Telecardiology on the Diagnostic Support of Chest Pain in Twenty-Two Emergency Care Units (UPA 24h) in The State of Rio de Janeiro

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Abstract

**Background:** Telecardiology may be a useful support in diagnosis and management of chest pain.

**Objective:** Evaluate the application of telecardiology to support the differential diagnosis of chest pain in patients admitted to Emergency Care Units.

**Method:** Observational, retrospective and documental study of 5,816 patients admitted with supposedly cardiological chest pain in twenty two Emergency Care Units in the state of Rio de Janeiro. Data were tabulated and analyzed by Excel® software, using simple descriptive statistics, from the database of the Cardiology Consultancy Nucleus.

**Results:** Diagnostic disagreement was found in 1,593 (27.39%) cases. Of these, 1,477 (92.72%) were diagnosed locally as non-ST-elevation myocardial infarction (non-STEMI), 74 (4.64%) as acute myocardial infarction with ST-segment elevation (STEMI), 40 (2.52%) as acute pulmonary edema (APE) and 2 (0.12%) as tachyarrhythmia. Intensive care referral was requested to 100% of these patients. After telecardiology, the diagnoses were: 385 (24.17%) unstable angina, 289 (18.14%) congestive heart failure, 212 (13.31%) APE, 174 (10.92%) STEMI, 152 (9.54%) hypertensive emergency, 113 (7.09%) acute chronic renal failure, 89 (5.59%) pneumonia, 39 (2.45%) sepsis, 26 (1.63%) myocarditis, 20 (1.26%) tachyarrhythmia and 5 (0.31%) orovalvar disease. The outcome after telecardiology was 1,178 discharges (73.94%), 338 (21.21%) referrals, 62 (3.90%) deaths and 15 (0.95%) unknown.

**Conclusion:** Telecardiology was effective in chest pain diagnosis and management, optimizing hospital admission in the public health system. (Int J Cardiovasc Sci. 2019;32(2)158-162)

**Keywords:** Telemedicine/methods; Chest Pain/diagnostic imaging; Emergency Medical Services; Electrocardiography/methods; Myocardial Infarction.

Introduction

Cardiovascular diseases are the leading cause of death in the world and were responsible for 32% of deaths on the planet by 2015. In Brazil, as reported by the Mortality Information System - SIM - ischemic heart disease is the leading cause of death, generating very high medical and socioeconomic expenditures to the public health system. In the United States of America, cardiovascular diseases have generated direct and indirect costs of more than 200 billion dollars to the health system with estimates of about US$ 220 billion in expenditures by 2020.

It is estimated that about 5% of patients with chest pain and myocardial infarction are mistakenly discharged without a confirmed diagnosis in the emergency room. Early diagnosis and treatment of ischemic heart diseases are critical for the reduction of morbidity and mortality, hospitalization time and optimization of costs in emergency care. Proper management and follow-up of these patients has been a priority for the public health system.

The 24-hour Emergency Care Units (UPA 24h) emerged as part of Brazil’s Emergency Policy program,
which structures and organizes emergency care in the
country. The UPA 24h are structures of intermediate
complexity between the primary health care units and
the chain of hospitals. In the state of Rio de Janeiro, the
UPA 24h were implemented in 2007. According to the
state’s demand profile, there was a need for cardiology
support to general practitioners working at the UPA 24h
units in the care of patients with chest pain. In 2009, the
Cardiology Consultancy Nucleus (CCN) was set up for
the purposes of providing specialized remote assistance
in the medical care for patients with cardiac disorders
at these units.

The objective of this study is to evaluate the support
of telecardiology in the diagnostic qualification of chest
pain in twenty-two 24-hour Emergency Care Units (UPA
24h) in the state of Rio de Janeiro.

Methods

Study design

This is an observational, retrospective and
quantitative study.

