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Pattern of Electrocardiographic Changes Among Adult Patients Booked for Elective Major Surgery in Port Harcourt, Nigeria

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Abstract

Background: Cardiac function is known to be affected by age, gender and disease conditions. This study evaluated the pattern of electrocardiographic changes among adult patients slated for elective major surgery operations at the Rivers State University Teaching Hospital, and the University of Port Harcourt Teaching Hospital from March 2023 to June 2023.

Materials and methods: A prospective analytical observational study was carried out among patients booked for major surgical operations, using systematic sampling method. Patients' medical records and the electrocardiographic recordings routinely requested for surgery were used.

Results: A total of 225 adult patients who were booked for elective major surgery were recruited with a mean age of 54.52±13.34 years and 105(46.7%) were males with 120 (53.3%) females. Common comorbidities documented included hypertension in 103 (45.8%) persons and 49 (21.8%) had diabetes mellitus. Seventy-four (32.9%) persons had abnormal ECG findings with the predominant abnormal ECG changes consisting of left ventricular hypertrophy in 60(26.7%) patients, left axis deviation in 52(23.1%) persons, T wave changes in 33(14.7%) and left atrial enlargement in 26(11.6%) persons. Patients who were above 40years of age were more likely to have abnormal ECG findings compared to their younger counterparts, but this difference was not statistically significant (p=0.316).

Conclusion: Abnormal electrocardiographic findings was common in patients billed for elective surgery, however, as these changes were found even in patients with no prior history of comorbidities, it is reasonable to continue to recommend screening ECGs for all patients who are billed for elective major surgery.

Keywords

Electrocardiographic Changes; Adult Patients; Elective Major Surgery; Port Harcourt; Nigeria.

Introduction

The importance of the heart for continuous maintenance of human existence is no longer in doubt with global and regional reports of cardiac accidents and sudden death occurring in apparently healthy individuals in sports, entertainment industry, etc. [1-5]. This is further buttressed by the availability of dedicated specialties, and organizations/associations (international or regional) that emphasize on the need to ensure a healthy heart [6-10]. Evaluation of heart healthiness is therefore often part of pre-school admission, [11,12] pre-employment assessment, [13,14] routine medical check-up, [15] and preparation of a patient for surgery [16-18]. Electrocardiography, echocardiography, magnetic resonance imaging, chest radiograph and others, are known tools / methods for evaluation of the activity and hence healthiness of the heart [19,20]. This study focuses on the first – use of electrocardiography (ECG) which is non-invasive and relatively cheap in our resource-poor setting.

Cardiac function is known to be affected by age, gender and different disease conditions [21-24]. About six decades ago certain peculiarities of ECG changes were reported among Africans and observed not to be related to any organic heart disease [25,26]. Athletes of black ethnicity have also been reported to have unique ECG changes, [27,28] and some other peculiar changes were observed among West Indians [29]. A cross-sectional descriptive study carried out in Enugu, Nigeria reported significant electrocardiographic abnormalities among sickle-cell disease patients, and left ventricular hypertrophy was found in 70% of patients [30]. Another study reported normal findings among 50% of these patients, and a tendency for abnormal changes in the remaining 50% even before the age of 20years [31]. Significant electrocardiographic hypertrophic patterns were reported among hypertensive Nigerians with the changes increasing with increase in the level of blood pressure [32,33]. Some changes have also been reported among apparently healthy athletes, [34,35] acute ischemic stroke patients,[36] in normal pregnancy, [37,38] and dialysis naive chronic kidney disease [39].

About ten years ago, the pattern of ECG changes among hypertensive patients in Port Harcourt was reported with significant left ventricular hypertrophy and left axis deviation [40]. Also in the literature, there have been researches carried out in Port Harcourt where ECG changes among hypertensive diabetic patients, [41] professional athletes, [42] patients with human immuno-deficiency virus,[43] as well as arrhythmias in secondary school students have been extensively documented [44].

The experience in our setting is that medical insurance coverage is not holistic, and some patients are not able to afford the cost of surgical care, especially paying for some routine investigations (e.g., electrocardiography and chest radiograph) required to evaluate the state of health of the heart in elective surgical patients who are forty years and above. The surgeon is sometimes faced with the challenge of using his / her discretion to apply the concept of customized care in helping these patients. To what extent can this "help" be rendered without exposing the patients to added risks, and being liable? This study therefore evaluated the pattern of electrocardiographic changes among adult patients slated for elective major surgery operations at the Rivers State University Teaching Hospital, and the University of Port Harcourt Teaching Hospital from March 2023 to June 2023.

