Serum Troponin I levels among Hypertensive Military Service Personnel at a Military Health Facility in Abuja, Nigeria

Nwagbara G.O. N\(^1\) and Emokpae M. A\(^*2\)

\(^1\)Defence Reference Laboratory, Abuja Nigeria. \(^2\)Department of Medical Laboratory Science, School of Basic Medical Sciences, College of Medical Sciences, University of Benin, Benin, Nigeria

Summary: Hypertension constitutes one of the major metabolic disease in Nigeria especially among military personnel and their families. Myocardial infarction and other cardiovascular diseases may occur in this group of patients due to uncontrolled or poorly controlled hypertension. The objective of this study was to determine serum cardiac Troponin I (cTnI), levels in hypertensive Nigerian Military service personnel attending clinic in a military health facility. We measured the serum levels of cTnI in 126 hypertensive subjects [76 males (19-73 years) and 50 females (26-77 years)] and 82 normotensive controls [41 males (19-60 years) and 41 females (18-53 years)] using Latex Enhanced Immunoturbidimetry technique. The data were compared between test and control group using Students’ t-test. Serum cTnI was detected in the sample of 95 (75.4%) subjects and was not detected in 31 (24.6%) subjects. Nine subjects (2.38%) had cTnI levels within the normal range (0.00-0.01 ng/mL), 85 (67.5%) subjects had significantly higher (p<0.001) cTnI levels (0.100 ± 0.091 ng/mL; CL: 0.02 – 0.47 ng/mL), while one (0.8%) subject had a cTnI value of 1.09 ng/mL. Nine (10.98%) control subjects had detectable cTnI levels (0.01 ng/mL) while 73 (89.02%) controls had a 0.00 ng/mL cTnI level. There was no significance difference in cTnI levels when subjects on chemotherapy were compared with newly diagnosed subjects (P = 0.0694). This study revealed that cTnI was detectable in the serum of majority of the study participants which may suggest sub-clinical cardiac necrosis. There may be risk of developing adverse cardiovascular disorders and the need for appropriate intensive management is emphasized.

Key Words: Cardiac Troponin I, Hypertension, Military service personnel.

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*Address for correspondence: mathias.emokpae@uniben.edu

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INTRODUCTION

Hypertension (High blood pressure) is a major health risk factor for heart attack and stroke with attendant biochemical consequences (Boyles and Salynn, 2011). It is a common condition, but little is known about its prevalence among military service personnel and their families. Rigorous-stress activities such as combat deployment of military service personnel might pose a potential risk factor for hypertension. There are paucity of published reports on the levels of cardiac biomarkers in the serum of hypertensive Nigerian military personnel and their families. Uncontrolled hypertension leads to heart attacks, stroke and cardiovascular diseases (CVDs) and kills more than infectious diseases (Kearney et al., 2005; Ogah et al., 2012). Early prediction of cardiovascular disease risk among subjects with hypertension provides an opportunity for appropriate intensive management, reduces morbidity and mortality. Assay of serum cardiac troponins are considered as standard biochemical markers in the diagnosis of myocardial infarction (MI) (Karar et al., 2015) but these markers are rarely assayed for in this health facility.

Troponin which is a trimeric regulatory protein complex consisting of troponin C, troponin I, and troponin T, is very necessary for muscle contraction in skeletal and cardiac muscles, but not smooth muscle (Takeda et al., 2003). They are released into circulation about 3-4 hours after myocardial infarction and are still detectable for 10 days afterwards. The long half-life allows for late diagnosis of MI, but makes it difficult to detect reinfarction. These three Troponin subunits form a complex that checks the interaction of actin and myosin, and thus regulate heart contraction. Troponin is localized primarily in the myofibrils (94-97%) with smaller cytoplasmic fraction (3-6%) (Heressi et al., 2012). Cardiac troponin (cTn) subunits I and T have different amino acid residue on the amino sequences encoded by different genes, and are different from skeletal muscle. Troponin I in humans is presented in three isoforms, two isoforms are expressed in skeletal muscle tissue and one isoform is expressed in cardiac muscle tissue (Schiefitz et al., 2015). Cardiac troponin has absolute myocardial tissue specificity and reflect even microscopic zones of myocardial necrosis but
cTn elevations are not always attributable to acute Coronary syndromes (Jeremias and Gibson, 2005; Barry et al., 2008), as individuals belonging to stressful occupations could have increased cTn levels. Stress-induced Cardiomyopathy however, is a reversible cardiac syndrome characterized by acute chest pain and wall motion abnormalities. It is usually triggered by physical and emotional stress and the subjects will usually recover within a few weeks (Ramaraj et al., 2009).