Study population

A study carried out with 9,692 patients evaluated by
telecardiology, including 5,816 (60%) who were admitted
with chest pain supposedly caused by a cardiac disorder,
in twenty-two UPA 24h in the state of Rio de Janeiro.
The information was extracted from the database of
the Cardiology Consultancy Nucleus of the Health
Department (SES) of the State of Rio de Janeiro, from
January 1, 2012 to December 31, 2013.

Statistical Analysis

The categorical variables were tabulated and analyzed
using the Excel software®, using simple descriptive
statistics: absolute numbers, mean and frequency.

Collection and evaluation of data by the Cardiology
Consultancy Nucleus

The purpose of the CCN was to answer questions
and provide specialized advice to the diagnosis and
decision-making of cardiac cases admitted by the general
practitioner in the UPA. The general practitioner could
request, whenever necessary, specialized support, based
on the guidelines of the Brazilian Cardiology Society, as
it related to the UPA 24h scenario.

Among all the information collected by the CCN about
the patients admitted with chest pain, the following
were important to support the differential diagnosis:
sex, age, main complaint, time of onset of diagnosis,
comorbidities, electrocardiogram (ECG), laboratory tests
and physical examination information.

At the first synchronous contact between the general
practitioner and the telecardiologist, the latter collected
the information reported and the initial diagnosis
suggested by the UPA physician. The ECG was sent
by fax or e-mail and immediately analyzed by the
specialist. Based on this clinical, electrocardiographic
and laboratory information (when laboratory tests were
immediately required), the telecardiologist presented
his/her diagnosis to the general practitioner and advised
on the immediate management of the case. Therefore, all
the information available for the clinical reasoning at the
time of the teleconsulting was shared between the general
practitioner and the telecardiologist.

Patient follow-up was performed by the CCN team
through active search (by making daily calls to the UPA),
assisting in the management of the cases until an outcome
was reached. Once the telecardiologist issued an opinion,
the patients who needed hospitalization were registered
by the UPA in the State System of Regulation (SER) and /
or in the city’s system of regulation (Sisreg) for hospital
transfer purposes.

All patients underwent double-blind peer evaluation
by the CCN team of cardiologists with over 10 years of
experience in cardiology. In none of the cases was there
diagnostic disagreement among the specialists.

Results

The mean age found in the group of patients
admitted with chest pain was 59.20 ± 11.33 years, with
a predominance of the male gender (59.32%, n = 3,450).

The average length of stay in the UPA 24h was
three days.

The main comorbidities reported were systemic arterial
hypertension (49.87%; n = 2,900), diabetes mellitus (10.09%;
n = 587), smoking (14.79%; n = 860), previous coronary
artery disease (7.60%; n = 442), dyslipidemia (8.82%;
n = 513), dilated cardiomyopathy (3.73%; n = 217), previous
stroke (2.13%; n = 124), family history of coronary artery
disease (2.13%; n = 124) and obesity (0.84%; n = 49).

Of the 5,816 patients admitted for chest pain
supposedly due to cardiac disorders and evaluated by
the telecardiologist, there was diagnostic agreement with the general practitioner from the UPA 24h in 72.61% of the cases (4,223 patients) and diagnostic disagreement in 27.39% of the cases (1,593 patients).

In the group in which there was diagnostic disagreement, the general practitioner classified patients as follows: 1,477 (92.72%) non-ST-segment elevation acute myocardial infarction (NSTEMI), 74 (4.64%) ST segment elevation acute myocardial infarction (STEMI), 40 (2.52%) acute pulmonary edema (APE) and 2 (0.12%) tachyarrhythmia. After evaluation by telecardiology, the diagnoses were: 385 (24.17%) unstable angina (UA), 289 (18.14%) congestive heart failure (CHF), 212 (13.31%) APE, 174 (10.92%) STEMI, 152 (9.54%) hypertensive emergency (HE), 113 (7.09%) acute chronic renal failure (ACRF), 89 (5.59%) non-STEMI, 89 (5.59%) pneumonia, 39 (2.45%) sepsis, 26 (1.63%) myopericarditis, 20 (1.26%) tachyarrhythmia, 5 (0.31%) orovalvar disease (OVD). (Table 1).

