CLINICAL AND ECHOCARDIOGRAPHIC PROFILE OF PAEDIATRIC PATIENTS WITH RHEUMATIC HEART DISEASE AT MOI TEACHING AND REFERRAL HOSPITAL

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DECLARATION

This research thesis is my original work being submitted in partial fulfillment of the requirement for M. Med (Child Health and Pediatrics) in Moi University and has not been submitted in any other university.

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ABSTRACT

Background

Rheumatic heart disease (RHD) is the commonest acquired heart disease and a major cause of morbidity and mortality among children in developing countries. Clinical features alone are inadequate in the diagnosis of specific valvular heart lesion even with a well-trained physician. While echocardiographic studies are capable of diagnosing valvular lesions, they are not readily available for those who require them the most. A combination of both a clinical and echocardiographic diagnosis is important to make a proper and early diagnosis.

Objective: To determine the clinical and echocardiographic profile of paediatric patients with RHD at Moi Teaching and Referral Hospital (MTRH), Eldoret, Kenya.

Methodology: This was a cross sectional study carried out between October 2009 and October 2010 in the general peadiatric wards, paediatric outpatient clinic and cardiology clinic at the MTRH. The study subjects were children with RHD aged 3 to 15 years, who met the inclusion criteria. Consecutive sampling was done. Data was collected in a structured questionnaire and analyzed using Genstat discovery.

Results: Eighty four children with RHD were enrolled**.** Of these, 46(54.76%) were new patients and 38(45.23%) were on secondary prophylaxis. There were 28 male and 56 female. The median age was 11 yrs. (3.5, 15).The commonest symptoms among the new patients included; dyspnea(84.78%), easy fatigability (82.61%), palpitations (73.91%),cough(69.57%) and orthopnea (63.04%), while the signs were systolic murmur (89.13%), thrill (78.26%) and tachycardia (76.09%).Six (13.04%) new patients were asymptomatic at presentation.

Sixty nine percent of the new patients were in NYHA class 3 and 4. Nine of the patients on follow up (23.68%) were non-compliant to secondary prophylaxis.

The commonest lesion was isolated mitral regurgitation 39(46.43%), followed by mitral regurgitation + aortic regurgitation 30(35.71%) then mitral regurgitation + mitral stenosis 5(5.95%).Mitral regurgitation and mitral stenosis alone or in combination were present in 94.04% and 14(16.67%) of the patients respectively. Most new patients had severe valvular lesion at the time of presentation. Complications observed include pulmonary hypertension (52.38%), functional tricuspid regurgitation (47.62%) and left ventricular systolic dysfunction (10.71%).

Conclusion and recommendations; the commonest symptoms among new patients were dyspnea, easy fatigability, palpitation, cough and orthopnea while the commonest signs were a systolic murmur, a thrill and tachycardia. Most new patients presented in NYHA class 3 and 4. Mitral regurgitation alone was the commonest lesion, followed by mitral regurgitation + aortic regurgitation. New patients had clinical and echocardiographic evidence of severe valvular disease and complication implying late presentation.

Since most of the new patients had severe disease at diagnosis, emphasis should be put on early detection and primary prevention. Studies need to be done to find out the reasons why patients at MTRH have severe disease at diagnosis**.**

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ACRONYMS

AR	-	Aortic Regurgitation
AS	-	Aortic Stenosis
ASOT	-	Anti Streptolysin O Titres
DALY	-	Disability-adjusted life years
IREC	-	Institutional Research and Ethics Committee
KHN	-	Kenyatta National Hospital
MR	-	Mitral Regurgitation
MS	-	Mitral Stenosis
MTRH	-	Moi Teaching and Referral Hospital
PI	-	Pulmonary insufficiency
RHD	-	Rheumatic Heart Disease
RF	-	Rheumatic fever
TR	-	Tricuspid Regurgitation
TS	-	Tricuspid Stenosis
WHO	-	World Health Organization

DEFINITIONS

A) *Carditis*-is the inflammation of the heart or its surroundings. It includes pericarditis or the inflammation of the pericardium, myocarditis or the inflammation of the heart muscle and endocarditis or the inflammation of the endocardium

B) *Rheumatic fever*-This diagnosis was made based on modified Duckett Jones criteria. The patients had to satisfy 2 major or 1 major and 2 minor Jones criteria for the diagnosis of rheumatic fever.

C) *Rheumatic carditis* – carditis during or following rheumatic fever and is almost always associated with a murmur of valvulitis although the endocardium, myocardium and pericardium are all affected to varying degrees.

D) *Rheumatic heart disease* – Is a cardiovascular sequel of acute rheumatic fever. In the study a diagnosis of RHD was made based on a history of rheumatic fever, clinical and echocardiographic evidence of rheumatic valvular involvement.

E) *Adherence*

Having not missed /delayed any dose of benzathine penicillin in the last six months.

CHAPTER ONE

1.0 Introduction

Rheumatic heart disease is the commonest acquired cardiovascular disease in children and young adults. In the past 50 years, it has remained a major paediatric public health problem in developing countries. There are 2.4 million children aged 5–14 years who have RHD worldwide. According to the WHO programme the global average prevalence rate of rheumatic heart disease was 2.2 per 1000 (range between 0.1 and 12.6) with the highest prevalence occurring in Sub-Saharan Africa with a prevalence of 5.7 per 1000 [the highest prevalence rates were Zambia (12.6), Sudan (10.2)], compared with 1.8 per 1000 in North Africa, and 0.3 per 1000 in developed countries.[1]In Kenya a prevalence of 2.7 /1000 was documented[2].Recent large scale population studies in Cambodia and Mozambique found prevalence of 21.5/1000 and 30.4/1000 respectively[3].

RHD accounts for 12–65% of hospital admissions related to cardiovascular disease, and for 2.0–9.9% of all hospital discharges [1, 2].It is a major cause of morbidity, disability and mortality in developing countries.

The disability-adjusted life years (DALYs) lost to RHD ranged from 27.4 DALYs per 100 000 population in the World Health Organization (WHO) Region of the Americas, to 173.4 per 100 000 population in the WHO South-East Asia Region. An estimated 6.6 million DALYs are lost per year worldwide[1].

An estimated 60 000 children and young adults die annually from rheumatic heart disease. The mortality rate per 100 000 population varied from 1.8 in the WHO Region of the Americas, to 7.6 in WHO South-East Asia Region. A case fatality rate

of, 9.7% has been reported in Fiji. The annual mortality is 1.5% per year which is a conservative estimate. The most devastating effects are on children and young adults in their most productive years[1, 4, 5] .

RHD is typically associated with poverty, in particular with poor housing and overcrowding, both of which favour the spread of upper respiratory tract infection. The most striking feature of the global epidemiology of rheumatic fever and rheumatic heart disease is the contrast between their progressive decline in industrialized countries and their continuing intensity in the developing world. The benefits of improved medical care and the introduction of antimicrobial agents has contributed to the accelerated decline in the incidence of rheumatic fever and hence RHD.

Rheumatic heart disease is the most serious complication of rheumatic fever (RF), the disease which "licks the joints, but bites the heart" … to put it lightly. Rheumatic fever develops in children and adolescents following pharyngitis infection with group A beta-hemolytic Streptococcus *(*i.e., Streptococcus pyogenes*)*. The organisms attach to the epithelial cells of the upper respiratory tract and produce a battery of enzymes allowing them to damage and invade human tissues. After an incubation period of 2-4 days, the invading organisms elicit an acute inflammatory response with 3-5 days of sore throat, fever, malaise, headache, and an elevated leukocyte count [1].

Rheumatogenic strains of group A beta-hemolytic Streptococcus often are encapsulated mucoid strains rich in M proteins and resistant to phagocytosis. These strains are strongly immunogenic, and M-binding antibodies and T cells against the streptococcal infection may cross react with heart tissue. Streptococcal antigens that

are structurally similar to those in the heart include hyaluronate in the bacterial capsule, cell wall polysaccharides (similar to glycoprotein in heart valves), and membrane antigens that share epitopes with the sarcolemma and smooth muscle.

Acute rheumatic heart disease often produces a pancarditis characterized by endocarditis, myocarditis, and pericarditis. Endocarditis is manifested as valve insufficiency. Severe valve insufficiency during the acute phase may result in congestive heart failure and even death. Whether myocardial dysfunction during acute rheumatic fever is primarily related to myocarditis or is secondary to congestive heart failure from severe valve insufficiency is not known. Pericarditis, when present, rarely affects cardiac function or results in constrictive pericarditis [6].

Chronic manifestations due to residual and progressive valve deformity occur in 9-39% of adults with previous rheumatic heart disease. Fusion of the valve apparatus resulting in stenosis or a combination of stenosis and insufficiency develops 2-10 years after an episode of acute rheumatic fever, and recurrent episodes may cause progressive damage to the valves [6].

In 0.3-3% of cases, infection leads to rheumatic fever several weeks after the sore throat has resolved. Only infections of the pharynx initiate or reactivate rheumatic fever. The organism spreads by direct contact with oral or respiratory secretions, and spread is enhanced by crowded living conditions. Patients remain infected for weeks after symptomatic resolution of pharyngitis and may serve as a reservoir for infecting others. Penicillin treatment shortens the clinical course of streptococcal pharyngitis and, more importantly, prevents the major sequel.

In addition to the human suffering involved, this vicious disease can also contribute to the crippling of a country's economy. This is not only because of the medical and surgical costs of treatment, but also because it is a disease that primarily attacks children, adolescents and young adults (the most economically active group of any country) [7].

The key to accurately diagnosing rheumatic heart disease is to widen the availability of echocardiographs and to standardize a screening approach. To date, many cases of rheumatic heart disease have been diagnosed with a stethoscope, but these pick up the worst cases only! Advantages of echocardiography include the fact that it allows the valve structure to be detected, which should prevent patients with carditis from being misclassified as non carditis and vice versa [8].

Clinical profile and real time imaging gives more insight into the nature of the disease and which valves are affected.

The clinical and echocardiography profiles of rheumatic heart disease in children at the Moi Teaching and Referral Hospital have not been documented.

1.1 Problem statement

RHD remains a significant cause of cardiovascular diseases in the world today. Despite a documented decrease in the incidence of acute RF and a similar documented decrease in the prevalence of RHD in industrialized countries during the past five decades, this non-suppurative cardiovascular sequel of group A streptococcal pharyngitis remains a medical and public health problem in both industrialized and industrializing countries even at the beginning of the 21st century. An estimated 6.6

million DALYs are lost per year worldwide. Rheumatic heart disease (RHD) continues to be a common health problem in the developing world, causing morbidity and mortality among both children and adults. Although little longitudinal data are available, evidence suggests that there has been little if any decline in the occurrence of RHD over the past few decades in developing countries. Africa has the largest number of children with the RHD, the highest prevalence occurring in Sub-Saharan Africa. In sub-Saharan Africa, where there is little access to the treatment that could enable them to survive and lead normal lives, over a million children are estimated to suffer from this debilitating and often fatal disease. [1, 9].