Materials and Methods

Research Design: A prospective analytical observational study was carried out.

Study Area: The study area was Port Harcourt, the capital of Rivers State, a Southern State in the Federal Republic of Nigeria.

Study Sites: The study site was the medical records (medical information unit) of the Surgical Out-Patient Clinics of the Rivers State University Teaching Hospital and the University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria.

Sampling Method: Systematic sampling method was used, as data was collected from alternate clinic days from the two centers where specialist surgical clinics held from Mondays to Fridays.

Study Population/Participants: All patients booked for elective major surgical operations on alternate days from March 2023 to June 2023 were included.

Sample Size Determination: Total population of patients who were booked for elective major surgery on the captured days was used for the study.

Study Instrument: A pre-designed study proforma was used, along with a copy of the patients' ECG recording.

Variables of Interest: Patients' demographics, Data on socio-demographics, comorbidities, and ECG pattern for each patient were entered into a proforma designed for the study.

Validity/Reliability of Instrument: The study instrument was scrutinized by all authors before use.

Data Analysis: All ECG recordings were interpreted jointly by two cardiologists and the findings were

entered in to the proforma for each patient. Data was then collated and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0, and expressed as mean and percentages, and Chi-square test was used to compare categorical variables.

Results

A total of 225 adult patients were booked for elective major surgery and were recruited for this study and table 1 shows the demographic characteristics of the patients. There were 105 (46.7%) males and 120 (53.3%) females. The mean age of the respondents was 54.52±13.34 years, and the youngest was 19 years while the oldest was 85 years old. One hundred and ninety-six (87.1%) were married and 19 (8.4%) were single. One hundred and twelve (54.2%) had tertiary level of education, while 26 (11.6%) has no formal education.

Variables	**Number**	**Percentage (%)**
Sex		
Male	105	46.7
Female	120	53.3
Age in years		
Less than 20	2	0.9
20 - 29	6	2.7
30 - 39	17	7.6
40 - 49	61	27.1
50 - 59	55	24.4
60 - 69	55	24.4
70 - 79	22	9.8
80 - 89	7	3.1
Marital Status		
Single	19	8.4
Married	196	87.1
Separated/Divorced	10	4.4
Educational qualification		
No formal education	26	11.6
Primary	9	4
Secondary	68	30.2
Tertiary	122	54.2
Religion		

Christianity	217	96.4
Islam	3	1.3
Others	5	2.2

Table 1: Socio-demographic characteristics of respondents (n = 225).

Patients presenting for elective major surgery had varying comorbidities as shown in table 2. There were 103 (45.8%) surgical patients who had hypertension, 49 (21.8%) had diabetes mellitus, 25 (11.1%) had bronchial asthma, 19 (8.4%) had chronic obstructive airway disease, and 6 (2.7%) had breast cancer.

Variables	**Present (%)**	**Absent (%)**
Hypertension	103 (45.8)	122 (54.2)
Diabetes Mellitus	49 (21.8)	176 (78.2)
Sickle Cell Disease	3 (1.3)	222 (98.7)
Chronic Obstructive Airway disease	19 (8.4)	206 (91.6)
Bronchial Asthma	25 (11.1)	200 (88.9)
Breast Cancer	6 (2.7)	219 (97.3)

Table 2: Comorbidities recorded in the study population.

A majority of the patients did not have any abnormal ECG changes. Out of the total of 225 adult patients who were booked for elective major surgery, 74 (32.9%) had abnormal ECG findings. Table 3 shows the pattern of the electrocardiographic changes among the patients. The predominant abnormal ECG changes were left ventricular hypertrophy (n=60; 26.7%), left axis deviation (n=52; 23.1%), T wave changes which consisted of flattened T wave and T wave inversion (n=33; 14.7%), left atrial enlargement (n=26; 11.6%), prolonged QRS duration (n=14; 6.2%), prolonged QTc interval (n=14; 6.2%), prolonged P-wave duration (n=13; 5.8%), and first-degree AV-block (n=9; 4.0%).

