less than 10,000

$$nf = \frac{n_0}{1 + \frac{n_0 - 1}{N}} = \frac{382}{1 + \frac{382 - 1}{120}} = 91$$

A Sample size of 91patients was sampled for the study.

12.0 Sampling method

A convenience sampling technique was used to recruit RA patient who visited the KNH Rheumatology clinic till a sample size of 91 patients was achieved. The clinic operates twice a week, every Tuesday and Thursday afternoons from 2pm except on public holidays. The research assistant obtained a list of patients booked for the clinic. An average of 10 patients were seen in each clinic visit. The process was repeated on every other clinic day until the sample size was attained.

13.0 Recruitment procedure.

The principal investigator (PI) reviewed all files of patients attending the rheumatology outpatient clinic. The files of the patients who met the criteria were selected. A Screening proforma (appendix 3) aided in the assessment of the eligibility of participants. These patients were then given relevant information (appendix 4) about the study and those who gave written informed consent (appendix5) were recruited. Those meeting the inclusion criteria and with signed consent (appendix 5) participated in the study.

13.0 Clinical methods.

The principal investigator with the help of a research assistant (a trained clinical officer) recruited study participants, took anthropometric measurements and recorded data. The principal investigator did direct interviews and examined the participants. Sociodemographic data and medical history was obtained from the patients' medical records.

All patients' cardiovascular risk factors i.e. diabetes mellitus, dyslipidemia, hypertension, cigarette smoking, alcohol intake were obtained from the records. Other relevant data pertaining to rheumatoid arthritis e.g. duration of disease and the medicine used to treat the patient were obtained from the patient and corroborated with information from patients' medical records at the clinic.

Patient weight was obtained using a digital weighing scale (seca r) in kilograms, while height in meters was measured with a standard stadiometer. The patient stood upright on a firm surface, looking straight ahead, arms at sides, with shoes removed and feet together as height was being measured. For accurate weight measurement, scales were calibrated to ensure accurate weight measurement. Patients removed shoes, heavy outer clothing, and items from pockets as they got weighed(39). BMI was obtained using the formula: Weight (kgs)/Height (m) 2.

13.1Patient variables

Age: documented in years

Gender: male/ female

Duration of RA: difference between current age of the patient and their age at diagnosis of rheumatoid arthritis.

Blood pressure: International Society of Hypertension 2020 guidelines were used to interpret and group various Blood pressure findings. Hypertension was diagnosed when a person's systolic blood pressure was ≥140 mm Hg and/or their diastolic blood pressure was ≥90 mm Hg and patients who were on treatment(40).

Disease severity-assessed using CDAI(41).

Treatment-the medication and other treatment modalities used by the patient were documented.

Body Mass Index: was calculated using the aforementioned formula and classified into:

- Underweight (<18.5)
- Normal (18.5-24.9)
- Overweight (25-29.5)
- Obese(>30)

Cigarette smoking: Centre for Disease control and prevention categories was used to define it i. e(42)

- Non - smoker: never smoked 100 cigarettes in their lifetime
- Former smoker: smoked at least 100 cigarettes in their lifetime and has stopped smoking within the last 1 year.
- Smoker: smoked at least 100 cigarettes in their lifetime

Alcohol intake: was recorded as intake of any alcoholic beverage in the past twelve months.

Diabetes Mellitus: was a historical diagnosis based on patients' records.

Dyslipidemia: was also a historical diagnosis based on patients' records.

13.2 ECG methods.

ECGs were done at the rheumatology clinic at a room designated for this activity. The procedure was well explained to the participants. A chaperone was present where needed during the procedure. Patient dignity was upheld as much as possible. ECGs were performed on participants adequately exposed and lying supine on an examination table. The principal investigator did all the ECGs following the AHA/ACCF/HRS Recommendations for the Standardization and Interpretation of the Electrocardiogram(43). A 12 lead ECG with a preset speed of 25mm/s and gain of 10mm/ms was used. All ECGS were interpreted by the principal investigator with the help of a supervising cardiologist in the event of any uncertainty. The AHA recommendations were adhered to in interpretation of the ECGs. All results were recorded in a study proforma. The results were directly communicated to the patient and where treatment was needed, the primary doctor was involved.

14.1 ECG variables

The anomalies were interpreted based on the *'AHA/ACC recommendations for the standardization and interpretation of the electrocardiogram* (43)

ECG VARIABLES

Arrhythmias	Supraventricular	Atrial fibrillation Sinus tachycardia Sinus bradycardia Atrial flutter Premature atrial contractions
	Junctional rhythms	
	Ventricular premature contractions.	
Conduction delays.	Atrioventricular blocks.	1st degree 2nd degree 3rd degree
	Interventricular conduction defects.	LBBB RBBB Left anterior fascicular block. Left posterior fascicular block. Bifasicular block.
Chamber enlargement.	LVH. RVH. LAE. RAE.	
Repolarization anomalies.	ST segment changes. T wave changes.	
Pathological Q waves		

14.2 ECG anomalies interpretation;

The ECG anomalies were further classified as major and minor anomalies as shown below and interpreted based on the *'AHA/ACC recommendations for the standardization and interpretation of the electrocardiogram* (43)*.*

Major Anomalies*:*

1. Severe or Moderate ST segment depression.
2. Deep or Moderate T wave inversion
3. Complete LBBB
4. Frequent PVCs.
5. Atrial fibrillation or atrial flutter.
6. Left ventricular hypertrophy with pronounced ST-T wave changes
7. Major rhythm and conduction abnormalities
8. Significantly prolonged ventricular re polarization

Minor anomalies:

1. Borderline Q waves and ST depression
2. Left or Right axis deviation
3. High voltage QRS complex
4. T wave flattening
5. Minor isolated ST segment and T wave changes

Further classification and interpretation is as indicated in Appendix II

15.0 Quality Assurance

The following were adhered to;

-All Clinical Officers acting as research assistants were trained on how to do ECG.

-ACCF/AHA guidelines were used to interpret the ECGS.

-Only calibrated equipment was used.

15.1Ethical Considerations

The study was conducted after approval was sort from the department of Clinical Medicine and Therapeutics at U.O.N and Kenyatta National Hospital Scientific and Ethical Committee. Patients were recruited strictly on a voluntary basis and had the liberty to withdraw from the study at any time without discrimination. The results of the ECGs were printed and communicated to all patients at the time of the procedure and were made available in their files for use by their attending physicians. Patients found to have cardiac abnormalities that required treatment, were referred to the cardiac clinic or the accident and emergency department in cases that requirement was deemed urgent.

