Original Research & Contributions

Electrocardiograms of Adult Outpatients Followed-Up in Basic Health Care Units in the Community of the South Region of São Paulo City

Alice T Yamada, MD, PhD; Renata X Baldow, MD; Carla Ribeiro, MD; Wilma N Ribeiro, MD; Carolina Peruzzi, MD; Nilce M Matsuda, MD, PhD; Alfredo J Mansur, MD, PhD

Abstract

Objective: The electrocardiogram (ECG) is an important, available, and inexpensive diagnostic tool to assess cardiac symptoms. Few studies address the prevalence of ECG abnormalities or changes of a normal tracing in ECG in outpatients. Our objective was to evaluate ECGs of adult outpatients to determine whether changes from a normal tracing could disclose the patients’ cardiovascular health status.

Methods: We evaluated all elective ECGs obtained in adult outpatients, from January 2009 to January 2010, at a municipal hospital in the city of São Paulo, Brazil. Electrocardiography was performed with a 3-channel, 12-lead machine (Dixtal Cardiopage EP-3, Dixtal Biomedica, São Paulo, Brazil), and results were interpreted by a cardiologist.

Results: Electrocardiography was performed in 3567 adult outpatients, 62.5% of whom were women, with a mean age of 51 years (standard deviation [SD] = 16 years). Of the 1918 patients whose ECGs showed abnormalities (mean age = 56 years, SD = 15 years), 1137 were women. Electrocardiographic changes were found in 1184 of the patients. Minor changes were found in 38.3% of patients. A total of 3133 changes were found in 1918 abnormal ECG results. There was a statistical difference related to sex and age, and abnormal ECG results were more frequent in men. There was a high prevalence of abnormal ECG results in the population studied.

Conclusions: There were more ECGs obtained from women; however, men and elderly patients more frequently had abnormal ECG results.

Introduction

The city of São Paulo, which is the capital of the state of São Paulo, Brazil, is one of the most populous cities in the world, with more than 11 million inhabitants.¹ Health care in the city of São Paulo (hereafter called São Paulo) consists of both public and private entities. Public health has financial support from the federal, state, and municipal governments.² The municipal public health is divided into regions and comprises several hospitals surrounded by several basic health care units.³ Municipal Hospital of Campo Limpo, located in the southern region of São Paulo, is responsible for 25 basic health care units. In the community, each basic health unit has general physicians, specialists, nurses, paramedics, and others who care for outpatients in both treating and preventing disease.²

The usefulness of ECG in acute cardiac diseases and its prognostic value are well established.² There are few studies, however, addressing the prevalence of ECG abnormalities in outpatients. Abnormalities in the ECG tracing have been shown to be independently associated with coronary artery disease and cardiovascular disease events.³ Changes in the ECG result, compared with a normal tracing, could reveal the cardiovascular health status of outpatients, which led us to perform this study.

Methods

This study evaluated all elective ECGs of adult outpatients performed in the Electrocardiography Division of Municipal Hospital of Campo Limpo from January 2009 to January 2010, as requested by physicians from 25 basic health care units in the south region of São Paulo.¹ Municipal Hospital of Campo Limpo is a tertiary care hospital with 254 beds. The 12-lead ECGs were performed with a 3-channel machine (Dixtal Cardiopage EP-3, Dixtal Biomedica, São Paulo, Brazil).

All elective ECGs were interpreted by an expert cardiologist, and results were classified as being normal or abnormal. “Abnormal ECG” was further classified into two categories: minor or major changes. Changes considered minor were sinus arrhythmia, bradycardia or tachycardia, nonspecific ST-segment or T-wave changes, and low QRS voltage. Changes considered major were bundle branch block, atrial or ventricular hypertrophy, arrhythmia, and pathologic Q waves. If a patient had more than one alteration, the ECG was ranked in the class according to the alteration of greater importance for potential influence on the prognosis.

Inclusion Criteria

Included in this study were all ECGs of outpatients age 18 years or older who were followed-up in 25 basic health care units of the southern region of São Paulo and whose tests were performed at Municipal Hospital of Campo Limpo and were ana-
Electrocardiograms of Adult Outpatients Followed-Up in Basic Health Care Units in the Community of the South Region of São Paulo City

Statistical Analysis
A comparison of demographic data (sex and age) between the ECGs considered normal and abnormal was performed; in the abnormal ECGs, the number and the type of changes found were evaluated. The χ² test and independent-samples Student's t test were performed, and differences were considered to be statistically significant when p < 0.01.

Results
This study evaluated the ECGs of 3567 adult outpatients with a mean age of 51 years (standard deviation [SD] = 16 years), and 2228 (62.5%) were women. The ECG was considered normal in 1649 (46.2%) of adult outpatients, and in this group 1091 (66.2%) were women, with a mean age of 45 years (SD = 17 years). The ECG was considered abnormal in 1918 patients (53.8%), and in this group 1137 (59.3%) were women with a mean age of 56 years (SD = 15 years).