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Variables	Present	Absent
	frequency (%)	frequency (%)
Prolonged P wave duration	13 (5.8)	212 (94.2)
Increased P wave dispersion	2 (0.9)	223 (99.1)
Prolonged PR Interval	8 (3.6)	217 (96.4)
Prolonged QRS Duration	14 (6.2)	211 (93.8)
Increased QRS Dispersion	2 (0.9)	223 (99.1)
Prolonged QTc Interval	14 (6.2)	211 (93.8)
Increased QTc Dispersion	1 (0.4)	224 (99.6)
T wave changes	33 (14.7)	192 (85.3)
ST-Segment Elevation	8 (3.6)	217 (96.4)
Left axis deviation	52(23.1)	173(76.9)
Right axis deviation	8(3.6)	217(96.4)
Left Atrial Enlargement	26 (11.6)	199 (88.4)

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Biventricular Hypertrophy	1 (0.4)	224 (99.6)
Right Ventricular Hypertrophy	1 (0.4)	224 (99.6)
Left Ventricular Hypertrophy	60 (26.7)	165 (73.3)
First degree AV Block	9 (4.0)	216 (96.0)
Right Bundle Branch Block	4 (1.8)	221 (98.2)
Left Bundle Branch Block	3 (1.3)	222 (98.7)

Table 3: Pattern of Electrocardiographic changes (N = 225)

Atrial tachyarrythmias were documented in 6 persons as 4(1.8%) had atrial fibrillation and 2(0.9%) had atrial flutter, whereas premature ventricular complexes were noted in 2(0.9%) persons. The mean heart rate was 80.42±16.36 beats per minute with a range of 49 to 145bpm. The average mean heart rate of the respondents with various comorbidities is shown in Table 4. Patients with sickle cell disease had the highest value while those with Bronchial Asthma has the mean lowest heart rate.

Variables	AMHR
Hypertension	79.87±18.75
Diabetes Mellitus	82.04±19.23
Sickle Cell Disease	97.00±15.72

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Chronic Obstructive Airway disease	86.79±20.95
Bronchial Asthma	73.72±16.54
Breast Cancer	85.83±17.78

Table 4: Comorbidities and Average Mean Heart Rate of respondents.

There was no significant relationship between the various comorbidities observed with the presence of abnormal ECG changes in the respondents and this is demonstrated in (Table 5).

Abnormal ECG changes					
Comorbidities of respondents	Present	Absent	Total	χ^2	p-Value
Hypertension					
Present	35 (34.0%)	68 (66.0%)	103		
Absent	39 (32.0%)	83 (68.0%)	122	0.103	0.749
Diabetes Mellitus					
Present	17 (34.7%)	32 (65.3%)	49		
Absent	57 (32.4%)	119 (67.6%)	176	0.092	0.761
Sickle Cell Disease					
Present	2 (66.7%)	1 (33.3%)	3		
Absent	72 (32.4%)	150 (67.6%)	222	1.572	0.21

COAD					
Present	5 (26.3%)	14 (73.7%)	19		
Absent	69 (33.5%)	137 (66.5%)	206	0.406	0.524
Bronchial Asthma					
Present	5 (20.0%)	20 (80.0%)	25		
Absent	69 (34.5%)	131 (65.5%)	200	2.117	0.146
Breast Cancer					
Present	1 (16.7%)	5 (83.3%)	6		
Absent	73 (33.3%)	146 (66.7%)	219	9.735	0.391
Total	74	151	225		

Key: COAD= Chronic obstructive airway disease

Table 5: Relationship with changes in ECG and Comorbidities of respondents.

The relationship between abnormal changes in the ECG and age of respondents demonstrates that abnormal ECG changes was observed to be higher among those 40 years and above compared to subjects less than 40 years, however, this difference was not statistically significant.

Abnormal ECG changes					
Age of respondents	Yes	No	Total	(χ^2)	p-Value
0 – 39 years	6 (24.0%)	19 (76.0%)	25		
40 years and above	68 (34.0%)	132 (66.0%)	200	1.007	0.316
Total	74	151	225		

Table 6: Relationship between Abnormal changes in ECG and Age of respondents.

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Discussion

For elective surgery, the patient's clinical characteristics and the nature of the surgery both influence their perioperative cardiac risk. The request for an electrocardiogram (ECG) is part of the routine tests carried out for preoperative evaluation of elective surgical patient in our institution. Subsequent action on the outcome of this investigation is based on the findings and discussions between the physician and/or cardiologist and the surgeon. Risk assessment, particularly CV risk assessment, before surgery aims to minimize potential perioperative complications.