In 2006,157 patients were seen in the paediatric clinics at Moi teaching and referral hospital with a diagnosis of rheumatic heart disease ,of these 56 patients were admitted with rheumatic fever and RHD accounted for 15% of the admissions due to cardiovascular diseases .

Rheumatic heart disease leads to significant morbidity including severe valvular damage pulmonary hypertension, congestive cardiac failure, arrhythmias, predispose to infective endocarditis, cerebral vascular accidents and death , if not diagnosed early and treated properly [1].

Clinical presentation of rheumatic heart disease may mimic respiratory tract infections like atypical pneumonia or pulmonary tuberculosis or even other cardiac diseases and a high index of suspicion is required in order to carry out the necessary investigations so as to diagnose it early. Factors such as shortage of resources for providing quality health care, inadequate expertise of health-care providers, ignorance and lack of finances on the part of patients and caretakers also contribute to late diagnosis.

RHD can be missed by clinical examination, even with a trained physician. The likelihood of misclassification is higher with only clinical examination which is all that is available in most facilities in western Kenya. Echocardiography has superior sensitivity in detecting rheumatic heart disease and its use in diagnostic work up should prevent patients with carditis from being misclassified as noncarditis. It is however available in just a few facilities.[1]The cost of an echocardiographic machine is high while that of doing an echocardiographic test varies from ksh 1000 to ksh 5000 in different facilities in Kenya.

There is no medical therapy to reverse the late sequel of RHD. Attempts at surgical reversal/corrections only ameliorates symptoms and the patients are at risk of late complications of valve repair and replacement that may include regurgitant or stenotic valve, paravalvular leakage, thromboemboli, bleeding due to anticoagulants, structural deterioration of the prosthesis, and infective endocarditis.

There are no studies that have been done in Kenya to document the clinical profile and severity of rheumatic heart disease among children with the disease. This study seeks to describe the clinical profile and echocardiographic characteristics including severity of valvular lesions of children with RHD at MTRH.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Epidemiology

Rheumatic heart disease in paediatrics still poses a major medical, surgical and public health challenge. It is a major cause of acquired cardiac disease despite antibiotic therapy. Being sequel of rheumatic fever the incidence of RHD depends on the incidence of rheumatic fever. The incidence of acute rheumatic fever (ARF) and RHD has declined in developed countries but remains prevalent in developing countries due to poor living conditions. It is usually self-limiting, the cardiac sequel being the most feared and worrisome complication. Rheumatic heart disease is a preventable chronic disease and is the leading cause of death due to heart problems in East Africa[4]. The timing and mode of treatment is of utmost importance as it often correlates with the outcome. The reasons for late presentation and delay in diagnostic testing for children suffering from RHD largely revolve around ignorance, poor access to health care, including financial reasons, geographical constraints or even lack of appropriately trained personnel at the grassroots level[1].

According to WHO the prevalence of RHD in Kenya is 2.7 /1000[1]. However a study in Eldoret schools by Anabwani et al in 1992-1994 showed a high prevalence rate of 27/1000[10].

In Lahore, Pakistan M Sadiq et al found the prevalence of RHD to be 21.9/1000 children screened 11.Although the developed world is for the large part free of RHD, there has been an unexplained resurgence and persistence in some areas[12,35].

Most of the above prevalence studies including the study in Kenya have been recently criticized because the investigators did not present any data on valve morphology or the characteristics of the regurgitant jet, it was not clear whether the regurgitation was physiologic or was due to rheumatic or congenital disease.

The most recent large school based population studies in Mozambique and Cambodia that used doppler evidence of left-heart valve regurgitation and morphologic features of rheumatic heart disease found a prevalence of 21.5/1000 and 30.4/1000 in Cambodia and Mozambique respectively. In León, Nicaragua even higher prevalence of 34 in 1,000 in urban children, and 80 in 1,000 in rural children were found in a study by John A. Paar et al [13, 48].

Several studies show insignificant difference in the prevalence of rheumatic heart disease by sex or a male predominance. However studies in Saudi Arabia, Yemen, Sudan and Nigeria have reported higher rates of rheumatic heart disease among females[3, 14, 15, 16, 17, 18] .

2.2 Pathogenesis

Rheumatic heart disease is a sequel of group A β- streptococcal infection. WHO and other studies by Kaplan et al have shown that approximately 0.3- 3% of individuals with untreated group A β- haemolytic streptococcal pharyngitis will develop rheumatic fever[1, 8]. The epidemiology of rheumatic fever is also influenced by the serotypes of group A streptococci present in a population. The pathogenesis of rheumatic fever is still poorly understood but it has been grouped into three major categories: (i) direct infection by the group A streptococcus; (ii) a toxic effect of streptococcal extracellular products on the host tissues; and (iii) an abnormal or

dysfunctional immune response to one or more as yet unidentified somatic or extracellular antigens produced by all (or perhaps only by some) group A streptococci. New data suggest that a unique surface marker on non-T lymphocytes in patients with rheumatic fever and rheumatic heart disease may prove helpful in defining which individuals are susceptible to developing rheumatic fever after a streptococcal infection because of abnormal immune responses [19].

Recent studies indicate that calcification in diseased/distorted valves in RHD is not merely an inactive; "dystrophic" process but involves a regulated inflammatory process associated with expression of osteoblast markers and neoangiogenesis. Increased plasma osteopontin levels correlated with severity of mitral valve calcification. Further evidence of inflammation is supported by high levels of advanced oxidation protein products and high sensitive C-reactive protein in plasma detected in patients with RHD[20].

Rheumatic carditis is present in 40 - 60% of patients with acute rheumatic fever; it ranges from mild to severe carditis. Abdul and others in 2000 in Faisalabad, India in a study on clinical profile of RHD showed that 91.6% of patients with rheumatic fever had cardiac involvement [21]. Cardiac involvement almost always occurs in recurrent episode. About 90% of children who have carditis during rheumatic fever episodes will develop chronic and progressive RHD from inflammation and scarring of the heart valves, which may result in haemodynamically significant valvular regurgitation and /or stenosis, heart failure, and death [1].

2.4 Clinical presentation

Clinical presentation of RHD range from no symptoms to ,cough, haemoptysis, orthopnea, anaemia ,signs and symptoms of heart failure or infective endocarditis, chest pain, excessive fatigue, palpitations, a thumping sensation in the chest, shortness of breath, and swollen ankles, wrists or abdomen [6].

A prospective surveillance on RHD in Fiji by Steer and colleagues found out that the most common reason for admission for RHD is cardiac failure (51%) [5]. A study in Kenyatta National Hospital in 1999 by Oyoo and Ogola showed that RHD was the commonest cause of congestive cardiac failure [21].It has also been shown that RHD is the commonest underlying heart disease in patients with infective endocarditis [22, 23].

Mild carditis is characterized by one or more of the following: sinus tachycardia, the murmur of mitral regurgitation, an S3gallop, a pericardial friction rub, cardiomegaly, prolonged PR interval and usually resolves. More than half of patients with acute mitral insufficiency no longer have the mitral murmur 1 year later [1, 2].

2.5 Valvular lesions

Severe carditis leads to varying degrees of various valvular lesions. Mild to severe mitral and/or aortic regurgitation are the commonest valvular lesions. Mitral and aortic stenoses are rare in children however mitral and aortic valve lesions occur in combinations [1, 2].

Mitral regurgitation is more severe in those under 5 years as compared to the general population. Studies done at Kenyatta National hospital Nairobi, Kenya and Nigeria showed the combinations of mitral and aortic regurgitation was the most common

lesion followed by isolated mitral regurgitation [16, 24]. However, studies in Lebanon, Pakistan, and Khartoum showed that the commonest lesions were mitral regurgitation and aortic regurgitation. Mitral stenosis alone was uncommon[25, 26, 27]. Mitral regurgitation in rheumatic carditis is related to ventricular dilatation and/or restrictions of leaflet mobility .Patients with isolated mitral regurgitation are more prone to infective endocarditis [1].

Generally rheumatic mitral stenosis is seldom encountered before adolescence and is not usually recognized until adult life. However the natural history of mitral stenosis varies across geographical areas. For instance in North America, it is most commonly a slow progressive disease, with a latency period as long as 20–40 years between the initial infection and the onset of clinical symptoms. In developing countries, on the other hand, mitral stenosis progresses much more rapidly, perhaps because of more severe or repeated streptococcal infections, genetic influences, or economic conditions, and may lead to symptoms in the late teens and early twenties. In India, mitral stenosis was found in 50% of the cases mainly in children aged 10-16yrs.Saleh in Yemen between 1999 and 2003 stenosis and multiple valve lesions predominated in adolescents and young adults [12]. A Nigeria study by Sani et al in 2007 in patients aged 5 to 60 (mean 24.02 +/- 12.75) years found that 7.8% had pure mitral stenosis [28].The incidence of juvenile mitral stenosis is however much more common India [29].Jowi and Bakari at Kenyatta National Hospital got a low prevalence of mitral stenosis at 2.7% [24].

Combined mitral and aortic insufficiency is more common than aortic involvement alone. A study done Jowi in Kenyatta National hospital showed, the combinations mitral and aortic regurgitation was the most common lesion. Isolated aortic

regurgitation was almost as rare as isolated mitral stenosis in the paediatric age group, 1.8% and 2.7% respectively [9]. However a Nigeria study in 2007 by Sani et al found that only 19.5% of the RHD patients had mixed aortic and mitral valve disease and only 3.1% had pure aortic regurgitation. Another Nigerian study by Danbauchi et al found out that 18% of the patients with RHD had combined mitral, aortic, tricuspid and pulmonary regurgitation however the combination of mitral, aortic and pulmonary regurgitation was the least (1%)[16, 24, 28] .

Tricuspid stenosis due almost exclusively to rheumatic inflammation; it is found in combination with rheumatic mitral stenosis in up to 30% of patients. Rheumatic tricuspid stenosis in usually accompanied by some degree of tricuspid regurgitation as well.[1]A study in India in 1999 found that 50% of patients with rheumatic tricuspid disease had tricuspid stenosis with or without tricuspid regurgitation whereas 50% had isolated tricuspid regurgitation. Isolated tricuspid stenosis was present in 7.4% of these cases. All patients had associated mitral stenosis [30].

In a retrospective study by Sani et al in Nigeria, complications of RHD observed included secondary pulmonary hypertension in 103 patients (72.1%), valvular cardiomyopathy in 41 (31.8%), and functional tricuspid regurgitation was seen in 39 (30.2%)[36]. In a Yemen study complications were detected in 20.8%, of which 80.4 % was pulmonary hypertension[18].