Cardiac Troponin-I (cTnI) is derived from genes specifically expressed within the myocardial tissue. It is one of the sarcomeric protein apparatus of the myocardium and controls myocardial contraction together with cTnT and cTnC in response to calcium incretion. About 3.5% of cTnI and 7% of cTnT exist freely in cardiac myocyte cytoplasm. The rest is bound within the sarcomere and is released as a result of proteolytic degradation. Myocardial Injury results to a disruption of the intracellular contractile proteins leading to an increase in the cytoplasmic pool content of cTnI and cTnT. Calcium and troponin controls the production of cardiac muscular force. Increased cardiac muscle calcium concentration leads to muscle contraction (Adams et al., 1993). Calcium is bound to troponin-C triggering activation of tropomyosin which in turn binds troponin-T to form troponin-tropomyosin complex. Cardiac troponin I now binds actin to link and sustain the troponin-tropomyosin complex in place thereby maintaining normal cardiac muscle contraction and normal heart physiology. Troponin-I is cardiac specific (Adams et al., 1993), while Troponin-T is derived from both the myocardium and skeletal muscles. The release of cardiac troponin I into the circulation is a manifestation of reversible or irreversible myocyte injury (Reichlin et al., 2009; Quarck et al., 2009). The World Health Organization (WHO) had suggested that elevated cTI ≥2 µg/L (2ng/mL) is diagnostic of myocardial infarction (Amsterdam et al., 2009). The World Health Organization (WHO) had suggested that elevated cTI ≥2 µg/L (2ng/mL) is diagnostic of myocardial infarction (Amsterdam et al., 2009).

Statistical Analysis:
Statistical analysis was done using the Statistical package for social sciences (SPSS) version 16.0 (Chicago, IL USA). All values were expressed as Mean ± Standard error of the mean. The students’s-test was used to compare the mean values of the observed measured parameters between the groups. A p-value of 0.05 was considered as statistically significant.

RESULTS
The results obtained from this study are as presented in tables 1,2 and 3. Table 1 shows the demographic characteristics of studied participants and serum cTnI levels. The mean serum cTnI in hypertensive subjects was significantly higher (P<0.001) when compared with controls. The differences in the means of serum cTnI between newly diagnosed hypertensive subjects not yet on treatment and those already on treatment was not statistically significant (table 2). Table 3 shows that of the 126 hypertensive subjects, serum cTnI above the manufacturer’s recommended reference range (<0.01ng/mL) was detected in 86 (68.3%) participants, while cTnI was not detected in 31 (24.6%) hypertensive subjects. Among the control subjects, serum cTnI was detected in 9 (10.98%) subjects but values were within normal reference range and 73 (89.02%) control subjects had undetectable levels.

Table 1: Serum Troponin I in hypertensive subjects and controls (means ± SEM).

<table>
<thead>
<tr>
<th>Measured variables</th>
<th>Hypertensive (n=126)</th>
<th>Control (n=82)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex:</td>
<td></td>
<td></td>
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<tr>
<td>Males</td>
<td>76</td>
<td>41</td>
</tr>
<tr>
<td>Females</td>
<td>50</td>
<td>41</td>
</tr>
<tr>
<td>Age (Years)</td>
<td>47.4±0.91</td>
<td>46.0±1.2</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>84.5±1.5</td>
<td>80.52±1.8*</td>
</tr>
<tr>
<td>Height (Cm²)</td>
<td>163.16±4.2</td>
<td>164.67±3.6</td>
</tr>
<tr>
<td>BMI (Kg/m²)</td>
<td>31.5±1.3</td>
<td>29.8±1.2</td>
</tr>
<tr>
<td>BP (mmHg): Systolic Diastolic</td>
<td>135.6±2.5 80.2±2.3</td>
<td>120±1.6* 70.0±0.8*</td>
</tr>
<tr>
<td>Troponin I (ng/mL)</td>
<td>0.077 ± 0.011</td>
<td>0.001±0.00*</td>
</tr>
</tbody>
</table>