16.0 DATA MANAGEMENT AND ANALYSIS

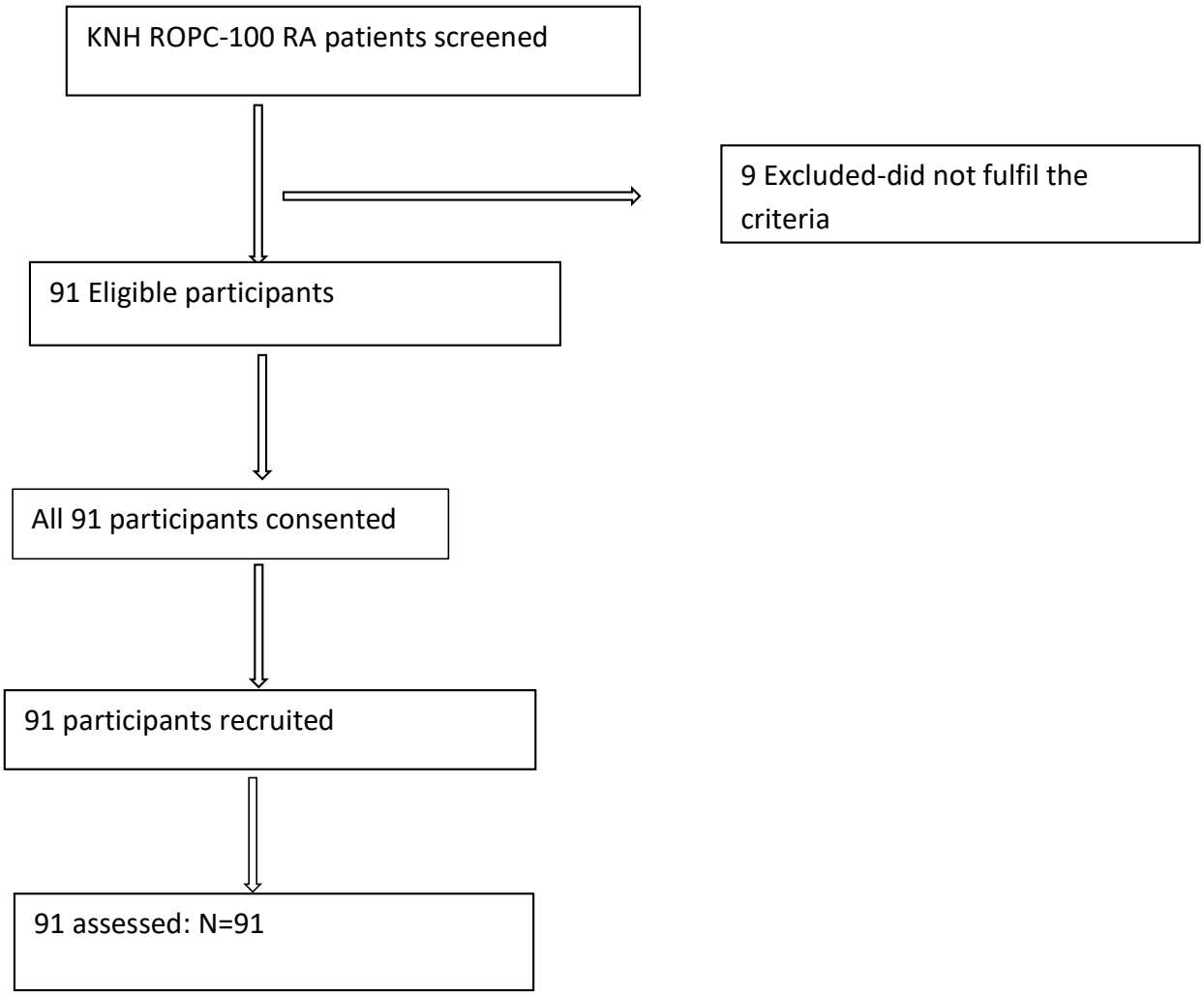
All data was recorded on a proforma sheet.

Data was collected via a printed questionnaire, and checked for completeness and free of error prior to entry into the Microsoft Excel 2017. Data cleaning and verification was performed at the end of data collection and statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 24.0. Data was stored in a password protected computer only accessible to the principal investigator and the statistician.

Descriptive statistics using means, medians, frequencies and proportions was used for the analysis and presentation of the demographic and clinical characteristics of the patients. The prevalence of resting ECG abnormalities in RA patients was calculated as a proportion of patients with ECG abnormalities and presented as a percentage. The type(s) of resting ECG abnormalities in RA patients were analyzed and presented as frequencies and proportions

17.0 RESULTS

17.1 PATIENT FLOW CHART



A Total of 100 subjects were screened between August 2022 and October 2022, 9 were excluded as they didn't fulfil the criteria. A total of 91 patients were included in the study as indicated above. ECGs were carried out on all the 91 participants recruited.

RESULTS

17.1 BASELINE CHARACTERISTICS OF THE STUDY POPULATION

The mean age of the study sample was 44.3±13.2 with females comprising 71 patients and males 20 patients. The Female to male ratio was 3.6:1 as indicated in table 1. Amongst the recruited participants 36.7% were hypertensive and 24.4% were diabetic. The other demographic characteristics are as summarized below.

Table 1: Demographic characteristics and risk factors for Rheumatoid Arthritis

	Frequency, *n=91*	**Percent**
Age in years, *Mean±SD*	44.3±13.2	
Sex		
Male	20	22.2
Female	71	77.8
F/M	3.6:1	
Hypertension		
Yes	33	36.7
No	58	63.3
Diabetes Mellitus		
Yes	22	24.4
No	69	75.6
Dyslipidemia		
Yes	10	11.1
No	81	88.9
Smoking		
Yes	4	4.4
No	87	95.6
Alcohol		
Yes	13	14.4
No	78	85.6
BMI		
<18.5	7	7.8
18.5 – 24.9	31	34.4
25.0 – 29.9	39	42.2
≥30.0	14	15.6

17.2 CHARACTERISTICS OF RHEUMATOID ARTHRITIS

The average disease duration for the study population was 10.1±5.9 years. Amongst the recruited participants 58.9% had moderate to severe disease and 3.3% were in remission. Almost all of the participants at 98.9% were on treatment.

Table 2: Characteristics of Rheumatoid Arthritis

	Frequency, *n=91*	**Percent**
Disease duration (years), *mean±SD*	10.1±5.9	
CDAI		
Remission (≤ 2.8)	3	
Low (2.9 - 10)	34	37.8
Moderate (11 - 22)	42	45.6
High (≥ 23)	12	13.3
Treatment		
Yes	90	98.9
No	1	

17.3 FREQUENCY OF DMARDS USED BY PATIENTS

Majority of the participants at 51.7% were on a single DMARD therapy predominantly hydroxychloroquine. Amongst the recruited participants 48.3% were on dual or triple DMARD therapy. The frequency of the other DMARDs are as indicated in the table below (table 3)

TABLE 3

NUMBER OF DRUGS	**FREQUENCY n=91**
1	47(51.7)
2	40(43.9)
3	4(4.4)
DMARDS	
Hydroxychloroquine	24(26.4)
Methotrexate	16(17.6)
Leflunomide	7(7.7)
Hydroxychloroquine + Methotrexate	30(32.9)
Hydroxychloroquine +Leflunomide	10(10.9)
Hydroxychloroquine+Methotrexate+Leflunomide	4

17.4 MAIN ELECTROCARDIOGRAPHIC ABNORMALITIES

The prevalence of electrocardiographic abnormalities observed in our study population was 27(29.6%). The most common abnormality was LVH with 25.6% of the study population, LAE was present in 16.7%, LAD in 8.9%, and Q waves were present in 7.8%. Majority of the population had a combination of both minor and major ECG abnormalities.The rest of the ECG abnormalities are as indicated below.