2.6 Diagnosis

Clinically RHD is suspected on the basis of a murmur on physical examination or unexplained cardiomegaly or heart failure. The positive predictive value of murmurs diagnosed by regional physicians was 62.22%, in a study in Omani [14].

A diagnosis of rheumatic heart disease is made after confirming antecedent rheumatic fever (except when chorea is only manifestation of acute rheumatic fever and indolent carditis months after the onset of acute rheumatic fever). The modified Jones criteria (revised in 1992) and the more recent World Health Organization (WHO) criteria and American heart association echocardiographic criteria provide guidelines for the diagnosis of rheumatic fever and RHD[2, 39].

Danbaauchi et al in Nigeria in 2004 showed that because of the prevalence of the disease process in their clinical setting nearly 90% of the physicians made the right diagnosis before echocardiography scan ,however, the echocardiography scan helped in the assessment of the structure of the affected valves and haemodynamic status of the heart (left ventricular function) and complications[16] .

The electrocardiogram and roentgenograms are normal if the lesion is mild. Echocardiography has taken the diagnosis of RHD step ahead by helping in diagnosing even mild or asymptomatic carditis. It is an imaging technique that rapidly evolved and matured, and currently it is a key component in the diagnosis of heart disease. Echocardiographic images provide information about the size of atria and ventricles, valvular thickening, leaflet prolapse, coaptation failure, pulmonary arterial pressure, restriction of leaflet motility, and ventricular dysfunction. It is the most important investigation in confirming the diagnosis of mitral stenosis and assessing severity. A scoring system exists to grade the morphological changes in the mitral valve during assessment with echocardiography [31].

To diagnose rheumatic carditis and assess valvular disease, however, M-mode, two-dimensional (2D), 2D echo-Doppler and colour flow Doppler echocardiography are

sufficiently sensitive and provide specific information not previously available. A study in Qatar in 1992 showed that echocardiography is a useful method of identifying subclinical mitral and aortic valvular disease at all stages of rheumatic fever when carditis cannot be otherwise detected[17] .The use of 2D echo-Doppler and colour flow Doppler echocardiography may prevent the over diagnosis of a functional murmur as valvular heart disease[1]. Echo-Doppler and colour flow Doppler imaging may also provide supporting evidence for a diagnosis of rheumatic carditis in patients with equivocal murmur, or with polyarthritis and equivocal minor manifestations [32].

The American Heart Association Guidelines for the Diagnosis of Rheumatic Fever published in1992 do not encourage the use of echocardiography as the sole criterion for the diagnosis of carditis, stating the possibility of over diagnosis and the lack of prospective studies evaluating its role. However there are emerging bodies, including WHO who support the utility of Doppler echocardiography for the diagnosis of rheumatic carditis recommending that it has the potential of being a useful diagnostic tool in the assessment[2,33]. Figueroa et al in Chile showed that Doppler echocardiographic imaging improves the detection of rheumatic carditis. Sub clinical valve lesions, detected only by Doppler imaging, can persist[34].

2.7 Justification

The clinical profile of rheumatic heart disease in children may mimic other conditions and make diagnosis confusing. Knowledge of the common modes of presentation will help in heightening the levels of suspicion and thus necessitate proper investigation. Echocardiography is the current gold standard for accurately identifying and quantifying the type and severity of valvular involvement in rheumatic heart disease.

In Kenya, a study on the echocardiographic pattern of RHD have been done at the Kenyatta National Hospital in Nairobi (KNH) [24] .This study will however also document the clinical profile, the severity of valvular lesions and the NYHA class at presentation this is of prognostic importance. The Knowledge of the echocardiography profile of RHD will help act as an indicator of the stage at which most patients with RHD present at diagnosis. This will help in changing the approach to care of children with RHD. Echocardiography profile may assist physicians to decide on the mode of treatment required based on the severity of the disease.[2]As most valvular lesions with timely intervention hold a good prognosis for the patient, the knowledge of the severity of valvular lesions in RHD patients is very important.

The natural history of mitral stenosis for instance varies across geographical areas.[1]Moi Teaching and Referral hospital has been chosen as the site for this study because it has a different catchment population and different climatic/geographical conditions from the KNH. The catchment area comprises the North Rift region which borders Sudan in the north and Uganda in the west.

As the second largest national teaching and referral hospital in Kenya, MTRH is suitable for this study because it has the medical personnel and infrastructure (for example echocardiography centre and laboratory) required. Findings from MTRH will also reflect on the entire region and will be useful in making guidelines for diagnosis and management of rheumatic heart disease in the region.

CHAPTER THREE

3.0 RESEARCH QUESTION AND OBJECTIVE

3.1 Research question

What is the clinical presentation and echocardiographic profile of children with RHD on follow-up and those on initial diagnosis (not on follow-up) at MTRH?

3.2 Broad objective

To evaluate the clinical presentation and echocardiographic profile of paediatric patients with RHD at Moi Teaching and Referral Hospital (MTRH), Eldoret, Kenya.

3.3 Specific objective

1. To describe the clinical profile of paediatric patients with RHD at MTRH.
2. To describe the echocardiographic findings among children with RHD at MTRH

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CHAPTER FOUR

4.0 STUDY METHODOLOGY

4.1 Study design

This was a cross-sectional study.

4.2 Study site

The study was conducted at MTRH paediatric wards, outpatient clinic and paediatric and adult cardiac/ echocardiography clinic of the Moi Teaching and Referral Hospital (MTRH). MTRH is located in Eldoret town in the Rift Valley province, Kenya. Eldoret is along the Nairobi Uganda highway, 310 km Northwest of Nairobi, Kenya. It was started in 1917 as a cottage hospital with a bed capacity of 60 to cater for the health needs of the communities in western Kenya. From this it has grown to a capacity of nearly 500 beds and over 1000 outpatients per day. The hospital serves as a teaching hospital for the Moi University School of Medicine, University of Eastern Africa, Baraton and the Kenya Medical Training College, Eldoret. It is the second largest national referral hospital in Kenya and serves patients from the western part of Kenya and the North and south Rift region. The hospital has a modern well equipped immunology laboratory and echocardiography centre and qualified personnel of all cadres. It has a catchment population of about 11- 13 million people and approximately 20 000 admissions per year. Approximately 30,000 children are seen at the paediatric outpatient clinics per year.

4.3 Study population.

Paediatric patients with rheumatic heart disease aged 3-15 years at MTRH paediatric outpatient clinic, cardiology clinic and echocardiographic laboratory in the study period. Children seen in the clinics and wards with a suspected or know diagnosis of

RHD were re-evaluated by the principal investigator and those with symptoms and signs suggestive of rheumatic heart disease were selected for investigation for possible inclusion into the study.

Children aged 3-15 years were chosen because the incidence of pharyngeal infections, rheumatic fever and RHD is highest in this age group.RHD is uncommon before 3 years of age.

4.4 Inclusion and exclusion criteria

Inclusion criteria

1. Children with rheumatic heart disease
2. Children aged 3 to 15 years
3. Consent by guardian or parent

Exclusion criteria

1. Patients with non-rheumatic cardiac diseases (patients who had clinical features that mimicked RHD but on echocardiography had non rheumatic heart disease)

4.5 Study period

October 2009 to October 2010

4.6 Sample specification

All children who met the clinical diagnosis and American heart association diagnostic criteria of RHD during the study period were included. A diagnosis of RHD was based on a combination of history, clinical examination, and WHO diagnostic criteria

of RHD defined by an expert panel convened under the auspices of the WHO and the National Institutes of Health in September 2005 (appendix 2).A Doppler echocardiography was performed to confirm the diagnosis using the American heart association combined criteria for diagnosis of RHD (appendix 3).

4.7 Sample size

Eighty four children were selected to increase the power of the study. The minimum sample that was required to meet the primary objective was 40 children as calculated using Fischer's formula below for determination of sample size based on a prevalence of 27/1000 in a study in Eldoret[10].

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

n = minimum sample size.

Z = 1.96 is the normal deviate corresponding to a confidence interval of 95%

a = 0.05 is the significance level

P = estimated prevalence of rheumatic heart disease

D = 5%, degree of precision or accuracy.

n= 40

4.8 sampling method

Systematic sampling of all children with RHD was done and those children meeting the inclusion criteria during the study period were selected for inclusion in the study.

4.9 Study procedure

The principal investigator sensitized the pediatric wards, pediatric outpatient, echocardiographic laboratory and cardiology clinic staff on the study. When children

with rheumatic heart disease were admitted or seen in the clinic the principal investigator was alerted and she evaluated them for possible inclusion in the study.

Informed consent (appendix 4) was obtained from the guardians of the children who qualified for inclusion into the study.

The principal investigator then evaluated all children with a diagnosis of RHD for the following symptoms and signs; cough, haemoptysis, dyspnea, paroxysmal nocturnal dyspnea, orthopnea, chest pain, palpitation, syncope, body swelling, easy fatigability, abdominal distention, oedema, murmurs, wasting, tachypnea, cyanosis, tender hepatomegally, thrill basal crepitations, and the heart rate and rhythm.

New York Hear association Classification was uses in this study to estimate the functional capacity of what the patient's heart will allow the patient to do.(Appendix 8).(NYHA developed as functional classification for patients with heart disease)[50].

Patients' parents /guardians were asked to recall if they patients has one or more episodes consisting of abnormal dancing involuntary movements that resolved with sleeping, migratory joint pains, fever, body swelling, palpitations, painless non-pruritic red rash that had a pale center and any tests were done at that time. For those with documentation of an ASOT, significant titers as age dependent(2-5yrs: >120-160 TU ,6-10 years >240 TU ,>10 years: >320 T U) but in general an ASOT >200 TU is considered significant(this was done in order to try illicit history of rheumatic fever)

The study was carried out between 8.00 am and 5.00 pm daily during the study period. Pertinent information obtained from the history and clinical examination was then entered in the data collection form. (Appendix 5)

A transthoracic, M-mode, two-dimensional (2D), 2D echo-Doppler and colour flow Doppler echocardiography was done by two trained technicians in conjunction with the principle investigator (the principal investigator underwent training on echocardiography while the technicians had a refresher course) and the results recorded on a video tape that was reviewed by a cardiologist and kept for future verifications if need be. At least 2 of the 3(2 technicians and principle investigator) plus the cardiologist had to agree on the finding for it to pass as valid. M-mode echocardiography provided parameters for assessing ventricular function, while 2D echocardiography provided realistic real-time image of anatomical structure. Two-dimensional echo-Doppler and colour flow doppler echocardiography were used to detect abnormal blood flow and valvular regurgitation. A Macune 2D echo-model HP 2500 (Hewlett Packard) machine was used .S_5 and S_8 prop was used depending on the need. A full study echocardiogram was done;-apical, subcostal, long and short parasternal and suprasternal axes views were done. Each procedure took 45 minutes-1 hour. (Appendix 7)

Valvular echo findings were graded in terms of severity into mild, moderate and severe based on American society of echocardiography and Wilkin scoring systems for mitral stenosis (appendices 11 and 12) these formed the basis for determining the treatment options.[24, 25, 26, 27] Left ventricular systolic and diastolic functions were also determined on echocardiography.

