

► The role of telecardiology in supporting the decision-making process of general practitioners during the management of patients with suspected cardiac events

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Summary

We studied the role of telecardiology in reducing unnecessary hospital admissions of patients with suspected life-threatening cardiac events (CEs), evaluated by general practitioners (GPs). Over one month, 456 consecutive patients (mean age 65 years, SD 19) complaining of typical (10%) or atypical (42%) chest pain, palpitations (19%), dyspnoea (19%) or syncope (10%) were enrolled. Before teleconsultation, the GPs recorded their own opinion (based on clinical evaluation only) about the presence of a CE. Following transmission of the electrocardiogram (ECG), this opinion was compared with that of the cardiologist. In total there was agreement between the GP and cardiologist about the presence of a CE in 316 of the patients (69%) and disagreement in 140 patients (31%). This represents a specificity and sensitivity of the GPs' diagnosis of 76% and 47%, respectively. For 84 of 134 patients judged as having a CE by the GP, telecardiology avoided hospitalization; on the other hand, telecardiology identified a CE in 56 of 322 patients judged as not having a CE by the GP. Telecardiology is a useful tool with which to reduce unnecessary hospitalizations in patients with suspected life-threatening CEs.

Introduction

Cardiovascular diseases represent the leading cause of mortality and morbidity in the adult population of Western countries¹. Cardiac events (CEs) such as acute coronary syndromes and some kinds of arrhythmia are life-threatening. Therefore, when a CE occurs, a good outcome depends upon its quick identification as a CE and the rapid initiation of treatment. To diagnose a CE correctly, it is mandatory to perform an electrocardiogram (ECG) immediately. Unfortunately, electrocardiographs are not available to most general practitioners (GPs), and it is GPs whom patients with a suspected CE usually first see. For these GPs, clinical

examination is the only way to make a diagnosis. The uncertainty of such examinations may lead to the over-referral of patients with a suspected CE to coronary care units and hospital emergency departments, and this increases both unnecessary admissions and public health costs²⁻⁷. On the other hand, if the symptoms of an acute CE are missed, there are likely to be serious health consequences for the patient⁸.

The application of telecommunication to cardiology has permitted new methods of managing patients with suspected or actual cardiac disease, who can gain direct access to specialist consultations with no need to travel. Studies have shown that telecardiology can play an important role both in the management of specific cardiac disorders⁹⁻¹¹ and in supporting the decision-making process of GPs dealing with patients with heart disease¹²⁻¹⁵.

The aim of the present study was to evaluate the role of a telecardiology diagnostic service (TDS) in reducing unnecessary hospitalizations without decreasing the rate

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of appropriate admissions of patients with suspected life-threatening CEs.

Methods

Study design

From 13 June to 12 July 2000, 100 GPs with experience in using trans-telephonic electrocardiography (TTE) and practising in remote or rural areas of Italy (defined as having fewer than 5000 inhabitants) were involved in the study. GPs used one of two hand-held TTE devices for recording and transmitting a 12-lead ECG. Forty-six GPs were equipped with a Heart View P12/8 (Aerotel, Israel) (Fig 1) and 54 GPs with a Cardiette Microtel (H&C Medical Devices, Italy) (Fig 2).

The TDS was located in Genoa at the Medicina Domani Telemedicine Institute (Fig 3). Two or more cardiologists were on duty 24 h a day. The unit was equipped with 30 ordinary telephone lines. Before starting the study, GPs and cardiologists agreed on the definition of a CE, as an acute coronary syndrome, with an ST-segment elevation or depression, or life-threatening arrhythmias.

Inclusion criteria

All patients consulting the participating GPs because of symptoms suggestive of an acute CE were considered eligible for the study. One or more of the following symptoms was considered suggestive of an acute CE:

- (1) atypical chest pain, defined, as in the CASS study¹⁶, as an intermittent or persistent transfixing pain, not enhanced by exertion or emotions, located on the left hemithorax, epigastrium, back and arms, without substernal pain;
- (2) typical chest pain, defined as substernal constrictive pain with or without radiation to the shoulders or to the left arm, precipitated by exertion and emotions, and relieved by rest or nitroglycerine;
- (3) palpitations;
- (4) dizziness or syncope;
- (5) dyspnoea at rest.