In the abnormal group of 1918 patients, 1184 (61.7%) patients showed major changes, and 734 (38.3%) patients had minor ECG changes. The most frequent minor change found was nonspecific ST-segment or T-wave changes, and the most frequent major change was bundle branch block (Table 1). Table 2 shows the breakdown of major ECG changes by specific type.

In total, there were 3133 changes in the group of 1918 patients with abnormal ECGs of which 1679 were considered to be major changes and 1454 minor ones. The most frequent alterations found were nonspecific ST-segment or T-wave changes (Table 3).

Of the 1918 adult patients with abnormal ECGs, 1088 (56.7%) of them had 1 change, 535 (27.9%) had 2, 219 (11.4%) had 3, 64 (3.4%) had 4, 10 (0.5%) had 5, and 2 (0.1%) had 6 changes.

There were 1157 women with 881 major changes, and the ratio of number of changes to women was 1:0.7. The distribution of major changes in women is shown in Table 4. There were 781 men with 798 major changes, and the ratio of changes to men was 1:1. The distribution of major changes in men is shown in Table 4.

There were 694 patients older than age 65 years with 538 major changes, with a ratio of 1:0.7. The distribution of their major changes is shown in Table 5. There was a statistically significant difference related to sex and age between patients with normal ECGs and those with abnormal ECGs. Men had more frequent abnormalities, with an odds ratio of 1.34 and a confidence interval of 1.17 to 1.53, as did patients older than age 65 years (odds ratio = 3.04; confidence interval = 2.54-3.63).

Discussion
This study has demonstrated that more than 50% of adult outpatients followed-up in basic community health care units in the south region of São Paulo presented abnormal ECG results. There was a high prevalence of abnormal ECGs in the population studied, suggesting that electrocardiography is a useful noninvasive method for diagnostic investigation and follow-up of adult outpatients. The statistically significant ECG changes found were arrhythmia, bundle branch block, atrial and/or ventricular hypertrophy, and pathologic Q wave, corresponding to 33.2% of all patients.

There are several limitations in our study. One important limitation of our study is the lack of advanced testing such as catheterization to confirm the coronary artery disease and echocardiography to evaluate left ventricular mass to corroborate hypertrophy found in the ECG. These examinations would have added more value to the clinical relevance of the ECG findings; however, our study was done not in protocol conditions but in the clinical setting, and not all patients were submitted to undergoing these advanced tests.
According to the Brazilian Ministry of Health, cardiovascular diseases account for 31.3% of all deaths registered in the country in a given year. This means that more than 319,000 people died mainly of heart attack and stroke in 2009. The number of deaths in Brazil by diseases of the circulatory system in 2005 was 283,888, 52.5% men and 47.5% women. In the city of São Paulo, 21,011 deaths occurred, 50.6% men and 49.4% women.

Recent studies showed that major ECG abnormalities are independently associated with coronary artery disease events. In our study, we found that 33.2% of all patients had major ECG abnormalities and probably were at high risk of cardiac disease events. These ECG changes could disclose the poor cardiovascular health status of our community and the necessity of investments to improve primary medical care. In our country, the public health policy prioritizes the construction of hospitals to treat acute myocardial infarction (MI) and stroke rather than the necessary investment in primary care and programs to prevent and to reduce rates of morbidity and mortality.

Studies performed at the Institute Dante Pazzanese of Cardiology in São Paulo showed that 60% of people who experience heart disease are men, with a mean age of 56 years. The high frequency of the problem puts Brazil among the 10 countries with the highest rate of deaths caused by cardiovascular disease.

Of 246,246 adult residents older than age 40 years in Kurashiki-city, Japan who were studied from May to December 2006, the overall prevalence of atrial fibrillation (AF) was 1.6% independently associated with cardiac disease. The 1.6% prevalence of AF in Japan is lower than in Western populations and is similar to our results, which also found AF to comprise 1.6% of abnormal ECG results.

An increased prevalence and incidence of left ventricular hypertrophy on ECG is associated with a poor prognosis in very old men and women. On the other hand, regression of left ventricular hypertrophy on ECG in older people, irrespective of causes, may confer improvement in risk of coronary artery disease. In a prospective, longitudinal study of 10 years’ duration with EGGs obtained from older subjects in the Bronx in New York City, which was a community-based cohort study consisting of 459 subjects (age 75 to 85 years, mean age = 79 years), left ventricular hypertrophy was found in 9.2% of subjects. In our community, we found left ventricular hypertrophy in 5.3% of abnormal ECGs in adults of all ages.