The general practitioner had requested intensive care admissions for the 1,593 patients identified by telecardiology as discordant diagnoses. After a careful evaluation by telecardiology, only 338 patients really needed to be transferred, and the great majority, 1,178 patients (73.94%), were discharged after clinical stabilization. Sixty-two (3.9%) patients died and 15 (0.95%) had an unknown outcome (Table 2).

The main points of diagnostic disagreement identified by telecardiology are described in the following table.

### Discussion

By analyzing the results found in this study, we observed the importance of telecardiology in remote

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**Table 1 - Diagnosis of chest pain between the initial evaluation by the general practitioner and after the telecardiology**

<table>
<thead>
<tr>
<th>Diagnoses</th>
<th>General practitioner N (%)</th>
<th>Telecardiologist N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-STEMI</td>
<td>1,477 (92.72)</td>
<td>89 (5.59)</td>
</tr>
<tr>
<td>STEMI</td>
<td>74 (4.64)</td>
<td>174 (10.92)</td>
</tr>
<tr>
<td>APE</td>
<td>40 (2.52)</td>
<td>212 (13.31)</td>
</tr>
<tr>
<td>Tachyarrhythmia</td>
<td>2 (0.12)</td>
<td>20 (1.26)</td>
</tr>
<tr>
<td>Unstable angina</td>
<td>0</td>
<td>385 (24.17)</td>
</tr>
<tr>
<td>CHF</td>
<td>0</td>
<td>289 (18.14)</td>
</tr>
<tr>
<td>Hypertensive emergency</td>
<td>0</td>
<td>152 (9.54)</td>
</tr>
<tr>
<td>ACRF</td>
<td>0</td>
<td>113 (7.09)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>0</td>
<td>89 (5.59)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>0</td>
<td>39 (2.45)</td>
</tr>
<tr>
<td>Myopericarditis</td>
<td>0</td>
<td>26 (1.63)</td>
</tr>
<tr>
<td>OVD</td>
<td>0</td>
<td>5 (0.31)</td>
</tr>
<tr>
<td>Total</td>
<td>1,593</td>
<td>1,593</td>
</tr>
</tbody>
</table>

*Non-STEMI: non-ST-elevation acute myocardial infarction; STEMI: ST-segment elevation acute myocardial infarction; APE: acute pulmonary edema; CHF: congestive heart failure; ACRF: acute chronic renal failure.*

**Table 2 - Outcome of patients with chest pain after evaluation by telecardiology**

<table>
<thead>
<tr>
<th>Outcome after telecardiology</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge</td>
<td>1,178</td>
<td>73.94%</td>
</tr>
<tr>
<td>Transfer</td>
<td>338</td>
<td>21.21%</td>
</tr>
<tr>
<td>Death</td>
<td>62</td>
<td>3.90%</td>
</tr>
<tr>
<td>Unknown</td>
<td>15</td>
<td>0.95%</td>
</tr>
<tr>
<td>Total</td>
<td>1,593</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Table 3 - Main points of diagnostic disagreement between the general practitioner and the telecardiologist**

<table>
<thead>
<tr>
<th>Points of diagnostic disagreement</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPK / CKMB elevation with normal troponin</td>
<td>1,059</td>
<td>66.48</td>
</tr>
<tr>
<td>Troponin interpretation curve</td>
<td>305</td>
<td>19.15</td>
</tr>
<tr>
<td>Electrocardiography</td>
<td>227</td>
<td>14.25</td>
</tr>
<tr>
<td>Exclusive clinical evaluation</td>
<td>2</td>
<td>0.12</td>
</tr>
<tr>
<td>Total</td>
<td>1,593</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Key: CPK: creatine phosphokinase; CPK: MB fraction of creatine phosphokinase.*
support to the general practitioner in the differential diagnosis of chest pain at the emergency care, directly influencing proper diagnosis, treatment and referral of the patients.