Table 4: Main Electrocardiographic Abnormalities

Parameters ECG	**Frequency**, *n=91*	**Percent**
Cardiac Abnormalities		
Abnormal	27	29.6 95% CI (20.5% - 39.0%)
Normal	64	70.3 95% CI (61.0% - 79.5%
Sinus Rhythm	71	
Normal Sinus Rhythm	62	87.3
Sinus Tachycardia	3	
Sinus Bradycardia	6	8.4
PR interval (ms), *mean±SD*	150.50 ± 20.82	
Normal	89	98.9
Prolonged PR Interval	2	
Shortened PR Interval	0	
QRS duration (ms), *mean±SD*	83.00 ± 15.00	
Normal	88	96.7
Prolonged QRS duration	3	
Shortened QRS duration	0	
QT interval (ms), *mean±SD*	400.32 ± 3.66	
Normal	90	98.9
Prolonged QT Interval	1	
Shortened QT Interval	0	
Anomaly of the QRS axis		
Left Axis Deviation		
Yes	8	8.9
No	83	91.1
Right Axis Deviation		
Yes	0	
No	91	100.0

ST segment and T wave abnormalities		
ST segment Depression	2	
ST segment elevation	0	
None	86	97.8
T wave inversion	3	
Arrhythmias		
Atrial Fibrillation		
Yes	4	
No	87	95.6
Premature Atrial Contractions		
Yes	3	
No	88	96.7
Premature Ventricular Contractions		
Yes	2	
No	89	97.8
Chamber enlargement		
Left Ventricular Hypertrophy		
Yes	23	25.6
No	68	74.4
Right Ventricular Hypertrophy		
Yes	3	
No	88	96.7
Left Atrial Enlargement		
Yes	15	16.7
No	76	83.3
Right Atrial Enlargement		
Yes	2	
No	89	97.8
Bundle Branch Blocks		
RBBB	2	
LBBB	1	
Atrioventricular Conduction Block		
Type I	3	
Type III	1	
None	87	95.6
Q waves		
Yes(pathological)	7	7.8
No	84	92.2

18.0 DISCUSSION

Heart involvement in RA is often clinically silent and can manifest after a long subclinical phase and it is well established that RA patients have increased mortality secondary to cardiovascular events even in the absence of traditional risk factors for CVD (28). Rhythm and conduction disturbances and sudden cardiac death in autoimmune rheumatic disorders have higher incidence than in the general population(44). The role of this study was to highlight the value of routine electrocardiography in evaluating cardiac abnormalities in asymptomatic RA patients. ECG is a non- invasive, affordable and widely available screening tool. The total prevalence of abnormal of electrocardiographic abnormalities observed in our study population was 29.6%. This represents a composite of all cardiac abnormalities. The prevalence of ECG abnormalities in our study is similar to a study done in Iran to check on cardiac anomalies in RA patients where the total prevalence was 32% (24). However, the overall prevalence in our analysis was higher as compared to a study done by Mouhamadou et al in Senegal on RA patients where the overall prevalence was 16.33% (11). This could be due to a larger number of our participants in this study had comorbidities like hypertension and diabetes mellitus.

The ECG anomalies were essentially dominated by left ventricular hypertrophy (25.6%), where nearly one in four patients presented with this anomaly. The explanation could be related to the natural history of the chronic inflammatory state of the disease affecting all structures of the heart including abnormal LV remodeling especially concentric remodeling. This could also be due to the combination of other comorbidities including diabetes, hypertension, dyslipidemias and age (13). The prevalence of LV hypertrophy (LVH) was 18% in a study by Rebecca et.al which hypothesized rheumatoid arthritis is independently associated with increased left ventricular mass but not reduced ejection fraction(45). Left atrial hypertrophy was noted in 16.7% of the participants and left axis deviation observed in 8.9% of the participants. In a study by Delgado et al on Left atrial dilatation in RA patients the prevalence was 14.3% which is similar to our study population(46). Right ventricular hypertrophy was noted in 3 of the participants and right atrial enlargement in 2 of the participants. Incidence of PA pressure of more than 30mmhg suggesting pulmonary hypertension was higher in RA in comparison to the controls (26.7 % vs 4.5%) as studied by Udayakumar et al (31).

Conduction disorders were in a minority of the participants. Type 1 AV Block was noted in 3 participants. Goulenok et.al indicated that atrioventricular blocks are rare in RA patient as compared to SLE patients and they were noted in 2.7% of participants in that study(47). In this study the prevalence of bundle branch blocks was in the minority of the participants. Unlike in our study, Villeco et.al noted that 35% of RA patients were found to have complete or incomplete right bundle branch block. This is probably due to the fact that the patients were at a more advanced stage of disease. Antibodies to cardiac conducting tissue were found significantly more in RA patients with RBBB than in those without conduction abnormalities(48).

Atrial fibrillation was noted in 4 of the participants in this study. In a study by Jesper et.al the overall incidence of atrial fibrillation was approximately 40% higher in rheumatoid arthritis patients than in the general population. However, this association has not been observed other studies. Women were at slightly higher relative risk than men, and the relative risk of atrial fibrillation was markedly increased in the youngest age groups due to increased disease activity index (37). Patients with RA are at higher risk of clinical AF recurrence, and are more likely to be taking antiarrhythmic drugs and require repeat ablation (36).PR interval prolongation was noted only in 2 participants. Pathologic Q waves were present in7.8% of the study population suggestive of prior myocardial infarction which confer poor prognosis (28) .Abnormalities in ST segment and T wave abnormalities were noted in 5% of the study population as compared to a cross sectional study done in Iran where the most abnormal findings in patient's ECG were ST interval and T wave changes at 15% (24).This was echoed by a study done by Monem et al on association of rheumatoid arthritis disease activity with electrocardiographic findings that found the prevalence ST segment and T wave abnormalities were the most common findings in RA patients at 33.3%(49). Our study population was recruited at an outpatient basis and may therefore have been skewed toward the less severe end of the disease spectrum as compared with the overall population of RA patients thus explaining the above mild and clinically insignificant findings. In a systematic review, Chou et al, found that resting ECG abnormalities, in particular ST-segment and T-wave abnormalities were associated with subsequent CVD events(50). Non-specific ST-T abnormalities can be found in 3–10% of ECGs of an otherwise healthy RA population, and these findings are known to predict an increased risk of CVD and mortality on long-term follow-up(51).

Premature electrical activity in our patients was noted in the form of premature beats as noted in 3 participants. The prevalence of PVCs in our study is similar to a study done by Malczuk et al on early myocardial changes in patients with RA without cardiovascular disease whose prevalence was 2%(52). This is hypothesized to be related to disease activity imposed by inflammation as patients with myocarditis have increased risk of getting PVCs (37). The calculated QT interval was normal in 98.9% of our study population as compared to Mouhamadou et al where the calculated QT interval was normal in 71.23% of cases (11). The length of the QTc is an independent cardiovascular risk factor with an extensive QTc prolongation being predictive of increased mortality in the general population (51). In patients with RA, Panoulas et al showed that a 50 ms increase in the QTc interval was associated with a doubling of the risk of all-cause mortality (34). In a study by Cindas et al on QT dispersion and cardiac involvement in patients with rheumatoid arthritis they noted that all patients had significantly longer QT dispersion and corrected QT dispersion values in patients with disease duration more than 5 years. They concluded that repolarization heterogeneity and diastolic dysfunction are commonly seen in RA patients(53).

