CLINICAL CHARACTERISTICS AND TEMPORAL PROFILEOF PATIENTS REFERRED TO A CARDIAC CENTRE FOR STRESS ELECTROCARDIOGRAPHY (ECG) IN SOUTHERN NIGERIA

Abstract

BackgroundThe stress electrocardiographic (ECG), also known as a treadmill stress test or exercise stress test (EST), is frequently used to diagnose and assess cardiac disease. It is a dependable method for evaluating cardiovascular health and examining potential heart conditions like myocardial ischemia and arrhythmia. Our main goal was to determine the clinical characteristics and timeline of patients referred to our cardiac center.

Method A retrospective cross-sectional study of adult patients aged (>18 years old) with low or intermediate pretest symptoms referred for EST to GoodHeart Medical consultant hospital between October 2019 and January 2023. Data included medication, smoking, alcohol, medical history, and symptoms.

ResultsIn a study of 102 subjects, mean age was 49±16 years, with 57.8% aged 41-60. Males comprised 72.5%, females 27.5%. Average exercise stress testing (EST) duration was 9 minutes; Stage 3 was max for 52.0%. Over half had normal results, 8.7% showed ST changes, 6.9% T wave inversion, 9.8% stress-induced ischemia, and 6.9% stress-induced arrhythmia. Chest pain led 44.2% of visits; muscle fatigue halted EST in 39.2% of cases.

ConclusionPatients did not experience any issues during ECG testing. Exercise stress testing is a safe and noninvasive procedure that is widely available in hospitals and clinics. It can be useful in diagnosing, assessing, and stratifying the risk of cardiac patients, as long as the appropriate patients are selected.

Keyword stress electrocardiographic, GoodHeart medical consultant hospital, Cardiac centre, Bruce protocol

INTRODUCTION

Exercise stress testing has been used for decades as a noninvasive test to diagnose and risk stratify coronary artery disease (CAD).(1)A stress test, sometimes called a treadmill stress test or exercise stress test(EST) is commonly used for the diagnosis and evaluation of cardiac disease.(2)Stress ECG evaluates cardiovascular response to exercise and has been a topic of interest for a long time. Electrocardiographic changes during exercise were first described over a century ago, which emphasized the importance of this dynamic assessment. The Bruce protocol which was introduced about 60 years ago transformed the field by providing a standardized framework for studying this subject. This has led to a widespread use of exercise stress testing with electrocardiographic monitoring (ExECG) in cardiovascular medicine. In recent decades, there have been significant advancements in the understanding and management of cardiovascular disease, which have challenged previous beliefs about its underlying mechanisms and overall treatment.(3) Stress electrocardiographic (ECG) testing is a reliable way to evaluate cardiovascular health and investigate various inducible heart conditions, such as myocardial ischemia and arrhythmia. Previous studies have shown that its diagnostic accuracy for detecting inducible coronary ischemia is only 60%(4). The American College of Cardiology (ACC), American Heart Association (AHA), American College of Sports Medicine (ACSM) and the American Society of Nuclear Cardiology all recommend an EST for diagnosing patients who are at risk of cardiovascular disease (CAD)(5).

Chest pain is a frequent reason for patients to seek primary care, affecting up to 40% of the general population at some point in their lives. In primary care studies, 8-18% of chest pain patients are diagnosed with heart disease and chest pain visits account for 0.7-4% of all primary care consultations. (6,7). Palpitations are the second most common reason for specialist cardiologic evaluation, accounting for 16% of presenting symptoms.(8)While other symptoms like fatigue and dyspnea may also be associated with coronary artery disease, they are not typically included in risk prediction models. However, studies have shown that dyspnea is an independent predictor of cardiac death risk. (9)

An exercise test is therefore still a diagnostic option for patient with pain. To our knowledge,limited studies have been carried outin our environment to address the use of exercise stress testing in medical setting for diagnosis. Our primary aim were to identify clinical characteristics andtemporal profile of patient referred to our cardiac centre.

MATERIALS AND METHOD

We conducted a clinical examination of patients referred for exercise stress testing (EST)to GoodHeart Medical consultant hospital between October 2019 and January 2023. It was a retrospective cross-sectional study of adult patients aged (>18 years old) and had low or intermediate pretest symptoms. Patients who were unable to conduct an exercise test or were referred for other reasons were excluded from the study. A pre-evaluation data were collected on present medication history, smoking and alcohol habits, past medical history, and presenting symptoms.