The importance of cardiological remote support for diagnosis and clinical management has been described by other authors7,8 and Molinari et al.,9 that evaluated 456 patients with chest pain and/or other symptoms suggestive of an acute cardiac event, comparing the initial diagnosis of the general practitioner with the final diagnosis of the cardiologist. In this study,7 two points stand out in our findings: the first one is the high percentage of diagnostic disagreement 31% (140 patients)9 compared to 27.39% (1,593 patients) in our study, demonstrating the need of the remote specialist; and the second one is the reduction of unnecessary admissions that was 63%9 compared to 73.9% (1,593 patients) in this study, thus representing effective savings in terms of unnecessary costly hospitalizations. Similar studies10-13 related to cost reduction have also proved the effectiveness of telecardiology in primary care.

In our study, the main points of diagnostic disagreement in patients admitted with chest pain were abnormalities on the electrocardiogram, showing ST-segment elevation not recognized at admission, similar to those described by Brunetti et al.,14 high CPK and MBK values with negative troponin defined as non-ST-elevation acute myocardial infarction and other causes of chest pain with positive troponin related and not related to cardiac disorders but not characterizing acute myocardial ischemia, which was also described by Chiu et al.15

Of all the inconsistent diagnoses, it is worth mentioning the patients arriving at the UPA 24h with ST-segment elevation acute myocardial infarction (STEMI) but who did not have this diagnosis recognized by the general practitioner. In this group, 80% of patients presented time from onset of chest pain to admission (delta t) shorter than 12 hours, but only 34% were evaluated in time by the telecardiology and received reperfusion treatment. This result was compatible with the finding in the TIET study,16 in which 44% of the STEMI patients who were within the 12-hour window of the onset of symptoms did not receive any thrombolytic therapy without any justification. The recognition of this diagnosis by the general practitioner, as well as the percentage of thrombolysis is still very low, as previously reported by other authors,15,17,18 with a significant impact on morbidity and mortality rates.19,20 This demonstrates the urgent need to implement measures that allow the rapid diagnosis of STEMI and, consequently, the therapy in a timely manner.

Regarding the safety of the thrombolytics administered (alteplase and tenecteplase), there were no reports of hemorrhagic complications or side effects secondary to medication in the period evaluated.

A total of 1,255 admissions at tertiary hospital were avoided. As already described by other authors,10,11 telecardiology plays an important role in avoiding unnecessary hospital admissions in patients with a supposed cardiac event in the first care by the general practitioner.

This study also shows the importance of a continued relationship established by telemedicine between the telecardiologist and the general practitioner on a daily basis to guide the management of patients admitted with suspected acute coronary syndrome until outcome, as recommended by the Brazilian Guidelines on Telecardiology in Acute Coronary Syndrome and other Cardiac Diseases.21 This new procedure of work can be considered a support in the country’s health system.

Limitations

The retrospective and observational nature does not allow us to make comparisons and associations to demonstrate the statistical significance of telecardiology. The presence of only one telecardiologist per day may not meet all the demand of the emergency care units when synchronous teleconsulting is required by the general practitioner at the emergency room.

Conclusion

Telecardiology has been shown to be an important and effective tool to support the differential diagnosis of chest pain in patients admitted at emergency care units, optimizing bed occupancy in the public health system.

The use of telecardiology as a remote support for general practitioners handling patients with chest pain symptoms is feasible, resulting on diagnostic support and identifying patients that really need to be transferred to tertiary referral hospital, thus avoiding unnecessary bed occupancy and expensive tests.

Authors’ contributions

Research creation and design: Farah S. Data acquisition: Farah S, Andréa BR, Silva RC. Data analysis
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Original Article

and interpretation: Farah S. Critical revision of the manuscript as for important intellectual content: Farah S, Monteiro, A.

Potential Conflict of Interest
No potential conflict of interest relevant to this article was reported.

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Study Association
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Ethics approval and consent to participate
This study was approved by the Ethics Committee of the Universidade do Estado do Rio de Janeiro under the protocol number 70594917.3.0005282. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

References

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