Qualitative data collected from laboratory studies for each patient were entered into the data research sheet which formed the main research tool. These details were then coded and entered into a Microsoft access and Genstat computer program for storage and analysis.

4.9 Data management.

Data was summarized in frequency tables and analyzed using Genstat discovery edition 3(GenStat is a complete package that is as good as the other statistical packages and which through the application of University of Nairobi and other organizations was made available at no cost for non-commercial use in Africa (students, lecturers, government researchers, NGOs). A biostatistician assisted with the analysis of data.

Rates and percentages were calculated and measures of central tendency used where appropriate. Tabulation of data was done as appropriate.

Frequency listings and percentages were used to describe categorical variables while descriptive statistics such as mean and median were used for continuous variables.

To assess whether there were any associations between the categorical variables the chi square test was used. In cases where the variables were less than 5 the fishers' exact test was used. In all the analysis p-values less than 0.05 were considered to be significant. In most cases, Fischer exact test was used to just find out if the was any association between categorical variables. This study was not powered enough to do post hoc test for instant logistical regression hence larger studies need to be done to find out if this associations are significant. . Logistical regressions could not be done

because some of the parameters had zeros (no patient) this would give a falsely wide confidence interval.

Principal component analysis was done.The signs and symptom were grouped according to the number of symptoms exhibited and an index given to each group (with the assumption that the more the sign and symptoms the greater the severity) for ease of analysis

For the valvular lesions and pulmonary hypertension an index was created so that the lesions could be treated as continuous variables based on the severity of the lesions. (Those with less severe valvular disease had a smaller index than those with severe disease.) A correlation co-efficient and probability of significance was the done for the main traits.

4.10 Study limitations

i) Recall bias may have contributed to high percentage of patients with a positive history of rheumatic fever, and compliance to secondary prophylaxis
ii) Social desirability bias may have led some patients' parents to say that they had been compliant to secondary prophylaxis while they were not.

4.11 Ethical considerations.

Permission to carry out the research was sought from the institutional research and ethics committee (IREC) of School of Medicine and MTRH.

Written informed consent (appendix 4) was obtained from the guardians/ parents before enrolment or any procedure was done. Verbal consent was obtained from children > 7 yrs. The cost of the echocardiography was met by principal investigator.

Copies of clinical notes and laboratory results were left in the file for use in patient management. Patients who required surgical treatment were referred. All data collected was treated with confidentiality.

CHAPTER FIVE

RESULTS

5.1 Demographic Characteristics

The demographic characteristics of the patients who were included in the study are presented in Table 5.1. A total of eighty four children with rheumatic heart disease were enrolled in the study (46 new patients and 38 on follow-up treatments).

Table 5.1; The demographic characteristics of patients with rheumatic heart disease

	Patient type		
	No. of patients with an initial diagnosis of RHD	No. of patients on follow up	Total
Female	32(38.10%)	24(28.57%)	56(67%)
Males	14(16.67%)	14(16.67%)	28(33%)
Total	46(54.76%)	38(45.23%)	84

Overall, there were more female patients 56(67%) than males 28 (33%), with a male to female ratio of 1:2.The median age was 11 yrs. (3.5, 15)

There were more new patients than those already on treatment who were being followed up.

There were no significant differences in nutritional status by gender, with 50 %(14) and 52 %(29) of males and females respectively having normal weight for age. Forty

three percent of both male and female were underweight while only 5% of the females and 7% of the male had marasmus.

The distribution of patients by age group and nutritional status is presented in Figure 5.1.

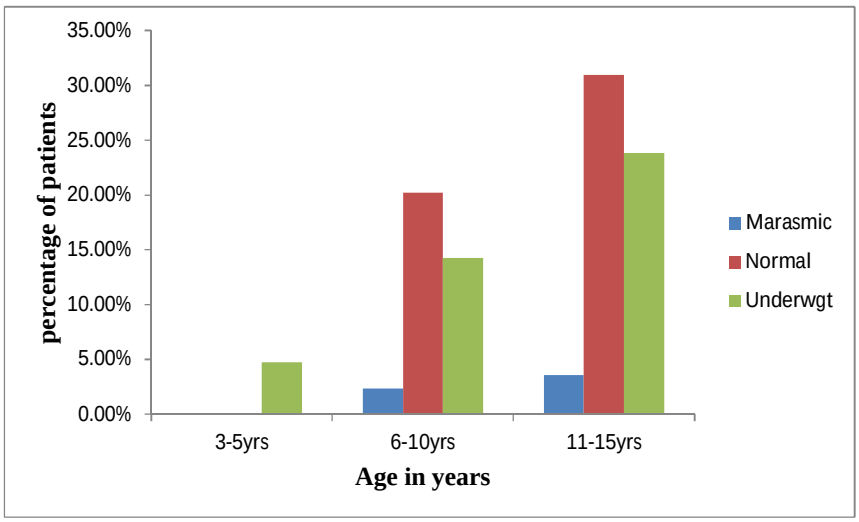

Figure 5.1. Percentage of patients with Rheumatic heart disease (y-axis) having different nutritional status within each age group of the population studied

There were 49(58.33%) children aged >10yrs, 31(36.90%) between 6-10yrs and four (4.76%) aged less than 5 years.

From the population studied, half of the patients (51.19%) had a normal weight for age, 42.68% were under weight and 5.95% were marasmus.

5.2 Clinical profile

Symptoms and signs

The symptoms and signs exhibited by patients with RHD for the population studied are presented in Tables 5.2 and 5.3 respectively.

Table 5.2: **Percentage of patients with RHD exhibiting different symptoms**

Symptoms	**New patients**	**Patients on follow up**	**P value**
Dyspnea	39(84.78%)	24(63.16%)	0.265[1]
Easy fatigability	38 (82.61%)	24(63.16%)	0.147[1]
Palpitation	34(73.91%)	18(47.37%)	0.089[1]
Cough	32(69.57%	14(36.84%)	0.416[1]
Orthopnea	29(63.04%)	13(34.21%)	0.660[1]
Paroxysmal nocturnal dyspnea	29(63.04%)	8(21.05%)	**<0.001[1]**
Body swelling	24(52.17%)	8(21.05%)	**0.003[1]**
Chest pain	19(41.30%)	11(28.95%)	0.175[1]
Abdominal distension	18(39.13%)	4(10.53%)	0.353[1]
Asymptomatic	6(13.04%)	8(21.05%)	0.992[1]
Syncope	6(13.04%)	0	0.014[2]
Haemoptysis	1(2.17%)	0	0.556[2]

[1]chi square test ,[2] fishers exact test

The most common symptoms presented by the new patients were dyspnea, easy fatigability, palpitations, cough and orthopnea. Six (13.04%) of the new patients were asymptomatic at presentation; these patients were referrals where they were discovered to have had a murmur after presenting for other non-cardiac diseases.

Paroxysmal nocturnal dyspnea and body swelling was significantly more common among the new patients.

Table 5.3; Percentage of patients with RHD exhibiting different signs

Signs	New patients	Patients on follow up	P value
Systolic murmur	41(86.96%)	30(78.95%)	0.458[1]
Tachycardia	35(76.09%)	20(52.6%)	**0.025[1]**
Loud P2	29(63.04%)	16(42.11%)	0.413[1]
Edema	24(52.17%)	7(18.42%)	0.050[1]
Wasting	23(50.00%)	12(23.68%)	0.480[1]
Diastolic murmur	22(47.83%)	13(34.21%)	0.861[1]
Tender hepatomegaly	21(45.65%)	8(21.05%)	0.615[1]
Pallor	18(34.78%)	11(28.05%)	0.079[1]
Tachypnea	18(39.13%)	6(15.79%)	0.111[1]
Collapsing pulse	16(34.78%)	7(18.42%)	0.595[1]
Fever	16(34.78%)	6(15.79%)	0.913[1]
Basal crepitation	15(32.61%)	5(13.16%)	0.721[1]
Increased jugular venous pressure	12(26.09%)	2(5.26%)	0.344[2]
Irregular heart rate	2(4.35%)	0	0.285[2]
Decreased breath sound	1(2.19%)	1(2.63%)	0.437[2]
Malar flush	0	0	-
Cyanosis	0	0	-

[1]chisquare test , [2] fisher's exact test

The most common signs exhibited by the new patients were a systolic murmur (89.13%), thrill (78.26%) and tachycardia (76.09%) of new the patients. Tachycardia was significantly more common in the newly diagnosed patients.

New York heart association classification

A clinical classification of patients was carried out using the New York heart association (NYHA). Comparisons of the various patient characteristics within the NYHA classes are presented in Table 5.4.

Table 4: Proportion of patients with various characteristics within each New

Characteristic	**NYHA CLASS**					
	1	**2**	**3**	**4**	**Total number**	**P value**
Gender						
Female	12(21.43%)	11(19.24%)	19(33.93%)	14(25%)	56	0.126[1]
Male	10(35.71%)	7(25%)	5(17.85%)	6(21.43%)	28	
Patient status						
New	7(15.23%)	7(15.23%)	16(34.78%)	16(34.78%)	46	<0.001[2]
On prophylaxis	15(39.47%)	11(28.95%)	8(21.05%)	4(10.52%)	38	
Total for each class	22(26%)	18(21%)	24(29%)	20(24%)	84	

York heart association classification class

[1]chisquare test ,[2] fishers exact test

Differences in the overall percentage of patients within the four NYHA classes were not large, with 26%, 21%, 29% and 24% of the patients in classes 1, 2, 3 and 4 respectively. There were significantly more new patients in NYHA classes 3 and 4,

than those on secondary prophylaxis who were mainly in NYHA class 1 and 2 (p <0.001).