The procedure was carried out according to the American Heart Association (AHA) recommendation and guidelines.(10)The Bruce protocol was used in exercise stress testing, the test begins with the treadmill set to a low speed (1.7 miles per hour) and a 10% incline, and every 3 minutes the speed and angle of incline are increased. Other protocols are similar. The test continues for a maximum of 27 minutes (usually attainable only by well-trained individuals) or until the patient quits or develops signs or symptoms of ischemia or an arrhythmia. Average time for a middle-aged adult is 8 to 10 minutes.(11)

Ethical approval was obtained from the Ethics and research committee of UPTH. We obtained informed consent obtained from all participants prior to procedure. Data obtained was analyzed using the Statistical Package for social science (SPSS) version 20 software.

RESULTS

The population consist of 102 subjects with an average age of 49±16 years with the majority 71(69.6%) falling in the age group of 41-60 years. This is made up of 74(72.5%) males and 28(27.5%) females. The average duration for EST was 9minutes.

The study participants baseline characteristics indicate that a small percentage of them were smokers or alcohol consumers 2.9% and 7.8% respectively. Hypertension 51(50%) was the most common cardiovascular risk factor, followed by obesity 45(44.1%) and diabetes mellitus 14(13.7%). A majority of the participants had a history of drug medication 76(74.5%). These findings are presented in Table 1.

According to the study, the main reason patients visited the facility was chest pain, accounting for 45(44.2%) of cases. This was followed by medical fitness at 27(26.5%) and dyspnea at 3(2.9%) was the least cases. In terms of medication, majority of the patients were on hypertensive medication 41(40.2%), followed by diabetic medication 12(11.8%), and the least were on peptic ulcer disease medication 2(1.9%). These findings are illustrated in Figure 2 and Figure 3.

The most common reason for stopping the EST was muscle fatigue accounting for 40(39.2%) of cases. This was followed by reaching the maximum heart rate for age, which accounted for 21(24.5%) of cases. The least common reasons for stopping was tachycardia accounting for 2(1.9%) of cases. 6.9% of the population experienced both muscle fatigue and maximum heart rate. These findings are summarized in Table 2.

The maximum stage for EST was recorded in stage 3 53(52.0%) and least stage recorded were stage 5 4(3.9%)(Table 3).ST elevation or depression and T wave inversion were recorded, more than half of the study population had normal study and 9(8.7%) had ST changes while 7(6.9%) had T wave inversion (Table 4).

The clinical interpretation for EST findings show that 10(9.8%) had stress induced ischemia and 8(7.8%) had stress induced Arrhythmia (Table 5).

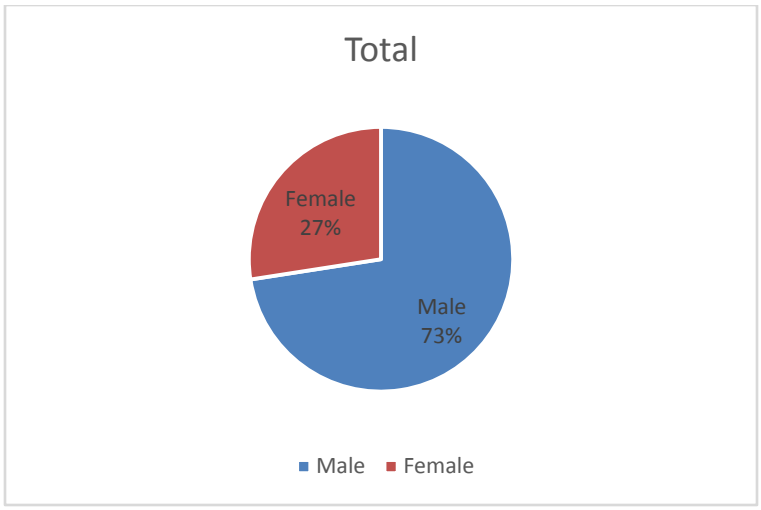

Figure 1. Pie chart showing the sex distribution of the study participants

Table 1: Baseline characteristics of study participants

Variables	Frequency (n=102)
Gender	
Male	74(72.5)
Female	28(27.5)
Age group	
<40	20(19.6)
41-60	71(57.8)
>60	11(10.8)
Average age	49±16
History	
Smokers	
Yes	3(2.9)
No	97(95.1)
Alcohol	
Yes	8(7.8)
No	94(92.2)
Cardiovascular risk factors	
Diabetic mellitus	
Yes	14(13.7)
No	88(86.3)
hypertension	
Yes	51(50.0)
No	51(50.0)
Obesity	
Yes	45(44.1)
No	57(55.9)
Medication history	
Yes	76(74.5)
No	26(25.5)
Average duration of EST time	9.0minutes