The clinical significance of our findings is that ECG abnormalities predominantly LVH and LAE are highly prevalent in RA patients. Pathologic Q waves were also present in a significant percentage of the participants, indicating probable prior myocardial infarction in the RA patients.

18.1 CONCLUSION

The study demonstrates a high prevalence of Left ventricular hypertrophy amongst RA patients despite being on disease modifying medications. As this forecasts an increased risk of cardiovascular morbidity and mortality. Early detection of cardiac involvement using ECG may reduce the morbidity and mortality in these patients by leading to the initiation of appropriate therapy that may help reduce the incidence of cardiovascular death in RA patients.

18.2 RECOMMENDATIONS

i. Baseline ECGs are recommended for all RA patients in order to assess for cardiac abnormalities since it's affordable and non -invasive.
ii. A prospective study with a larger sample size and longer follow-up period for evaluation of further cardiac involvement in patients with RA to evaluate the progression of these ECG findings and define the long-term impact on cardiovascular morbidity and mortality.

18.3 LIMITATIONS

A non-RA comparative group wasn't used hence some of the variations may have been of normal variation.

The study was conducted in one hospital with a small sample population hence lack of generalizability hence it might not be a representation of all RA patients

APPENDIX 1

19.0 REFERENCES

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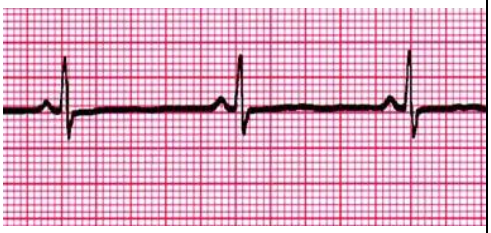
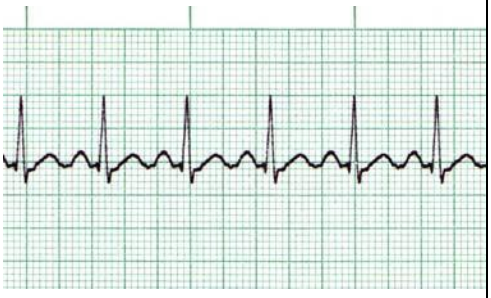
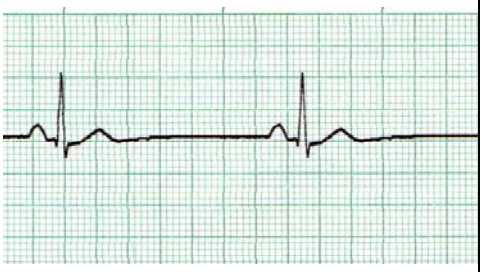
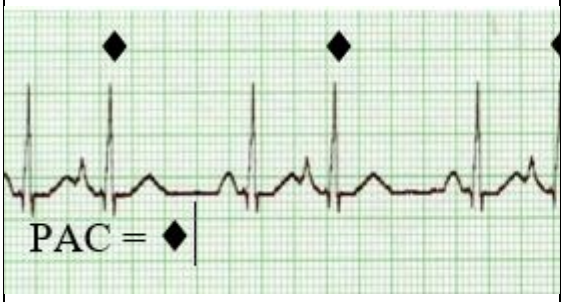
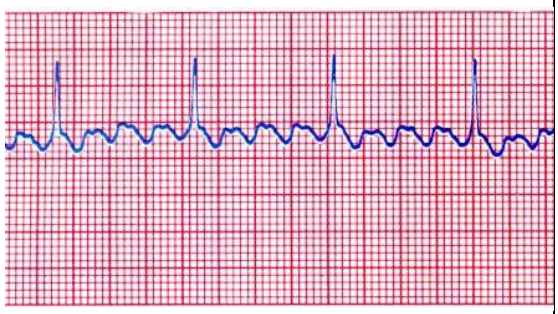
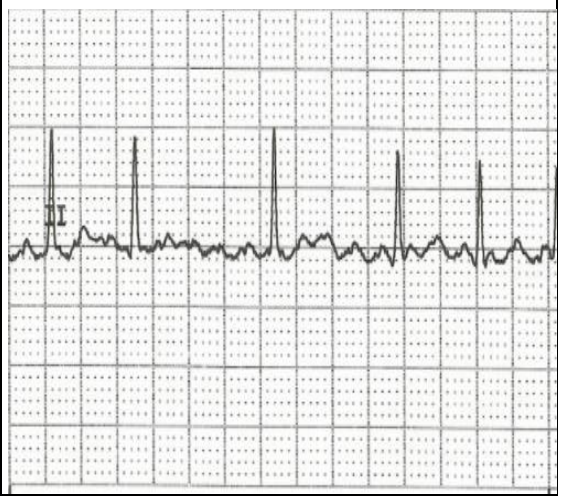
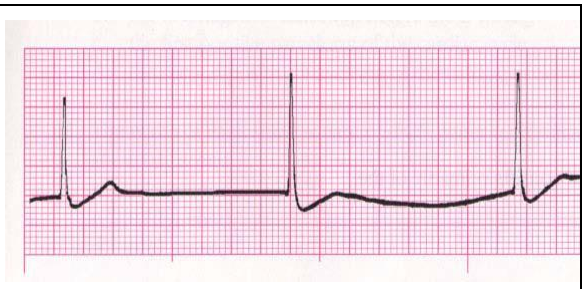
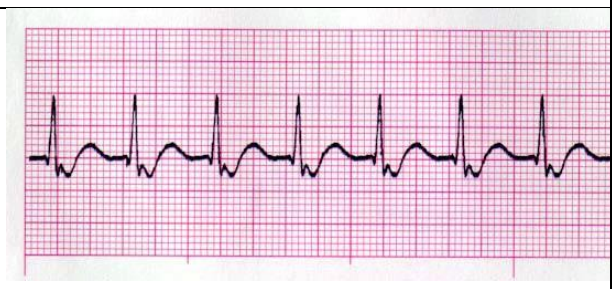
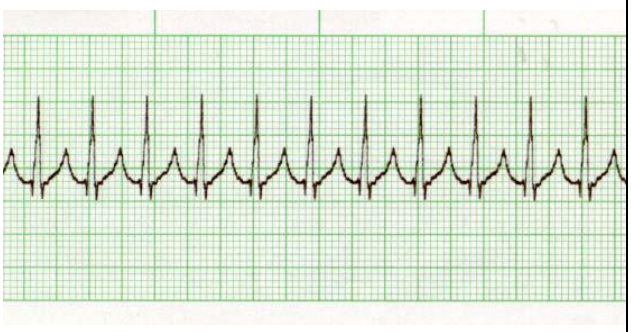
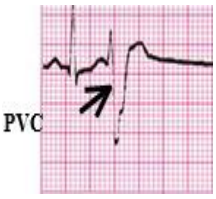
20.0 APPENDIX II