Numbers of patients who were in heart failure and their NYHA class are illustrated in Figure 5.2

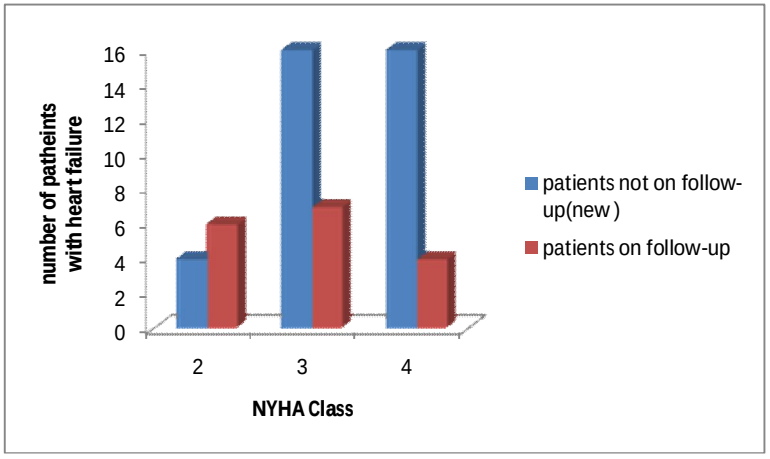

Figure 5.2; NYHA class of patients in heart failure in the different patient cohorts

Eighteen (47.37%) of the patients on follow-up and 36 (78.26%) of the newly diagnosed patients were in heart failure. The new patients were mainly in NYHA class 3 and 4

***Compliance to secondary prophylaxi*s**

Numbers of patients on prophylaxis and their relative compliance to the secondary prophylaxis are illustrated in Figure 5.3. Generally, most patients were compliant; however, patients who were on secondary prophylaxis for less than a year were more likely to be non- compliant.

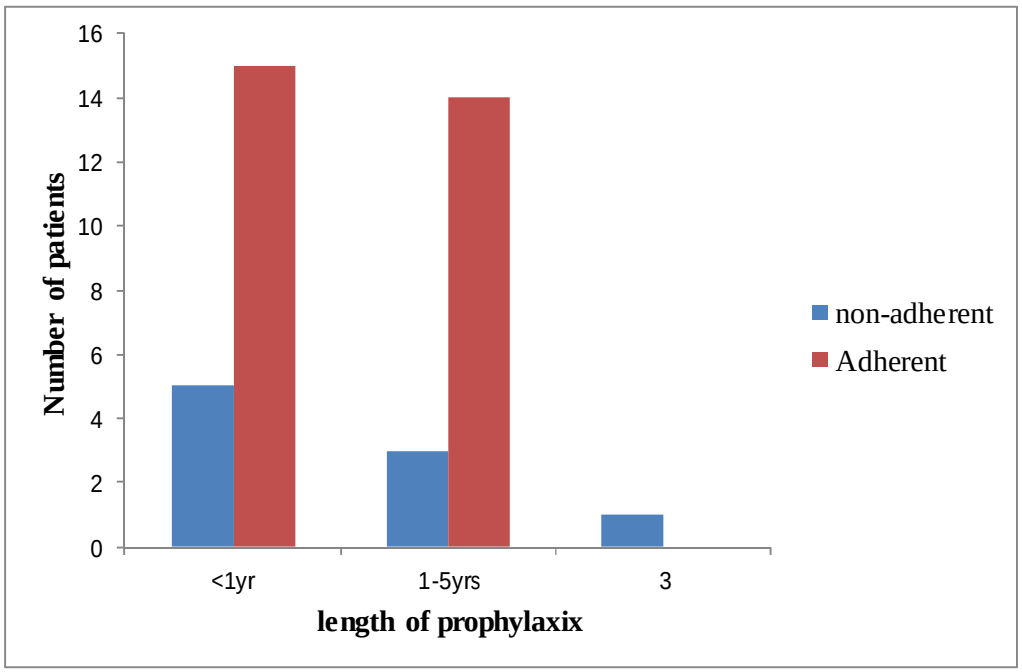

Figure 5.3: Duration of prophylaxis versus number of compliant and non-compliant patients

Mean duration of follow up was 14.6 month, with a range of 1 month to 6 years. Twenty nine (76.32%) of the children were compliant while 9(23.68%) were non-compliant.

Though there were only 9 patients who did not adhere to secondary prophylaxis. Among these patients, the main reasons given for non-compliance were lack of finances, long distance to a health facility and lack of understanding on the need for sustained treatment.

History of rheumatic fever

Sixty nine (86.96%) patients recalled a positive history of rheumatic fever.

5.3 Echocardiographic profile of patients with RHD

Valvular Lesions

Different types of valvular lesions and the percentage of patients exhibiting combinations of the lesions are presented in Table 5.5.

Table 5.5 : Frequency distribution of valvular lesions in total study population

Valvular lesion type	Number of patients	Percentage of total number of patients (T=84)
MR	39	46.43%
MR+AR	30	35.71%
MR+MS	5	5.95%
MR+MS+AR	3	3.57%
MS+AR	3	3.57%
MR+MS+AR+AS	2	2.38%
MS	1	1.19%
AR	1	1.19%

The most common lesion was isolated MR present in 39 (46.43%) patients followed by combined MR+AR present in 30 (35.71%) of the patients.

Overall more patients had more than one type of valvular lesion 43(51.19%) compared to those who had only one diseased valve 41(48.81%).

Mixed mitral valve and mixed aortic valve disease were present in 40(47.62%) and 38(45.24%) of the patients of respectively.

MR was present in 94.04% of the patients (only 5 patients did not have MR). No patients had lesions in all the 4 valves.

A Wilkin score was determined for all patients with Mitral stenosis either alone or in combination with other lesions, and differences exhibited by patients on secondary prophylaxis and patients not on prophylaxis, patients of different gender and NYHA classes were tested to determine whether or not they were significant (Table 5.6)

Patients with a score < 8 are more favorable candidates for balloon valvotomy while those with a score of >8 are candidates for surgery.

Table 5.6: Proportions of patients with mitral stenosis with different characteristics

Characteristic	Observations with Wilken score<8	Observations with Wilken score>8	Total number of observations	P value
Gender				0.700[2]
Male	4	1	5	
Female	6	3	9	
NYHA class 1	1	-	1	0.006[2]
2	2	-	2	
3	3	3	6	
4	4	1	5	
New patients	5	1	6	0.004[2]
Patients on follow-up				0.028[2]
Adherent	3	1	4	
Not adherent	2	2	4	

[1]chisquare test , [2] fishers' exact test

MS was present in 16.67% of the patients aged 8-15 years. Most patients (71.48%) with MS had a Wilkin score of <8, with significantly more non-compliant patients than patients compliant to secondary prophylaxis presenting with Wilkin score >8. Patients in NYHA class 3 and 4 were more likely to have a Wilkin score >8

Table 5.7: Severity of valvular lesion

Valvular lesion	New patients	Patients on secondary prophylaxis			Total
		Adherent	Not adherent	P value	
MR				0.135[2]	
Mild	6(13.04%)	6(21.43%)	0		12
Moderate	7(15.22%)	6(21.43%)	1(11.11%)		14
Severe	30(65.22%)	13(46.43%)	7(77.78%)		50
Normal	3(6.52%)	4(14.29%)	1(11.11%)		8
MS				**0.011**[2]	
Mild	1(2.17%)	0	1(11.11%)		**2**
Moderate	2(4.34%)	4(13.79%)	3(33.33%)		**9**
Severe	3(6.52%)	0	4(44.44%)		**7**
Normal	40(86.96%)	25(96.15%)	1(11.11%)		**66**
AR					
Mild	6(13.04%)	5(17.86%)	1(11.11%)	**0.024**[2]	**12**
Moderate	11(23.91%)	3(10.71%)	0		**14**
Severe	23(50%)	1(3.57%)	4(44.44%)		**28**
Normal	6(13.04%)	20(71.43%)	4(44.44%)		**30**
AS				0.425[2]	
mild	0	0	1(11.11%)		1
Moderate	1(2.17%)	0	0		1
Severe	0	0	0		0
Normal	45(97.83%)	29(100%)	8(88.89%)		82

[1]chisquare test ,[2] fishers exact test

Non- compliant to secondary prophylaxis had an association with more severe MS and AR with p values of 0.011 and 0.024 respectively. However since this study was not powered enough to determine the significance of this association, larger studies need to be done to find out if this associations significant. Logistical regressions could not be done because some of the parameters had zeros (no patient) this would give a falsely wide confidence interval.

Most new patients had severe valvular disease especially those with mitral regurgitation and aortic regurgitation.

5.4. Complications found on echocardiography

Pulmonary hypertension was the commonest complication (52%) followed by functional tricuspid regurgitation. There were no patients with left ventricular diastolic dysfunction

Occurrence of vegetation's did not differ significantly with gender, NYHA class or nutritional status. However, vegetation's were more common among patients with severe valvular lesions ($p < 0.05$), the significance of this association need to be determined by larger studies.

Table 5.8; Complications versus valvular lesion

	Pulmonary Hypertension	TR	LV systolic dysfunction	Vegetation	PI
MR	16(36.36%)	13(32.5%)	4(36.36%)	1(20%)	1(50%)
MR+AR	15(34.09%)	17(42.5%)	6(54.54%)	2(40%)	1(50%)
MR+MS	5(11.36%)	4(10%)	0	1(20%)	0
MR+MS+AR	2(4.54%)	1(2.5%)	1(11.11%)	0	0
MS+AR	3(6.82%)	2(5%)	0	1(20%)	0
MS	1(2.27%)	2(5%)	0	0	0
AR	1(2.27%)	0	0	0	0
MR+MS+AR +AS	1(2.27%)	1(2.5%)	0	0	0
Total	44(52.38%)	40(47.62%)	11(13.10%)	5(5.95%)	2(2.38%)

Complications were commoner in patients with isolated MR and MR with AR than in those with other valvular lesions.

Analyses of factors affecting pulmonary hypertension

Results from the analysis of variance for factors influencing the severity of pulmonary hypertension are presented in Table 5.9 respectively.

Table 5.9: Levels of significance for various patient characteristics (factors) influencing the severity of pulmonary hypertension in patients with RHD

Patient Characteristic	**Severity of pulmonary hypertension**			**Total**	**Significance level (P value)**
	Mild	Moderate	Severe		
Gender					**0.033[2] (*)**
Male	2	4	6	12	
Female	3	8	21	32	
NYHA Class					**<0.001[2](*)**
1	0	1	0	1	
2	2	2	3	7	
3	3	2	13	18	
4	0	7	11	18	
New patients	2	9	18	29	0.096[2] (ns)
Adherence					**0.039[2] (*)**
Yes	3	1	4	8	
No	0	2	5	7	
Severity of valvular lesions (Covariate)					**<0.001[2] (*)**

ns = not significant, * = significant

[1]chisquare test , [2]fisher's exact test

More female patients had severe pulmonary hypertension than their male counterparts ($p<0.05$).The severity of pulmonary hypertension was greater for patients in the NYHA classes 3 and 4($p<0.001$). A large number of new patients had severe

pulmonary hypertension (18), but this was not statistically significant. Compliant to the secondary prophylaxis was associated with normal pulmonary pressure for a large number of patients ($p<0.039$), with only four of the patients on follow-up treatment having severe pulmonary hypertension.