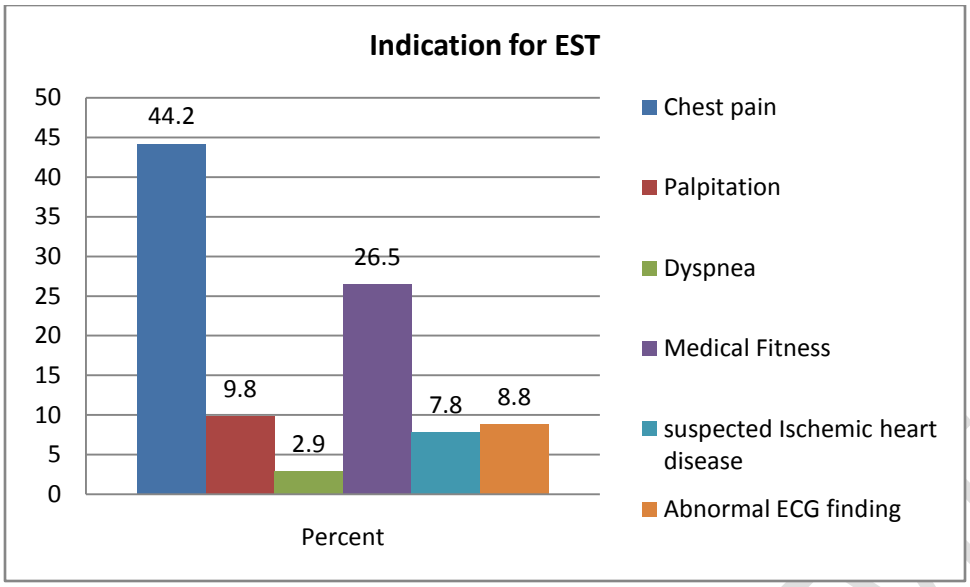

Figure 2: Clinical indication for Exercise stress testing

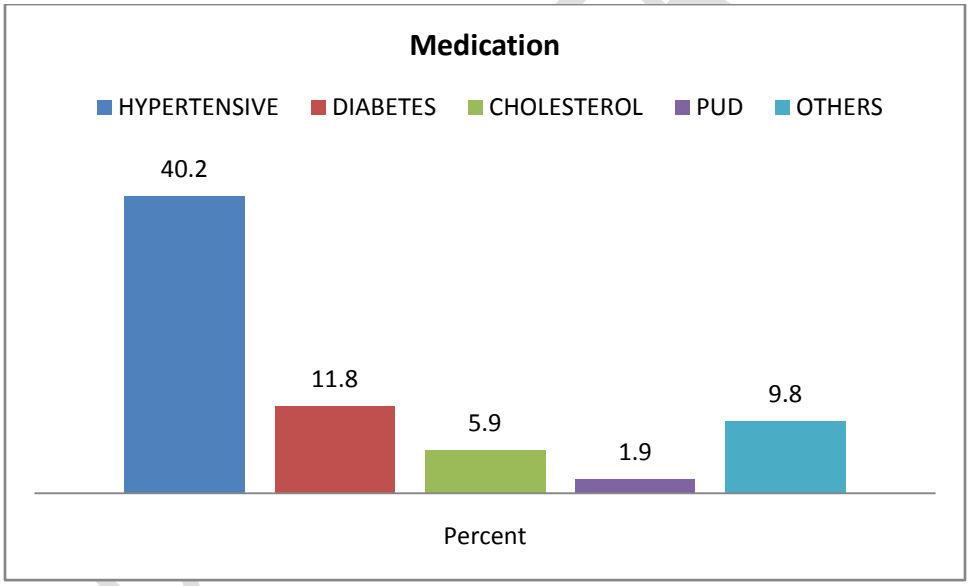

Figure 3: Medication history for patient undergoing exercise stress stressing

Table 2: Patients reason for interrupting the EST

Reason For Stopping	Total	Percent
Muscle fatigue	40	39.2
Maximum HR age	21	24.5
Breathlessness	11	10.8
Chest pain	5	4.9
Tachycardia	2	1.9
Blood pressure spike	3	2.9
Significant ST/ T wave	4	3.9
Muscle fatigue +maximum HR age	7	6.9
Muscle fatigue +chest pain	4	3.9
Muscle fatigue +breathlessness	2	1.9
Breathlessness + maximum HR age	2	1.9
Breathlessness + chest pain	1	1.0