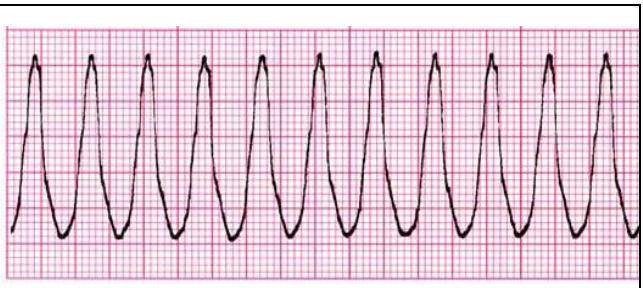
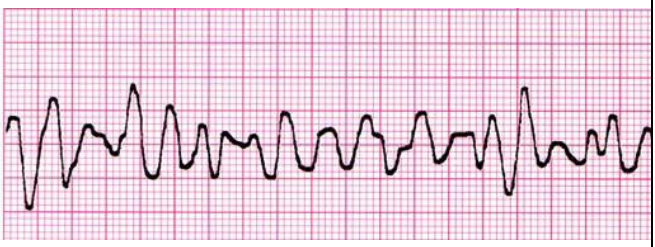
ECG CHARACTERISTICS

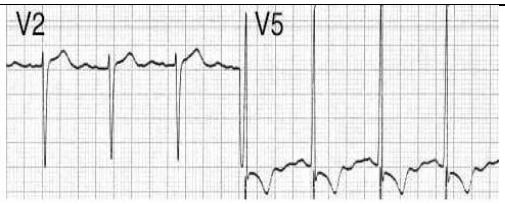
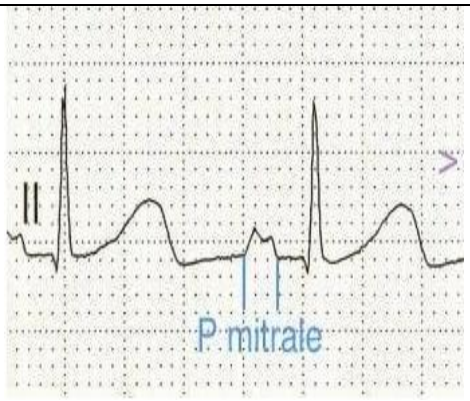
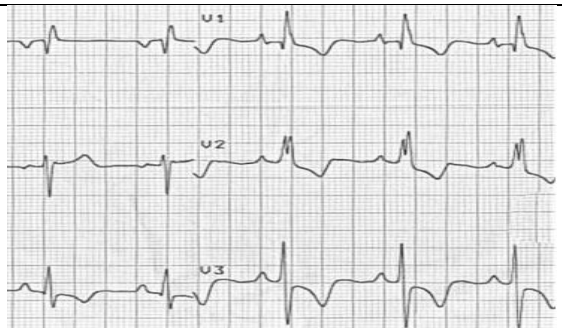
Rhythm	ECG Characteristics	Example
Normal Sinus Rhythm (NSR)	**Rate:** 60-100 per minute **Rhythm:** R- R = **P waves:** Upright, similar **P-R:** 0.12 -0 .20 second & consistent **qRs:** 0.04 – 0.10 second **P:qRs:** 1P:1qRs	
Sinus Tachycardia Causes: • Exercise • Hypovolemia • Medications • Fever • Hypoxia • Substances • Anxiety, Fear • Acute MI • Fight or Flight • Congestive Heart Failure	**Rate:** > 100 **Rhythm:** R- R = **P waves:** Upright, similar **P-R:** 0.12 -0 .20 second & consistent **qRs:** 0.04 – 0.10 second **P:qRs:** 1P:1qRs	
Sinus Bradycardia Causes: • intrinsic sinus node disease • increased parasympathetic tone • Drug effect.	**Rate:** < 60 **Rhythm:** R- R = **P waves:** Upright; similar **P-R:** 0.12 -0 .20 second & consistent **qRs:** 0.04 – 0.10 second **P:qRs:** 1P:1qRs	

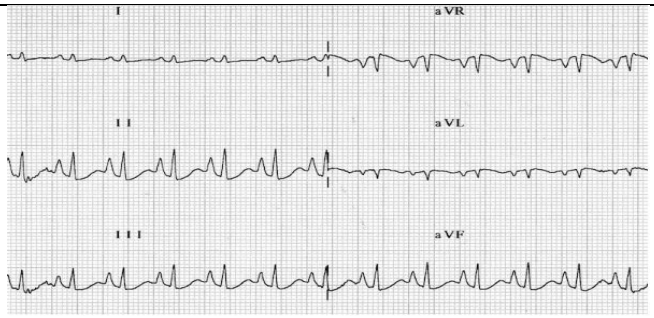
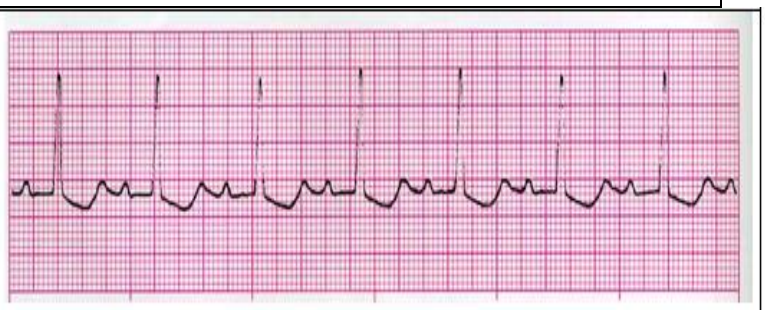
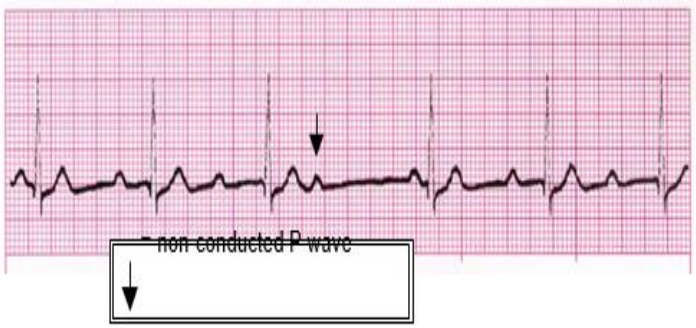
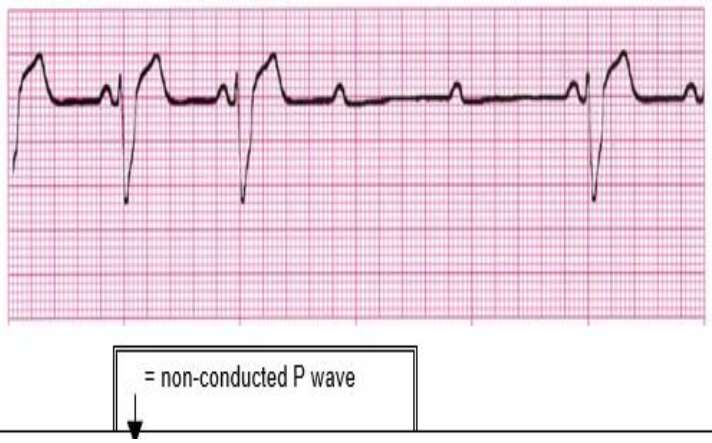
Premature Atrial Contractions (PAC)	**Rate:** usually < 100,dependent On underlying rhythm **Rhythm:** irregular **P waves:** Early & upright, different from Sinus **PR:** 0.12 – 0.20 second; different from Sinus **qRs:** 0.04 – 0.10 second **P:qRs** = 1:1	
Atrial Flutter Causes: ◦ ischemic heart disease ◦ Hypoxia ◦ Acute MI ◦ Dig Toxicity ◦ Mitral or Tricuspid valvedisease ◦ Pulmonary embolism	**Rate:** Atrial rate 250-350 Vent 150 common **Rhythm:** Atrial = Regular Vent = Reg. or irreg **P waves:** Not identifiable **F waves:** Uniform (saw tooth or picket fence) **PRI:** not measurable **qRs:** 0.04 – 0.10 second	
Atrial Fibrillation ◦ Ischemic heart disease ◦ Hypoxia ◦ Acute MI ◦ Digitalis toxicity ◦ Mitral or tricuspiddisease	**Rate:** Atrial: 400-700 Vent. 160-180/minute **Rhythm:** Atrial: irregular; Vent.: irregular **P waves:** No identifiable Ps **f waves:** may be seen. **PRI:** unable to measure(No identifiable P) **qRs:** usually normal	