Severe pulmonary hypertension was higher in patients with more severe valvular lesions ($p=<0.001$).

5.5 Correlations between main traits present in patients with RHD

The correlation matrix for the main traits present in patients with RHD is presented in Table 5.10.

Table 5.10; Correlation coefficients and probability of significance for main traits present in patients with RHD

Trait	Pulmonary Hypertension	Severity of Vulvular lesions	Left Ventricular function	Number of symptoms displayed	Number of signs displayed	NYHA class
Pulmonary Hypertension	1	0.618 (0.0000)*	0.243 (0.0261)	0.648 (0.0000)*	0.667 (0.0000)*	0.657 (0.0000)*
Severity of Vulvular lesions		1	0.145 (0.1888)	0.461 (0.0000)*	0.558 (0.0000)*	0.453 (0.0000)*
Left Ventricular function			1	0.344 (0.0013)*	0.352 (0.0010)*	0.307 (0.0052)
Number of symptoms displayed				1	0.828 (0.0000)*	0.802 (0.0000)*
Number of signs					1	0.728 (0.0000)*
NYHA class						1

In brackets are P values, * significant values

All correlations between the traits studied were positive, however, the magnitude of the correlation between the traits was different.

The correlation between pulmonary hypertension and the number of symptoms displayed, number of signs displayed and NYHA was high (p value, 0.0000), indicating that the greater the number of signs and symptoms displayed by patients,

the greater the likelihood of the patient having pulmonary hypertension. However, larger studies need to be done to find out if these correlations are significant.

5.6 Comparisons of the initial clinical diagnosis and echocardiographic diagnosis

Of the 84 children studied, only 19(22.62%) had a documentation specific clinical diagnosis of a valvular lesion after a cardiac exam before echocardiography. Of these nineteen patients, 9(47.37%) had a clinical diagnosis that correlated with the echocardiographic diagnosis. Seven (78%) of these patients had mitral regurgitation. Most clinician missed diastolic murmurs of aortic regurgitation and mitral stenosis. Forty nine (58.33%) of the initial diagnosis was made by clinical officer, followed by medical officers 28(33.33%), pediatrics registrars 6(7.14%), and consultant 1(1.19%).

CHAPTER SIX

6.0 DISCUSSION

6.1: Demographic characteristics of patients with rheumatic heart disease

Rheumatic heart disease continues to be a major health problem in the developing countries. It accounts for a large percentage of cardiovascular disease related pediatrics admissions in Kenya. The last prevalence study that was done in 1992-1994 in Kenya showed a high prevalence (27/1000) of RHD, results which are consistent with recent studies in other developing countries.[5] However; this is in contrast to its virtual extinction in the developed world.

Results from this study revealed that there were more females, than male with RHD, with a male to female ratio of 1:2.This is similar to Karen Sliwa's et al study in Soweto, South Africa where African females had a prevalence of 68%, Essein et al in Nigeria and Paar et al in Nicaragua. Other recent studies have however depicted either no difference in the prevalence of RHD amongst males and females, or depicted females as the dominant patient population while others depicting males as the most predominant gender [3, 11, 13, 14, 15, 16, 17, 28, 18, 35, 36,45]. Rheumatic fever and RHD are more severe and have a worse prognosis in females than in males. Women produce more vigorous immune response and increased antibody production and estrogen significantly increases proinflammatory cytokine productions thus the elevated immune response in females may even further amplify the adjuvant effect of infection thus putting them more at risk of chronic autoimmune diseases [37]. This may account for the high number of females in this study, because they are more likely to be symptomatic and hence brought into hospital for treatment [6].

Children aged less than 5 years were the least prevalent forming 4.8% of those with RHD while those aged 5-15yrs had a prevalence of approximately 95%. This is similar to what was found by Yuko- Jowi at Kenyatta National Hospital who found that 76.4% of cases were aged between 5 and 15 years, while only 3% were less than 5 years old.[24]

Almost half of children studied had a weight that was less than 80% weight for age (either underweight or marasmic). This could be because of the disease process. Patients with rheumatic heart disease, especially mitral valve disease, are most likely to have cardiac cachexia, but nearly all patients with cardiac disease demonstrate wasting of body fat and skeletal muscle, with muscular weakness and easy fatigability. This is due to disturbances in neuroendocrine, inflammatory, and metabolic systems; anorexia from chronic illness, the unpalatability of a low salt diet, and to a great extent to poor cardiac output due to heart failure. In this study evidence for cardiac cachexia may be seen in the fact almost half of the patients had advanced tricuspid regurgitation which is one of the major criteria for diagnosis of cardiac cachexia in patients with mitral valve diseases. M. Sadif in Pakistan found a higher prevalence (67%) undernourished children with RHD [11, 38].

6.2 Clinical profile of patients

The commonest symptoms were dyspnea, palpitation and easy fatigability, while the commonest signs were systolic murmur, tachycardia and a thrill. Thirteen percent of the new patients were asymptomatic they came into MTRH as referrals where they were discovered to have had a murmur after presenting for other non-cardiac diseases/symptoms.

Almost three quarters of the patients were symptomatic. This is contrary to what would be expected in a population where the commonest valvular lesion is isolated MR. In most cardiology literature patients with mild to moderate MR are usually asymptomatic. The reason for this difference is that most patients in this study had severe valvular disease with complications of pulmonary hypertension and also because MTRH being a referral hospital receives very sick patients. Daniel Bernstein reported that easy fatigability and dyspnea is present in over 70% of the patients, this corroborates with what was found in this study. Fatigability and dyspnea are common in patients with severe MR and moderate to severe MS[1, 39, 40].

There was an almost equal distribution of patient in all the NYHA classes when all the patients were analyzed together. There was an association between the NYHA class and severity of MR and TR. Almost three quarters of the new patients came in stage 3 and 4. Only 13% of the new patients were asymptomatic showing that most patients seek medical attentions when they are very sick and probably having severe disease.

The mean duration of secondary prophylaxis was 14.6 month and a range of 1 month to 6 yrs. Kimberly-Leaky in Brazzaville found compliance of 75% after one month of follow-up and 37.5% after 3 month of follow-up, this is contrary to what was found in this study where patients who were on prophylaxis for a longer duration were more compliant than patients who were on it for a shorter duration [41] .Almost a quarter of the patients on prophylaxis were non-compliant with lack of knowledge, lack of finances and long distance to nearest health facility being the main reasons for non-compliance. Children who were non-compliant had more severe pulmonary hypertension, MS, AR and TR (p values = 0.039, 0.011, 0.024 and 0.038 respectively.

There were however few non-compliant patients (9 patients).Al-Khalifa et al in Sudan found a strong correlation between severity of the lesion and irregular prophylaxis (P < 0.001).This study was a cross-sectional study hence could not find out the dropout rates from secondary prophylaxis which is an important parameter [25].

6.3 Echocardiographic characteristic

This study revealed that the most common lesions seen in patients with rheumatic heart disease were of regurgitant type with mitral valve leading, followed by functional tricuspid, aortic valves and the least common was functional pulmonary regurgitation. However, TR and pulmonary regurgitation were all functional. Functional TR was secondary to pulmonary hypertension. This is consistent with previously reported data from different countries [39, 45]. Mixed mitral, mixed aortic and mixed tricuspid (functional TR) valvular lesions were commoner than their respective stenotic valve lesions. A slightly different pattern was reported by a study by Yuko-Jowi in KNH that found that a combination of MR and AR was the most common lesion followed by isolated mitral regurgitation.[9]The least common lesions were isolated AR and MS and those mixed with AR and PI. This was similar to what was found by Yuko –Jowi [24, 28].

The most common stenotic lesion was mitral stenosis with a prevalence of 16.7%, with an age range between 8-15 yrs. This prevalence is high compared to other studies done for patients of the same age because in general rheumatic mitral stenosis is seldom encountered before adolescence and is not usually recognized until adult life. However the natural history of mitral stenosis varies across geographical areas. In developing countries, mitral stenosis progresses much more rapidly, perhaps because of more severe or repeated streptococcal infections, genetic influences, or economic

conditions, and may lead to symptoms in the late teens and early twenties [2] .Higher prevalences of mitral stenosis have been found in India of up to 50% in some studies mainly in children aged 10-20yrs [46,47] .Al-Khalifa M .S in Sudan found mitral stenosis in 9% of the patients [25]. A study at Kenyatta national hospital found a lower prevalence of MS at 2.7% in children aged up to 20 yrs [24] .This difference may be due to low detection rate related to slow stenotic process and subtle sign, genetic and geographical variations.

Only one patient had aortic stenosis and none had tricuspid stenosis and pulmonary stenosis. This finding was similar to a study by Aurakzai et al in Pakistan [27] .A different picture was observed in 1999 in a study in India that found that 50% of patients with rheumatic tricuspid disease had tricuspid stenosis with or without tricuspid regurgitation whereas 50% had isolated tricuspid regurgitation. Isolated tricuspid stenosis was present in 7.4% of these cases. All patients had associated mitral stenosis [30].

In this study with exception of pulmonary insufficiency and mitral stenosis a higher percentage patients had severe valvular disease. This may be because of the female predominance in this study. RHD tend to more severe in females. Other possible explanations are that most patients present for medical care late in the disease because they are symptomatic and late referrals.

6.4 Complications detected on echocardiography

Complications of RHD observed included secondary pulmonary hypertension in more than half of the patients and functional tricuspid regurgitation almost half of the patients, this may because most of the patients had severe valvular lesion. Few

patients had left ventricular systolic dysfunction and vegetation. Jowi et al in KNH also found pulmonary hypertension as the most common complication commonly seen in mitral valve disease [24]. Sani MU in Nigeria found pulmonary hypertension in 72.19%, cardiomyopathy in 31.8% and functional TR in 30.20% of the patients [28].

Almost three quarters of the new patients had pulmonary hypertension at diagnosis most of whom (more than 90%) had moderate to severe pulmonary hypertension. Severe MR, MS and TR were associated with severe pulmonary hypertension. Seventy five percent of the patients that were non–compliant to secondary prophylaxis had moderate to severe pulmonary hypertension compared to just a few of the compliant patients. This may be because secondary prevention of recurrent acute RF prevents development of severe valvular lesion and hence pulmonary hypertension.

None of the patients had left ventricular diastolic dysfunction.

6.5 Correlations between main traits present in patients with RHD

The greater the number of signs and symptoms displayed by patients, the greater the likelihood of the patient having pulmonary hypertension. There was also a positive and strong correlation between the New York heart association and the severity of pulmonary hypertension. This is consistent with the WHO classification of pulmonary hypertension which is a modification of New York heart associations where patients who are more symptomatic and have right sided heart failure have a worse WHO pulmonary hypertension classification [44].