Table 3:maximum exercise stress testing stage

Stages	Frequency	Percent
2	17	16.6
3	53	52.0
4	28	27.5
5	4	3.9

Table 4: ST and T wave evaluation

ST/T Evaluation	Frequency	Percent
T wave inversion	7	6.9
ST changes	9	8.7
Ectopics	1	1.0
Tachycardia	1	1.0
Normal study	84	82.4

Table 5 clinical interpretation of EST finding

Stress induce	frequency	Percent
Ischemia	10	9.8
Arrhythmia	8	7.8
Normal study	83	81.4
hypertension	1	1.0

DISCUSSION

This study is a retrospective cross-sectional study that involved 102 subjects referred to GoodHeart Medical Consultants Hospital between October 2019 and January 2023. The average age of the referred patients was 49±16, with a higher proportion of males in the study population. Most of the subjects were aged between 41 and 60 years, and the rates of smoking and alcohol intake were low. However, due to the small sample size, our data may not have enough statistical power to detect differences. Patients may not always accurately describe the characteristics of their symptoms, making it difficult to identify especially in cases of normal rate palpitations. Further research is needed to investigate if middle-aged patients are more likely to be referred for exercise stress testing.

The prevalence of hypertension was 50%, diabetes 13.7% and obesity (BMI > 30 kg/m2) was 44.1%. In terms of medication, the highest numbers of patients were on hypertensive medication, followed by diabetic medication, and the least were on peptic ulcer disease medication. Hypertensive heart disease was the most prevalent co-morbidity, followed by Ischemic heart disease and coronary artery disease. Previous research has shown that self-reported history of IHD is reliable. Medication was recorded from questionnaires due medication lists may not be current and patient compliance with a medication list is not always complete.(7) and the main reason patients visited the facility was chest pain, accounting for 45(44.2%) of cases.

In our study, 9.8% of the population experienced palpitations, which is similar to the 11.7% reported in a UK cardiology outpatient clinic.(12)Palpitations pose a challenge for primary care services, as patients may be referred due to concerns about missing potential heart issues. Many patients seen in secondary care for palpitations do not have cardiac arrhythmias, but rather benign palpitations.(13)

Dyspnea account for 2.9% of the study population. It can be explained that patients experiencing dyspnea, regardless of whether they have a history of coronary artery disease or not, face higher mortality rates due to cardiac causes and overall mortality. In comparison to asymptomatic patients, those with dyspnea have a fourfold increased risk of death from cardiac causes and more than double the risk compared to patients with typical angina. These results suggest that dyspnea may be an indicator of underlying cardiovascular disease.(9)

Stress electrocardiograph was interrupted mostly due muscle fatigue accounting for 40(39.2%) of our study population this was followed by maximum heart rate age attained 21%, breathlessness 10.8%, chest pain 4.9%. The study also recorded a co-morbidities of muscle fatigue and maximum heart rate as more prevalent reason followed by muscle fatigue and chest pain with the least occurring as breathlessness and chest pain as a reason for interruption during the EST.

8.7% of the total population experienced ST changes.These changes, whether they occur during exercise or recovery, have been shown to have negative prognostic significance. Resting ST-segment depression has also been identified as a marker for adverse cardiac events.(14)Exercise stress testing is useful for diagnosing and predicting outcomes in patients

with ischemic heart disease who have normal resting ECGs. However, its value in patients with abnormal resting ECGs has been uncertain, and some researchers have been hesitant to subject these patients to stress testing due to potential hazards and questionable diagnostic value.(15)

The interpretation of EST finding of our study showed Ischemia 10(9.8%), Arrhythmia 7(6.9%). The ECG interpretation is considered positive if the ST criteria are met regardless of heart rate, and there are no factors that would prevent a proper interpretation. On the other hand, if no significant ST changes are observed, the interpretation is negative. (1)

CONCLUSION

More than half of the study population had normal study with minimal ST changes and T wave inversion. The maximum stage for EST was recorded in stage 3 and the most common reason for stopping the EST was muscle fatigue with the clinical interpretation for EST findings in this study showing fewstress induced ischemia and stress induced Arrhythmia. Chest pain accounted for major reason patients visited the facility.

Patients had no negative experience during ECG testing. Therefore, Exercise stress testing should be encouraged in diagnosing, assessing and stratifying patients with risk of cardiac events.

LIMITATION OF THE STUDY

The current data may not have enough statistical power to detect differences due to its the small sample size and patients may not always accurately describe the characteristics of their symptoms, making it difficult to identify cardiac abnormality indicators.

Statement of ethical approval

Ethical approval of this study was obtained from the University of Port Harcourt teaching Hospital ethical committee.

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