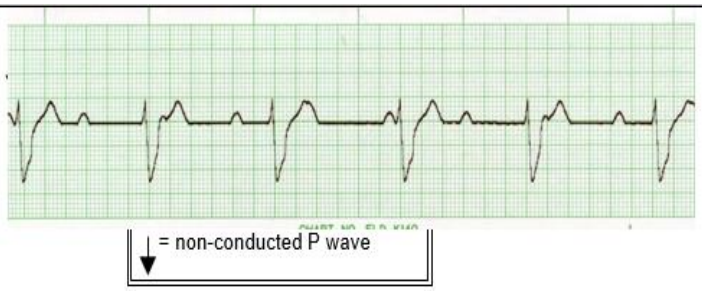
Junctional escape Rhythm Causes: □ healthy athlete at rest □ related to medications- Beta Blockers, Calcium Channel Blockers, Dig Toxicity □ or increased parasympathetic tone □ Acute Inferior Wall MI □ Rheumatic Heart Disease □ Post-Cardiac Surgery □ Valvular Disease □ SA Node Disease □ Hypoxia	**Rate:** 40-60 61 – 100 (accelerated) **Rhythm:** Regular **P waves:** Inverted before or after qRs or not visible **PR interval:** < 0.12 second when inverted P is before qRs **qRs:** 0.04 – 0.10 second **P:qRs** 1:1 if Ps are visible	
Junctional Tachycardia Causes: □ Same as Paroxysmal Atrial Tachycardia (PAT)	**Rate:** 101-200 Same as Junctional EscapeRhythms.	
Supraventricular Tachycardia (SVT) An umbrella term used when unable to distinguish which rhythm is present. Causes: Same as Sinus, Atrial, and Junctional Tachycardia, and Atrial Flutter	**Rhythm:** Absolutely regular**Rate:** > 150 per minute **P Waves:** Not visible (PRI not measurable) **qRs:** **normal** 0.04 – 0.10 sec	

Premature Ventricular Complex (PVC) Causes: ▫ Gastric overload ▫ Stress ▫ Caffeine, Alcohol, Nicotine ▫ Heart Disease ▫ Acid-Base Imbalance ▫ Electrolyte Imbalance ▫ Cyclic Antidepressants ▫ Hypoxia ▫ Acidosis ▫ Acute MI	**Rate:** Dependent upon underlying rhythm **Rhythm:** R – R ≠ **P waves:** Usually absent, if present, not associatedwith PVC **qRs:** 0.12 second or greater; bizarre and notched **ST & T:** Often opposite in direction to the qRs. **Timing** One on a strip = Rare One in a row = Isolated Two in a row = Pair, couplet Three in a row = V Tachycardia **Pattern** Every other = Bigeminy Every third = Trigeminy **Morphology** Similar shape = Uniformed Different shape = Multiformed **Location** R – on – T = PVC falls on the T wave of the complex before the PVC	

Ventricular Tachycardi **a**Causes: ▫ Same as PVCs ▫ R on T Phenomenon	**Rate:** > 100 per minute and usually not > 220**Rhythm:** Usually regular **P Waves:** P waves or if present, not associated with qRs **qRs:** Wide (≥ 0.12 sec), bizarre **ST/T wave:** Opposite direction of qRs A group of three PVCs in a row or more at a rate greater than 100/ minute or more constitutes Ventricular Tachycardia.	
Ventricular Fibrillation Causes: ▫ Acute Myocardial Infarction ▫ Untreated Ventricular Tachycardia ▫ Hypothermia ▫ R-on-T PVCs ▫ Electrolyte imbalance ▫ Electrical shock	**Rhythm:** regularity, chaotic undulating waves No Cardiac Output or Pulse	

LVH pressure overload secondary to conditions such as aortic stenosis and hypertension	Sokolov-Lyon criteria: S wave depth in V1 + tallest R wave height in V5-V6 > 35 mm	 LVH by voltage criteria: S wave in V2 + R wave in V5 > 35 mm
LAE mitral stenosis In association with LVH Systemic hypertension Aortic stenosis Mitral incompetence Hypertrophic cardiomyopathy	<u>In lead II</u> • Bifid P wave with > 40 ms between the two peaks • Total P wave duration > 110 ms	
RVH Pulmonary hypertension Mitral stenosis Pulmonary embolism Chronic lung disease Arrhythmogenic right ventricular hypertrophy	Right axis deviation of +110° or more. Dominant R wave in V1 (> 7mm tall or R/S ratio > 1). Dominant S wave in V5 or V6 (> 7mm deep or R/S ratio < 1). QRS duration < 120ms (i.e. changes not due to RBBB).	

RAE Primary pulmonary hypertension Cor Pulmonale	> 2.5 mm in the inferior leads (II, III and AVF) > 1.5 mm in V1 and V2	
1st degree AV Block	♦ 1P : 1 qRs ♦ Prolonged PRI (> 0.20 sec not > 0.40 sec)	
2nd degree AV Block, Type I	♦ More P waves than qRs ♦ PRI progressively increases in a cycle until P appears w/o qRs ♦ Cyclic pattern reoccurs ♦ R – R ≠	
2nd degree AV Block, Type II	More P waves than qRs ♦ PRI consistent ♦ qRs normal or wide (bundle branch block) ♦ R - R≠ or R – R =	

3rd degree AV Block	◆ More P waves than qRs ◆ P not r/t qRs (P too close, P too far) ◆ PRI varies greatly ◆ qRs normal or wide ◆ R – R =	

21.0: APPENDIX III: STUDY PROFORMA

Participant ID			
Date ,consent, contact			Code
1	Date and time of interview	Date Time	
2	Consent read and obtained	Yes = 1 No = 2 if no end interview	
3	Telephone contact		

DEMOGRAPHIC INFORMATION			
Question		Response	Code
4	Gender (record male/female as observed	1=Male 2=Female	
5	What's your age?	Years	
6	In total how many years have you spent at school or in full time study	Years	
7	What is the highest level of education you have attained	1=No formal education 2=Less than primary school 3=Primary school completed 4=Secondary school completed 5=College/university completed	
8	What is your marital status	1=Never married 2=Currently married 3=Separated 4=Divorced 5=Widowed	
Risk factor profile			
Question		Response	Code
9	History of smoking	1=Current smoker 2=Former smoker 3=Non smoker	
10	History of alcohol use	1=yes 2=No	
11	History of diabetes Mellitus	1=Yes 2=No	
12	History of hypertension	1=Yes 2=No	
13	Family history of diabetes /hypertension.	1=Yes 2=No 3=Don't know	