6.6 Comparison of clinical and echocardiographic diagnosis

In this study clinical diagnosis correlated with the echocardiographic diagnosis in almost half of the patients who had documentations of a specific clinical diagnosis. This may be due to the fact that most of the initial diagnosis was made by clinical officer followed medical officers or due to poor documentation.

Most clinician missed diastolic murmurs of aortic regurgitation and mitral stenosis.

CHAPTER SEVEN

7.0. Conclusions and recommendations

7.1 Conclusions

1. **1.** Most new patients with RHD at MTRH present in NYHA class 3 and 4 with moderate to severe valvular lesion and complicated disease on echocardiography implying very late presentation.
2. **2.** The commonest symptoms of new patients at MTRH were dyspnea, easy fatigability, palpitations, cough and orthopnea while the commonest signs were systolic murmur, thrill and tachycardia. A significant number of patients were asymptomatic.
3. **3.** On echocardiography isolated MR was the commonest valvular lesion, while pulmonary hypertension functional TR were commonest complication in patients with RHD at MTRH. Other complications found were pulmonary insufficiency and left ventricular systolic dysfunction
4. **4.** Patients who were non-compliant to secondary prophylaxis were more likely to have severe valvular lesion and pulmonary hypertension

7.2 Recommendations

1. Mixed methods studies (qualitative and quantitative) need to be done to better understand reasons why children with RHD present at MTRH with severe disease to facilitate intervention.
2. Because most of the new patients had severe disease at diagnosis, emphasis should be put on early detection and primary prevention

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APPENDICES

APPENDIX 1: JONES CRITERIA

Require the presence of 2 major or 1 major and 2 minor criteria for the diagnosis of rheumatic fever.

- The major diagnostic criteria include carditis, polyarthritis, chorea, subcutaneous nodules, and erythema marginatum.
- The minor diagnostic criteria include fever, arthralgia, prolonged PR interval on ECG, elevated acute phase reactants (increased erythrocyte sedimentation rate [ESR]), presence of C-reactive protein, and leukocytosis.

- Additional evidence of previous group A streptococcal pharyngitis (for active carditis) is required to diagnose rheumatic fever. One of the following must be present:
  - Positive throat culture or rapid streptococcal antigen test result
  - Elevated or rising streptococcal antibody titre
  - History of previous rheumatic fever or rheumatic heart disease
- These criteria are not absolute; the diagnosis of rheumatic fever can be made in a patient with chorea alone if the patient has had documented group A streptococcal pharyngitis.

After a diagnosis of rheumatic fever is made, symptoms consistent with heart failure, such as difficulty breathing, exercise intolerance, and a rapid heart rate out of proportion to fever, may be indications of carditis and rheumatic heart disease

APPENDIX 2: WHO GUIDELINE FOR DIAGNOSIS OF RHD

Diagnostic criteria for rheumatic heart disease in children defined by an expert panel convened under the auspices of the World Health Organization and the National Institutes of Health in September 2005

Definite RHD (either A or B)

A. Significant mitral stenosis, defined as echocardiographic evidence of mitral stenosis with a mean diastolic pressure gradient across the mitral valve >4 mmHg and clinical findings of mitral stenosis with or without other valvular lesions. Such abnormalities as dogleg deformity of the anterior mitral valve leaflet, fixed or restricted mitral leaflet abnormality, calcification, and commissural thickening were expected.

B. The presence of a heart murmur consistent with any combination of MR or aortic regurgitation and Doppler echocardiographic evidence of rheumatic valvular damage, defined as any of the following:

1. Significant MR, with an MR jet ≥2 cm from the coaptation point of the valve leaflets, seen **in** 2 planes, of high velocity (mosaic pattern), holosystolic, plus thickened mitral valve leaflets and/or dogleg deformity of the anterior mitral leaflet. Additional changes might include multiple regurgitant jets, especially posterolaterally directed.

2. Significant aortic regurgitation, defined as an aortic regurgitation jet ≥1 cm from the coaptation point of the valve leaflets, of high velocity, seen **in** 2 planes, plus thickened mitral leaflets and/or dogleg deformity, without another apparent cause for the aortic insufficiency, such as a bicuspid aortic valve or annuloaorticectasia. Aortic stenosis might be associated, but aortic stenosis without associated rheumatic mitral valve disease is not accepted as evidence of rheumatic valvular disease.

Probable RHD

The presence of a heart murmur consistent with any combination of MR or aortic regurgitation, and the subject comes from a population with known or suspected high rates of ARF and/or RHD and no history of definite or probable ARF, and any of the following findings are present on echocardiography:

1. Thickened mitral valve leaflets and/or dogleg deformity of the anterior mitral valve leaflet without significant mitral stenosis.

2. Significant MR, as defined under definite RHD, without thickened mitral valve leaflets and/or dogleg deformity of the anterior mitral valve leaflet.

3. Significant aortic regurgitation, as defined under definite RHD, without thickened mitral valve leaflets and/or dogleg deformity of the anterior mitral valve leaflet.

Possible RHD

The absence of a valvular heart murmur **in** a subject from a population with known or suspected high rates of ARF and/or RHD with any of the following Doppler echocardiographic changes:

1. Thickened mitral valve leaflets and/or dogleg deformity of the anterior mitral valve leaflet.

2. Significant MR, as defined under definite RHD.

3. Significant aortic regurgitation, as defined under definite RHD.

APPENDIX 3: American heart association echocardiographic criteria for RHD

Doppler criteria

Any degree of valvular regurgitation seen in at least 2 planes

Associated with at least 2 morphological signs

Morphological signs

Leaflet restriction

Subvalvular thickening

Valvular thickening

APPENDIX 4; CONSENT FORM.

Clinical and echocardiographic profile in children with RHD at Moi Teaching and Referral hospital, Eldoret, Kenya.

I……the guardian/parent of ……

……..have been asked to allow my child to participate in the study to determine clinical and echocardiographic profile in children with RHD at Moi Teaching and Referral hospital, Eldoret, Kenya. I have been informed that my child will be given the best treatment according to current knowledge and management of the disease.

I have also understood that an echocardiography shall be done on my child for purposes of making an accurate diagnosis. It has been explained to me that this procedure will not cause any pain or harm to my child.

I have been assured that I am free to withdraw my child from the study at any time and this decision would not affect his/her treatment because he/she would still get quality treatment from the hospital. I have also been assured that information concerning the care of my child in the study will be handled with confidentiality.

I have also been informed that if I have any complain about the investigator I should contact the IREC secretariat Tel. 33471/2/3.

I have understood the foregoing and hereby give consent for my child to participate in the study.

Signature of parent/guardian…….

Signature of investigator……...

Date……..

APPENDIX 5: DATA COLLECTION TOOL

Researcher's name……..…

a] Demographic details.

IPNO …….……Serial NO…… ward…….…….

Age ……. .Gender…… clinic……..

District ……..… Location……..…… weight……..

Parents/guardian employment mother …….father…….……

Level of education mother ……..father.....

1. Does the patient have the symptoms below (tick where appropriate).

	Yes [1]	No[2]
Cough		
Haemoptysis		
Dyspnea(at rest, on mild/strenous exertion,)(circle the grade present)		
Paroxysymal nocturnal dyspnea		
Orthopnea		
Chest pain		
Palpitations		
Syncope		
Body swelling		
Easy fatigability		
Abdominal distension		
Asymptomatic		

2. Does the patients have the signs below(tick where appropriate)

	Yes [1]	No[2]
Wasting		
Edema/anasaca		
Tachypnea		
Tachycardia/bradycardia		
Collapsing pulse		
Malar flush		
Fever		
Cyanosis		
Pallor		
Tender hepatomegaly		
Increase jugular venous pressure		
Thrill(systolic/diastolic)		
Loud P_2		
Systolic murmur		
Diastolic murmur		
heart rate		
Basal crepitation on the lung		
Decrease breath sounds		

3. New York Heart Association Class……

4 .History of rheumatic fever (use the Jones criteria) YES/NO- Ask if the patient has ever had history of episodes consisting of:

- abnormal dancing involuntary movements that resolved with sleeping,
- migratory joint pains and swelling
- fever
- joint pain

- body swelling, palpitations
- painless non-pruritic red rash that had a pale center
- Was any tests were done at that time.
- Is there documentation of an ASOT titres .(yes/no). What was the value……..

5. Echocardiography findings (use the table below to gauge severity of the cardiac lesion)

LESION	**FINDINGS**		
	Mild[1]	Moderate[2]	Severe [3]
Mitral regurgitation			
Mitral stenosis			
Aortic regurgitation			
Aortic stenosis			
Tricuspid regurgitation			
Tricuspid stenosis			
Other findings			
	Normal	Mild dysfunction	Moderate dysfunction
Left ventricular systolic function			
left diastolic function			
Vegetation			
Thrombus			
Ventricular hypertrophy			
Pulmonary hypertension			
Wilkins score for Mitral stenosis			

6.Is the patient on secondary prophylaxis? Yes/No

If yes a) for how long has she/he been on it…….……

b) Is she/ he compliant……...…….

[Ask how many injections has the patient received in the last 6 month?(1,2,3,4,5,6) .If the patients has their clinic card where benzathine penicillin injections given is recorded –confirm.]

c) Reasons for non-compliance ……...……..

d) Where was it started…….…….

APPENDIX 6: ANTI STREPTOLYSIN O TITRE PROCEDURE

Principle

The ASO reagent is a suspension of polystyrene latex particles coated with stabilized streptolysin O. The reagent has been adjusted in the way that the presence of an ASO titer of 200 IU/ml or higher in the serum gives a visible agglutination of the latex particles without previous sample dilution.

Procedure

1. Reagents are brought to room temperature before use
2. A drop of positive control on field # 1 of the reaction slide. Place one drop of negative control on field # 2. A drop of each undiluted test specimen is place on successive fields.
3. Gently resuspend the latex reagent and add one drop to each test field. Use a stick to spread reaction mixture over entire test field. Use different sticks for each sample.
4. Rotate the slide (80-100 r.p.m) for 2 minute and read immediately under direct light.

Reading and Interpretation:

• Examine macroscopically for the presence or absence of clumps or agglutination within 1 minute of removing the card from the rotator.

• The presence of visible agglutination indicates a content of antistreptolysin 200 iu/ml.

• Positive sera may be titrated. To titrate make serial two-fold dilutions in 9g/L saline as indicated in the Quantitative Test procedure. The serum titre is defined as the

highest dilution showing positive agglutination. The approximate ASO level (iu/ml) present in the sample may be obtained multiplying the titer by the limit of sensitivity (200 iu/ml).