The data from 4102 patients with heart failure hospitalized during a prospective national survey in Israel showed that right bundle branch block was present in 381 patients (10.2%) and left bundle branch block was present in 504 patients (13.5%). In our community-based study, the adult outpatients of the south region of São Paulo presented with right bundle branch block in 78 cases (4%) and left bundle branch block in 41 (2%) of abnormal ECGs.

It is widely known that mortality caused by diseases of the circulatory system is higher in men, although women in our study had more ECGs performed. However, the number of ECGs considered abnormal was higher in men than in women in our study.

In Brazil, the idea is quite widespread that basic health care units are designed almost exclusively for women, children, and elderly people. The male identity is linked to the devaluation of self-care and low health concerns. Actually, men prefer to use other types of health services such as pharmacies and hospitals, which respond more objectively to their demands. This and some other points can perhaps explain the female predominance in ECG examinations in our study.

In the Netherlands, 566 participants age 85 years (377 women, 189 men) were studied during a 5-year period to evaluate routinely performed ECGs in older people from the general population. In elderly people, a history of cardiovascular disease is a strong predictor of cardiovascular morbidity and mortality. Although abnormal findings on routine ECGs predict cardiovascular mortality, they do not provide additional prognostic information beyond the information available from medical records. Therefore, when accurate medical records are available, ECG recording is not ef-

---

### Table 3. Minor and major changes in abnormal electrocardiograms

<table>
<thead>
<tr>
<th>Type of alterations</th>
<th>Number of alterations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonspecific ST-segment or T-wave changes</td>
<td>974</td>
</tr>
<tr>
<td>Incomplete bundle branch block</td>
<td>138</td>
</tr>
<tr>
<td>Sinus arrhythmia, bradycardia or tachycardia</td>
<td>215</td>
</tr>
<tr>
<td>Low QRS voltage</td>
<td>67</td>
</tr>
<tr>
<td>Other minor changes</td>
<td>60</td>
</tr>
<tr>
<td>Subtotal</td>
<td>1454</td>
</tr>
<tr>
<td>Bundle branch block</td>
<td>570</td>
</tr>
<tr>
<td>Atrial or ventricular hypertrophy</td>
<td>650</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>347</td>
</tr>
<tr>
<td>Pathologic Q waves</td>
<td>112</td>
</tr>
<tr>
<td>Subtotal</td>
<td>1679</td>
</tr>
</tbody>
</table>

* There were 56.7% patients with 1 change, 27.9% with 2, 11.4% with 3, 3.4% with 4, 0.5% with 5, and 0.1% with 6 changes.

### Table 4. Distribution of major electrocardiographic changes in relation to subject’s sex

<table>
<thead>
<tr>
<th>Change</th>
<th>Women</th>
<th>Men</th>
<th>Total, no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bundle branch block</td>
<td>313</td>
<td>257</td>
<td>570</td>
</tr>
<tr>
<td>Atrial or ventricular hypertrophy</td>
<td>324</td>
<td>326</td>
<td>650</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>178</td>
<td>169</td>
<td>347</td>
</tr>
<tr>
<td>Pathologic Q waves</td>
<td>66</td>
<td>46</td>
<td>112</td>
</tr>
<tr>
<td>Total</td>
<td>881</td>
<td>798</td>
<td>1679</td>
</tr>
</tbody>
</table>

### Table 5. Distribution of major electrocardiographic changes in relation to age

<table>
<thead>
<tr>
<th>Change</th>
<th>Age, years</th>
<th>Total, no.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 65</td>
<td>&gt; 65</td>
</tr>
<tr>
<td>Bundle branch block</td>
<td>374</td>
<td>196</td>
</tr>
<tr>
<td>Atrial or ventricular hypertrophy</td>
<td>432</td>
<td>218</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>266</td>
<td>81</td>
</tr>
<tr>
<td>Pathologic Q waves</td>
<td>69</td>
<td>43</td>
</tr>
<tr>
<td>Total</td>
<td>1141</td>
<td>538</td>
</tr>
</tbody>
</table>
Electrocardiograms of Adult Outpatients Followed-Up in Basic Health Care Units in the Community of the South Region of São Paulo City

Conclusions
There was a high prevalence of abnormal ECG in the population studied, suggesting that the ECG is a useful noninvasive method for diagnostic investigation and follow-up of adult outpatients in the community. Although there were more ECGs of women, men and patients older than age 65 years had abnormal ECGs more often.

Disclosure Statement
The authors have no conflicts of interest to disclose.

Acknowledgments
The authors thank Steven M Miller, PhD, for help revising the manuscript. Kathleen Louden, ELS, of Louden Health Communications provided editorial assistance.

References

The Heart’s Beat

If a pair of electrodes ... are strapped to the front and back of the chest, and connected with a Lippmann’s capillary electrometer, the mercury in the latter will be seen to move slightly but sharply at each beat of the heart.

— Augustus Désiré Waller, 1856-1922, British physiologist who produced the first electrocardiogram