Abnormal electrocardiographic changes were seen in 32.9% of adult patients who were booked for elective major surgery. This prevalence is similar to that documented by Adebola et al [45] as a third of their patients had abnormal ECG findings but slightly higher than 26.9% noted in a multicenter study in Western Nigeria.[46] Although a majority of the patients did not have abnormal ECG changes, left ventricular hypertrophy, left axis deviation and T wave changes were the most common abnormalities noted. In a South-Western Nigerian study, the common ECG findings among hypertensive patients were left axis deviation, left ventricular hypertrophy, rhythm abnormalities, and left atrial enlargement, for which the diagnostic yield of ECG was reported highest in elderly and intermediate in middle aged patients [47]. The high occurrence of left ventricular hypertrophy in this study could be as a result of co morbidities noted as 45.8% of recruited patients were hypertensive and 21.8% diabetic and LVH is a complication of hypertension [32] also reported LVH as the most common ECG abnormality in patients booked for elective surgery, [45] and this was closely followed by left axis deviation. This is similar to a Nigerian multicenter study that also reported LVH, LAD and ST segment changes as the most common ECG abnormalities in their patient population [46].

In a retrospective study of 23,036 patients, Noordzij et al. found that in patients undergoing elevated-risk surgery,[48] those with an abnormal preoperative ECG had a higher incidence of cardiovascular death than those with a normal ECG, thus emphasizing the importance of preoperative cardiovascular assessment which can be planned and conveniently carried out before elective surgery. An ECG is relatively affordable and easily accessible in most centers that have facilities for major surgery in Port Harcourt. Most of the respondents booked for elective major surgery were middle aged and elderly and almost all of the abnormal ECG findings (68 persons, 91.9%) were documented in patients aged 40 years and above. Increasing age has been significantly associated with the presence of abnormalities on the surface ECGs and this has been documented in various similar studies on preoperative screening of surgical patients [45,46]. Cardiovascular disease (including coronary artery disease, peripheral arterial and cerebrovascular disease, cardiac arrhythmias and valvular heart disease) and its associated risk factors of hypertension and diabetes are prevalent in the elderly [49]. It is important to identify cofounding factors which may had not been previously recognized in these patients.

Hypertension was the single predominant co-morbidity (45.8%) found among the patients, followed by diabetes mellitus (21.8%), bronchial asthma (11.1%), and chronic obstructive airway disease (8.4%). This finding agrees with the report from other researchers where hypertension was found to be the most prevalent cardiovascular risk factor among middle-aged and elderly rural Nigerian population.[50] It is interesting to note that abnormal ECG findings were recognized in patients who did not have any

comorbidities, which necessitated a referral to the cardiology clinic. From a cardiac perspective, a number of conditions require identification and stabilization before surgery [51]. These include acute ST-elevation myocardial infarction and other unstable coronary syndromes, decompensated congestive cardiac failure and significant arrhythmias (second- or third-degree heart block, atrial fibrillation or flutter with rapid ventricular response, sustained supraventricular tachycardia, sustained or newly recognized ventricular tachycardia and severe sinus bradycardia - heart rate less than 40 beats/minute).

The heart rate of recruited patients in this study ranged from 49 to 145 beats per minute. Unlike most other co-morbidities, sickle cell disease had the highest mean heart rate among the study population and the least was bronchial asthma. The high mean heart rate observed in sickle cell disease patients may be related to the presence of anemia as well as cardiovascular autonomic dysfunction described in previous studies [52,53]. Arrhythmias documented in this patient population included atrial fibrillation, atrial flutter, AV block and bundle branch block. Patients suspected of having these conditions need further cardiac evaluation or referral as medical optimization before surgery is recommended for these patients before their elective surgery [7].

Conclusion

About a third of the patients booked for elective surgery had abnormal electrocardiographic findings. Co-morbidities are significant contributors to the health of surgical patients different from the main surgical condition for which surgical care is being offered. This is evident in this study as almost half of the surgical patients had hypertension, and almost a quarter had diabetes mellitus. There were significantly abnormal ECG changes seen, and left ventricular hypertrophy was the most predominant observed in about a quarter of the patients.

Recommendation: Only a third of the patients in this study had abnormal ECG findings, however, as these changes were found even in patients with no prior history of comorbidities, it is reasonable to continue screening ECGs for all patients who are billed for elective major surgery (as the ECG is relatively affordable and easily accessible) to identify CV diseases that may worsen perioperative outcome.

Other Information

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Ethical Statement: The approval of the Research Ethics Committee of the Rivers State University Teaching Hospital, and the University of Port Harcourt Teaching Hospital was obtained.

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Conflict of interest: None declared.

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