Positive results

2-5yrs: >120-160 TU

6-10 years >240 TU

>10 years: >320 T U

Quality Control: Each run of tests should be validated with a positive and negative control.

APPENDIX 7; ECHOCARDIOGRAPHY PROCEDURE

Echocardiogram will be done the echocardiography clinic.

For the procedure,

1. The patient will remove his /her clothing from the waist up.
2. Privacy will be ensured by using drapes across the chest and limiting access into the procedure room during the test.
3. The patient will lie on his/ her left side on a cardiac bed, but may be asked to change position during the procedure.
4. The echocardiography technician will apply warmed gel to the patient's chest.
5. Then he/she will position the transducer on the patient's chest and use a small amount of pressure to obtain the desired image.
6. The technician will move the transducer around on the patient's chest so that all areas and structures of the heart can be observed.
7. During the test, the different echo techniques described above (M-mode, 2-D, Doppler, and color Doppler) may be used.
8. The patient will not be aware of the different techniques except that during the Doppler or color Doppler, will hear a "whoosh-whoosh" sound. This whooshing sound is the patient's blood moving through the heart.
9. Once all the images have been taken, the technician will wipe the gel from the patient's chest and assist the patient to dress, if necessary.
10. The procedure usually takes about 45- 60 minutes to perform.

APPENDIX 8: NEW YORK HEART ASSOCIATION (NYHA) FUNCTIONAL CLASSIFICATION IN A PATIENT WITH HEART DISEASE [50]

NYHA developed a functional classification for patients with heart disease.

Patients: Heart disease must be present.

Parameters:

(1) Limitations on physical activity

(2) Symptoms (undue fatigue, palpitations, dyspnea and/or angina pain) with ordinary physical activity

(3) Status at rest

Limitations on Physical Activity	**Symptoms with Ordinary Physical Activity**	**Status at Rest**	**Class**
none	none	comfortable	I
slight	symptomatic with ordinary activities	comfortable	II
marked	symptomatic at less than ordinary levels of activity	comfortable	III
unable to perform any activity	discomfort with any activity	symptomatic at rest	IV

APPENDIX 9: IREC APPROVAL FORM

INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE (IREC)

MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 33471/2/3

MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET
Tel: 33471/2/3

Reference: IREC/2009/88
Approval Number: 000436

15th September, 2009

Dr. Audrey Chepkemoi Kironget,
Moi University,
School of Medicine,
P.O. Box 4606 - 30100,
ELDORET, KENYA.

Dear Dr. Kironget,

RE: FORMAL APPROVAL

The Institutional Research and Ethics Committee has reviewed your research proposal titled:

"Clinical and Echocardiographic Profile of Patients with Rheumatic Heart Disease at Moi Teaching and Referral Hospital".

Your proposal has been granted a Formal Approval Number: **FAN: IREC 000436** on 15th September, 2009. You are therefore permitted to continue with your study.

Note that this approval is for 1 year; it will thus expire on 14th September, 2010. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Yours Sincerely,

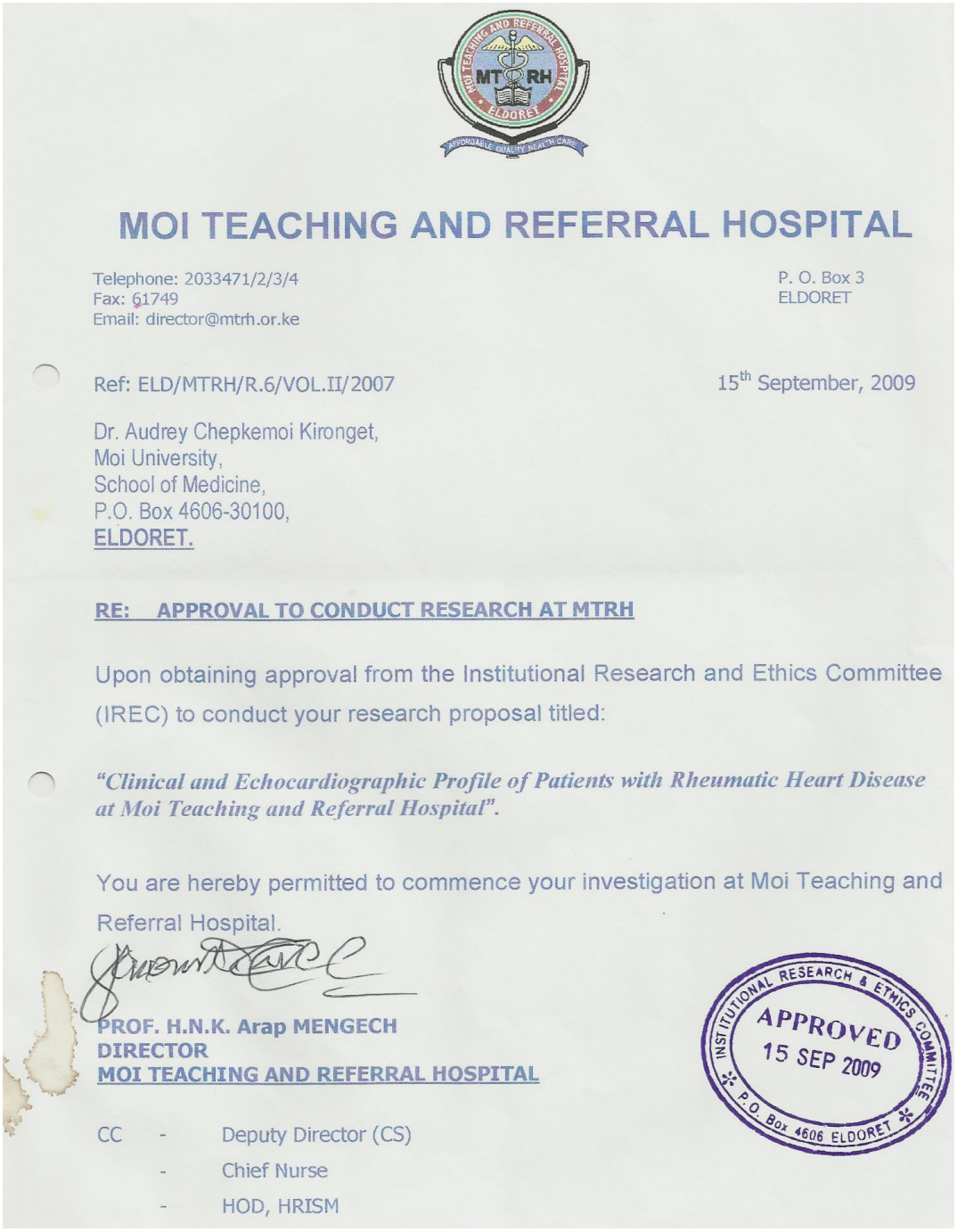
22/09/09

PROF. D. NGARE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
APPROVED
15 SEP 2009
P.O. Box

cc: Director - MTRH
Dean - SOM
Dean - SPH
Dean - SOD

9.10 APPENDIX 10: APPROVAL TO CONDUCT RESEARCH AT MTRH



MOI TEACHING AND REFERRAL HOSPITAL

Telephone: 2033471/2/3/4
Fax: 61749
Email: director@mtrh.or.ke

P. O. Box 3
ELDORET

Ref: ELD/MTRH/R.6/VOL.II/2007

15th September, 2009

Dr. Audrey Chepkemoi Kironget,
Moi University,
School of Medicine,
P.O. Box 4606-30100,
ELDORET.

RE: APPROVAL TO CONDUCT RESEARCH AT MTRH

Upon obtaining approval from the Institutional Research and Ethics Committee (IREC) to conduct your research proposal titled:

"Clinical and Echocardiographic Profile of Patients with Rheumatic Heart Disease at Moi Teaching and Referral Hospital".

You are hereby permitted to commence your investigation at Moi Teaching and Referral Hospital.

PROF. H.N.K. Arap MENGECH
DIRECTOR
MOI TEACHING AND REFERRAL HOSPITAL

INSTITUTIONAL RESEARCH & ETHICS COMMITTEE
APPROVED
15 SEP 2009
P.O. Box 4606 ELDORET

CC - Deputy Director (CS)
- Chief Nurse
- HOD, HRISM

APPENDIX 11: SEVERITY OF VALVULAR LESIONS (Modified from

American society of echocardiography and Wilkin scoring system)

LESION	**CHARACTERISTIC**	**SEVERITY**		
		MILD	MODERATE	SEVERE
Mitral regurgitation	Jet area	<4 cm	4-8 cm	>8cm
	Jet width	Thin	-	>0.6
	Vena contracta	<0.3	0.3-0.7	>0.7
	Pulmonary venous flow	Systolic dorminant	-	Systolic reverse flow
	Mitral flow	A wave dominant	-	E wave dominant
	Continuous wave Doppler	Soft and parabolic	-	Dense and triangular
	LV/LA	Normal	-	Enlarged in chronic MR
Mitral stenosis	Mitral valve area	2.2-1.5	1-1.5	<1
	Pressure half-life(msec)	100-150	150-220	>220
	Mean pressure gradient (m/sec)	<5	5-10	>10
	TR Velocity(m/sce)	<2.7	-	>3
	Pulmonary arterial pressure(mmhg)	<30	-	>30
Aortic regurgitation	Width of vena contracta	<3.0	3.0-5.9	≥6
Aortic stenosis	Valve area	2.0-1.5	1-1.5	<1
	Peak velocity(m/s)	2-3	3-4	>4
	Peak gradient(mmHg)	<35	35-65	>65
	Mean gradient(mmHg)	<20	20-40	>40

APPENDIX 12: WILKIN SCORE OF MITRAL STENOSIS (Modified from American society of echocardiography and Wilkin scoring system)

	Grade 1	Grade 2	Grade 3	Grade 4
Mobility	Highly mobile valve with leaflet tips only restricted	mid and base portions have normal mobility	Valve continues to move forward in diastole mainly from the base	No or minimal forward movement of the leaflets in diastole
Leaflet thickening	4 to 5 mm	5 to 8 mm-only on the margins	5 to 8 mm – involves the entire leaflet	>8 mm
Subvalvular thickening	Minimal	Thickening of chordal structures extending up to one third of the chordal length	Thickening extending to the distal third of the chords	Extensive thickening and shortening of all chordal structures extending down to the papillary muscles
Calcification	single area of increased echocardiographic brightness	Scattered single area of increased echocardiographic brightness	Brightness extending into the mid portion of the leaflets	Extensive brightness throughout much of the leaflet tissue

To determine the echocardiographic score add the grades from the 4 categories. The minimum score is 4 and maximum score is 16. Patients with score < 8 are more favorable candidates for balloon valvotomy.