BMI, Body Mass Index; BP, Blood Pressure; *P<0.01
The detection of significant levels of cTnI in samples of hypertensive Nigerians is in agreement with earlier studies elsewhere (Platek et al., 2014; Aeschbacher et al., 2015). It was reported that detectable cTnI and other biomarkers like brain natriuretic peptide (BNP) are found in the serum of patients with pulmonary hypertension (Velez-Martinez et al., 2013). The complications of hypertension include Aneurysm (abnormal bulge in the wall of an artery), chronic kidney disease, cognitive changes, eye damage, heart attack and failure as well as peripheral artery disease and stroke (National Heart, Lung and Blood Institute, 2015). In most cases, hypertension is undetected for years because symptoms may not appear until damages occur in the body. Such damages take place due to sustained elevation of blood pressure over time. If untreated, circulatory failure from severe left ventricular dysfunction or any of the mechanical complications of MI frequently account for most fatalities (Batal et al., 2016). The results of this study may indicate sub-clinical myocardial injury since hypertension is commonly associated with microvascular and macrovascular complications (Whiteley et al., 2009; Sata et al., 2016). Even though circulating cTnI may reflect myocardial necrosis and diagnostic of MI in the presence of signs and symptoms (Morrow et al., 2007), elevated cTnI may be detected in other conditions such as coronary artery disease (Eggers et al., 2017), left ventricular failure (Horwich et al., 2003), Chronic kidney disease (Apple et al., 2002), sepsis (Ammann et al., 2001), Demand Ischaemia (Barry et al., 2008) and mixed critical care population (Quenot et al., 2005). It was suggested that underlying mechanism other than myocardial necrosis may be responsible for the high cTnI levels. Irrespective of the aforementioned observations, detectable cTnI is specific for ongoing myocardial damage and may be associated with worse prognosis. Elevated cTnI has been associated with left ventricular hypertrophy (LVH) among hypertensive subjects (Siliciano et al., 2000). These authors observed higher serum cTnI levels in 12 out of 23 hypertensive subjects with LVH. It was concluded that a significant proportion of hypertensive subjects with LVH had slightly higher cTnI levels (Siliciano et al., 2000).

It is needful to note that there are potential causes of cTnI elevations without underlying acute or chronic cardiovascular disease. The cytosolic-bound cTnI may be released by altered cellular wall permeability due to myocardial stretch or mild ischaemia (deFillippi et al., 2010).

This study revealed that cTnI was detected in the serum of majority of Nigerian military service personnel diagnosed with hypertension. The levels of cTnI may be responsible for the high cTnI levels.

**DISCUSSION**

This study was aimed at determining the level of cTnI, among hypertensive Nigerian military service personnel and comparing the results obtained with normotensive Nigerians. Serum cTnI was detected in the sample of 95 (75.4%) hypertensive subjects while 31 (24.6%) hypertensive subjects had an undetectable level (0.0ng/mL). Nine of the subjects had normal values of ≤0.01ng/mL while 86 had significantly diagnostic values of 0.02 – 1.09ng/mL. None of the subjects had up to 2ng/mL which is the WHO diagnostic criteria that indicates myocardial infarction. Nine normotensive (control) samples (10.98%) had detectable value of ≤0.01ng/mL in their serum while 73 control subjects (89.02%) gave an undetectable (0.00 ng/mL) result for cTnI. There was significantly higher (p<0.001) levels of cTnI in hypertensives when compared with controls. Subjects within categories 3-4 were at risk of cardiovascular diseases according to WHO stratification. Majority of the subjects constituting 67.5% had cTnI values ranging from 0.02-1.0ng/mL while only one HTN subject (0.8%) had a cTnI value above 1.0ng/mL. Findings also showed that there was no significant difference in the mean value of serum cTnI in hypertensives on chemotherapy when compared with newly diagnosed hypertensives (P=0.59).

Death of cardiac muscles due to cardiac myopathies such as hypertension leads to spillage of cTnI into the blood stream. Thus, this cardiac specific biomarker is very important in the diagnosis and management of hypertension and heart diseases.
cTnI detected may indicate sub-clinical cardiac necrosis which could predict the possibility of developing adverse cardiovascular disorders such as stroke and myocardial infarction in hypertensive individuals. The data presented may indicate cardiac involvement in hypertensive Nigerian Military personnel and an appropriate intensive management is suggested.

This study had the following limitations: (a) The level of compliance to drug therapy and other medications are not known to the researcher; (b) The exact duration of hypertension in the subjects was not stated; (c) Other cardiac biomarkers such as lactate dehydrogenase (LDH), B-type Natriuretic Peptide (BNP), Total CK, Myoglobin and others were not measured; and (d) The interferences by other metabolic disorders such as Diabetes mellitus, Obesity, Cancers and even infectious diseases in the study population were not ruled out.

REFERENCES


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