Measurements and records			
Parameter		Recording/ Interpretation	Code
14	Weight (Kg) to the nearest 0.5 Kg		
15	Height (M) to the nearest 0.01M		
16	Body Mass Index (BMI) IN Kg/M^2	1=Underweight (<18.5) 2=Normal (18.5-24.9) 3=Overweight (25-29.5) 4=Obese (>30)	
17	Clinic Blood pressure Time between two readings is 5minutes	1^{st} reading 2^{nd} reading Average	
18	Blood pressure control (Based on ISH guidelines)	1=Normal. 2=Pre hypertension. 3=Hypertension stage 1. 4=Hypertension stage 2.	
19	CDAI score	1=Remission ≤ 2.8 2=Low$\leq$10 3=Moderate$> 10 \leq$22 4=High>22	
20	Mode of treatment of Rheumatoid arthritis(72)	1= Nonpharmacological i.e Exercise, occupational, therapy, orthodontics and splints. 2= DMARDs monotherapy 3= Combined DMARDs or TNF inhibitor or non TNF inhibitor. 4= Steroids /NSAIDs + biologics or nonbiologics or immunosuppresants. 6= None	

Electrocardiographic abnormalities			
Question		Response /interpretation	Code
20	Is the ECG recording normal?	1=Yes 2=No. If NOT proceed to	
A	Does the ECG recording show an arrhythmia?	1=Yes 2=No If YES specify in part B below	
B	If yes to (A) above what is the origin of the arrhythmia?	1=Supraventricular.....Go to C 2=Junctional 3=Ventricular.....Go to D	
C	If supraventricular, what type of arrhythmia is it?	1=Atrial fibrillation 2=Atrial flutter 3=Premature atrial contraction 4=Sinus bradycardia 5=Sinus tachycardia 6=Others	
D	If ventricular what type of arrhythmia is it	1=Premature ventricular contraction 2= Others (specify)	
E	Does the ECG show chamber enlargement?	1=Yes .....Go to F and specify 2=No	
F	What is the type of chamber enlargement? For each indicate the response 1= yes, 2=No	1=Left ventricular hypertrophy 2=Right ventricular hypertrophy 3=Left atrial abnormality 4=Right atrial abnormality	
G	Does the ECG show atrioventricular conduction abnormality	1=Yes.....Go to G below 2=No .....Go to I	
H	What is the specificity of the atrioventricular conduction abnormality	1=First degree AV block 2=Mobitz type I AV block 3=Mobitz type II block 4=Third degree AV block	
I	Does the ECG show intraventricular conduction abnormalities?	1=Yes 2=No	
J	What is the type of Intraventricular conduction abnormality	1=Left Bundle Branch Block 2=Right Bundle Branch Block 3=Left anterior fascicular block 4=Left posterior fascicular block 5=Bifascicular block 6=Incomplete left bundle branch block 7=Incomplete right bundle branch block	

K	Does the ECG show any ST segment changes?	1=Yes 2=No	
L	What type of ST segment abnormality does the ECG show?	1= ST elevation 2= ST depression	
M	Does the ECG show any T wave abnormalities?	1=Yes 2= No	
N	What type of T wave abnormality does the ECG show?	1= T wave inversion 2= T wave flattening 3= other T wave abnormality	

21.1 APPENDIX IV: Consent explanation form

Prevalence and types of electrocardiographic abnormalities in rheumatoid arthritis patients without clinically detectable cardiovascular disease.

Background

I Dr. Rose Gakenia Kiarie, a postgraduate student in the department of Clinical Medicine and Therapeutics at U.O.N. would like to inform you that I am conducting a study on the 'Prevalence and types of ECG anomalies in rheumatoid arthritis patients without clinically detectable cardiovascular diseases.

An ECG is a test that measures the electrical activity of the heart. The heart is an important organ that pumps blood through the body. In order to do this, the heart has to generate an electrical impulse that stimulates its muscles to contract and pump blood. In an ECG test, these electrical impulses are recorded and printed out in a graphical representation by a machine attached to the body through electrodes. The ECG is able to detect different heart problems such as rhythm disturbances, heart chamber enlargement and conduction defects among others. In diabetic patients, some of these abnormalities may be more frequent than in non-diabetic patients.

Study Objective This study seeks to determine the prevalence (burden) and types of ECG anomalies in rheumatoid arthritis patients without clinically detectable cardiovascular disease

Voluntarism of Participation: I would like to request you to participate in this study on your own free will. You will not be required to make any payments for any tests performed as part of this study. We will also not offer you any money to participate in this study. Participating in this study will not delay your treatment.

Benefits of participating: You stand to benefit from this study by getting free screening for heart disease. In case you are found to have any ECG abnormality appropriate management will be recommended to you and your primary doctor in accordance with existing guidelines.

Risks of participating: there is no harm involved in participating in this study. You may experience a little discomfort when we perform the ECG. We will also require you to expose you to expose your chest when we perform the ECG but this will be done in privacy and in the presence of a chaperone.

Confidentiality: All information collected from you will be kept confidential. Any publications arising from this study will not identify you in person.

Right to withdraw: You may decline to participate in this study or drop out at will and at any time during the study. This will not lead to any denial of treatment or any form of care you require in the hospital.

If you have understood the information I have given you and you are willing to participate in this study, I will require you to sign a form indicating our willingness to participate. Thank you

If you have any questions about this study, you may contact:

Dr. Rose Gakenia Kiarie. Dept. of Internal Medicine, University of Nairobi. P.O BOX 974-10100, Nyeri, Kenya. Telephone number **(+254)711204225)** or e-mail rosegkiarie@gmail.com

21.2 APPENDIX V: CONSENT FORM

Prevalence and types of electrocardiographic abnormalities in rheumatoid arthritis patients without clinically detectable cardiovascular disease.

I _____ do confirm that I have read/ been explained to the above study, understood the information presented to me and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw from this study at any time without giving reason. I confirm that I have agreed to have an electrocardiogram (ECG) be recorded on me

I agree to take part out of my own free will and no coercion or incentive has been offered.

Signature of participant_____ Date: _____

Signature of investigator _____ Date: _____

KNH-UoN Ethics and
Research Committee
P. O. Box 19676 Code 00202
Nairobi
Tel. (254-020) 2726300-9 Ext
44355

Email: uonknh_erc@uonbi.ac.ke

21.3 APPENDIX V1: Fomu ya maelezo kuhusu utafiti

Kiwango na aina ya magonjwa yanayoathiri umeme wa moyo kwa wagonjwa wanaougua ugonjwa wa yabisi kavu na hawajawahi kupatikana na ugonjwa wowote wa moyo.

Kitangulizi**:**

Jina langu ni Daktari Rose Gakenia Kiarie. Mimi ni mwanafunzi wa somo la udaktari katika kiwango cha shahada ya uzamili katika chuo kikuu cha Nairobi. Ningependa kukujulisha kwamba ninatafiti kuhusu kiwango na aina ya magonjwa yanayoathiri umeme wa moyo kwa wagonjwa wanaougua ugonjwa wa yabisi kavu na hawajawahi kupatikana na ugonjwa wowote wa moyo.

Kipimo cha ***'ECG'*** ni aina maalum ya picha inayokagua umeme wa misuli ya moyo. Moyo ni kiungo cha mwili ambacho kazi yake huwa ni kusambaza damu kwenye maeneo yote ya mwili. Ili kufanikisha kazi hii, umeme unaotoka kwenye sehemu speshelesli ya moyo lazima isisimue misuli ya moyo ndipo iweze kusambaza damu mwilini. Kwenye kipimo cha ECG, aina hii ya umeme wa moyo huwa unasajiliwa kwenye kifaa cha ECG kisha kuandikisha ujumbe huu kwa njia ya mchoro kwenye karatasi. Wagonjwa wanaougua ugonjwa wa yabisi kavu na pia vilevile mtu yeyote huwa wanaweza kuwa na magonjwa yanayoathiri umeme wa moyo.

Lengo la utafiti huu: Lengo la utafiti huu ni kutathmini kiwango na aina ya maradhi yanayoathiri umeme wa moyo

Hiari ya Kujiunga na Utafiti

Nakualika ujiunge na utafiti huu kwa hiari yako. Hautahitajika kulipa chochote kwa vipimo ambavyo utafanyiwa kwenye utafiti huu. Vilevile hakuna malipo yoyote ambayo mtafiti atakupea ili uweze kushiriki. Kushiriki katika utafiti huu hakutachelewesha matibabu yako ya kawaida kwa njia yoyote ile.

Manufaa ya kushiriki utafiti huu

Utaweza kupata uchunguzi wa moyo wako bila malipo yoyote. Kunaweza kuwa na manufaa kwako pia iwapo utapatikana na ugonjwa wowote wa moyo ambao haukuwa umejulikana hapo awali. Kama utagunduliwa kuwa na ugonjwa wowote katika huu utafiti, utaelekezwa jinsi utakavyopata matibabu mwafaka.

Madhara ya kushiriki kwenye utafiti huu

Utafiti huu hautaleta madhara yoyote kwako. Ili kufanya hiki kipimo cha ECG, utahitajika kutoa nguo kwenye sehemu ya kifua.Matokeo ya kipimo cha ECG yatawekwa kwenye rekodi zako za matibabu ili kusaidia daktari wako kwenye matibabu yako.

Haki ya Kujiondoa Kwenye utafiti

Unaweza kukataa kushiriki kwenye utafiti huu au hata kujiondoa wakati wowote bila hofu ya kubaguliwa, kunyimwa matibabu yoyote ama aina yoyote ya huduma hospitalini.

Faragha yako

Ujumbe utakaokusanywa kwenye utafiti huu utahifadhiwa vizuri ili kulinda faragha yako. Machapisho yatakayoambatana na utafiti huu hayatachapisha majina yako, yale ya jamaa wako wala taarifa yoyote ambayo itaweza kufanya utambuliwe.

Iwapo umeelewa haya maelezo kuhusu huu utafiti, nitakuhitaji uweke sahihi kwenye fomu ya ridhaa.

Iwapo ungependa kuuliza maswali yoyote kuhusu utafiti huu, unaweza kuwasiliana na wafuatao

Daktari Rose Gakenia Kiarie. Chuo kikuu cha Nairobi. ANWANI 974-10100 Nyeri, Kenya. Nambari ya simu **(+254)711204225)** ama barua pepe rosegkiarie@gmail.com

21.4 APPENDIX VII: FOMU YA RIDHAA

Kiwango na aina ya magonjwa yanayoathiri umeme wa moyo kwa wagonjwa wanaougua ugonjwa wa yabisi kavu na hawajawahi kupatikana na ugonjwa wowote wa moyo.

Mimi _____nathibitisha ya kwamba nimesoma/ nimesomewa maelezo kuhusu huu utafiti, nikaelewa na nikapata fursa ya kuuliza maswali. Naelewa kuwa kushiriki ni kwa hiari yangu na kwamba niko na uhuru wa kujiondoa kwenye utafiti wakati wowote bila kutoa sababu yoyote. Nathibitisha kwamba nimekubali nifanyiwe kipimo cha ECG.

Sahihi ya mhusika_____ Tarehe: _____

Sahihi ya mtafiti _____ Tarehe: _____

KNH-UoN Ethics and Research Committee
P. O. Box 19676 Code 00202
Nairobi
Tel. (254-020) 2726300-9 Ext 44355

Email: uonknh_erc@uonbi.ac.ke

ETHICS APPROVAL DOCUMENT

KENYATTA NATIONAL HOSPITAL
P.O. BOX 20723, 00202 Nairobi

Tel.: 2726300/2726450/2726550
Fax: 2725272
Email: knhadmin@knh.or.ke

Ref: KNH/HOD-MED/37/VOL.II/61 **Date: 8th August 2022**

Dr. Rose Kiarie
Reg.No H58/33996/2019
Dept. of Clinical Medicine and Therapeutics
Faculty of Health Sciences
University of Nairobi

Dear Dr.Rose

RE: APPROVAL TO CONDUCT A STUDY AT THE KNH MEDICINE DEPARTMENT

Following approval by the KNH/UON-Ethics & Research Committee for your research proposal and subsequent filing of the study registration certificate, this is to inform you that authority has been granted to collect data in Medicine Department, on your study titled ***"The Prevalence and types of ECG abnormalities in Rheumatoid arthritis patients without clinically evident cardiovascular disease at the Kenyatta National Hospital."***

By a copy of this letter, Assistant Chief Nurse Incharge - MOPC is informed and requested to facilitate.

You will also be required to submit a report of your study findings to the office of the undersigned after completion of your study.

Dr. Kinoti Ndege
HOD - MEDICINE

Cc: ACN - MOPC Clinic

Vision: A world class patient-centered specialized care hospital

ISO 9001: 2015 CERTIFIED

PREVALENCE AND TYPES OF ECG ABNORMALITIES IN RHEUMATOID ARTHRITIS PATIENTS WITHOUT CLINICALLY EVIDENT CARDIOVASCULAR DISEASE AT KENYATTA NATIONAL HOSPITAL

ORIGINALITY REPORT

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5	Gonzalez-Juanatey, C.. "Carotid Intima-Media Thickness Predicts the Development of Cardiovascular Events in Patients with Rheumatoid Arthritis", Seminars in Arthritis and Rheumatism, 200904 Publication	1%
6	Submitted to American Sentinel University Student Paper	1%

APPROVAL OF LEAD SUPERVISOR AND CHAIRMAN OF THE DEPARTMENT

Professor Elijah Ogola

Consultant Physician and Cardiologist.

Department of Internal Medicine and Therapeutics

University of Nairobi.

Signed..... Date 08/11/2023

Professor Erastus Amayo

Consultant Physician and Neurologist.

Professor and Chairman,

Department of Clinical Medicine and Therapeutics

University of Nairobi.

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF CLINICAL MEDICINE & THERAPEUTICS
P.O. Box 19676-00202 NAIROBI

Signed..... Date 14/11/2023