GPs' evaluation

Patients were evaluated by a GP either at home or in the GP's surgery. The GPs performed a clinical examination—without recording an ECG—and then communicated the patient's symptoms and clinical data to the cardiologist. The GPs gave their opinion about the presence of a CE. The GPs identified two groups of patients:

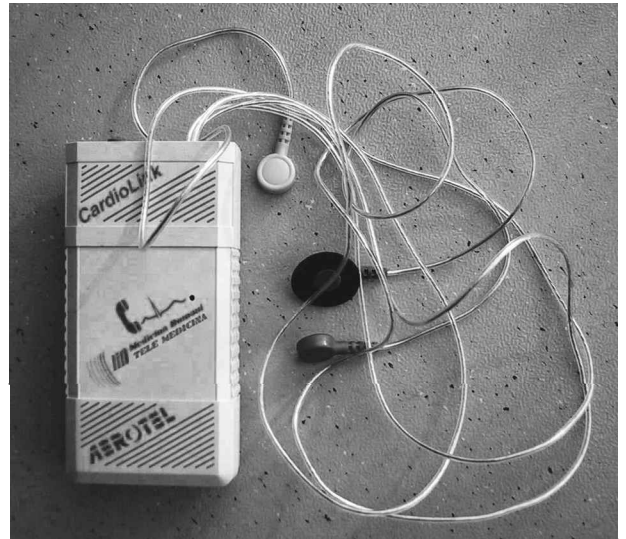


Fig 1 The Heart View P12/8, one of the two TTE devices used by GPs for recording and transmitting ECGs.

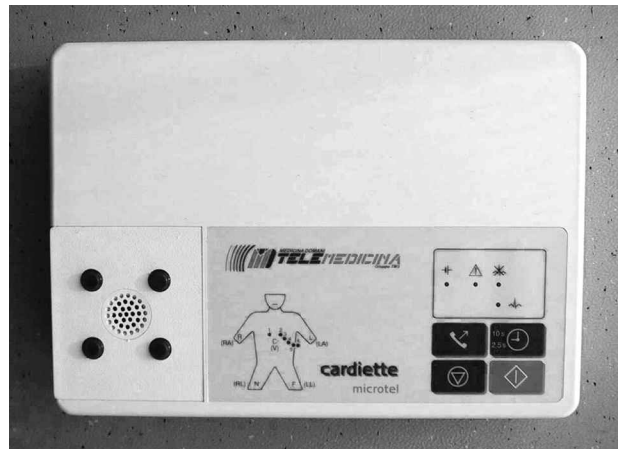


Fig 2 The Cardiette Microtel, one of the two TTE devices used by GPs for recording and transmitting ECGs.



Fig 3 The TDS of Medicina Domani Telemedicine Institute.

- (1) patients with a CE, who required hospital admission (group CE+);
- (2) patients without a CE, who did not require hospital admission (group CE-).

The GP then recorded an ECG using the TTE device and transmitted it to the TDS by telephone.

Cardiologists' evaluation

Following the TTE transmission, on the basis of clinical history, symptoms and ECG findings, the cardiologist decided what action to take; the cardiologist's opinion was taken as the gold standard or reference diagnosis. All patients classified as CE+ by the cardiologist were sent to hospital. Patients with no symptoms during the TTE examination were excluded from the study.

After the teleconsultation, a full report, including an ECG print-out, was sent to the GP.

To exclude the possibility of a patient with a non-diagnostic ECG suffering an acute myocardial infarction, patients with typical chest pain, a normal ECG and a low (<10%) probability of acute myocardial infarction, and patients with atypical chest pain, a normal ECG and a moderate to high probability of acute myocardial infarction, were re-examined 1, 3 and 12 h later. Patients with typical chest pain, a normal ECG and a moderate to high probability of acute myocardial infarction were promptly sent to hospital.

Results

Of the 100 GPs enrolled in the study, 82 evaluated one or more patients according to the protocol. The remaining 18 GPs did not call the TDS during the study period.

A total of 456 consecutive patients (260 female, 196 male), with a mean age of 64.8 years (SD 18.8, range 7–99 years), were enrolled in the study. The examination was performed at the patient's home in 332 cases (73%) and at the GP's surgery in 124 (27%). The symptoms were: atypical chest pain in 192 patients (42%), typical chest pain in 46 (10%), palpitations in 86 (19%), dizziness/syncope in 46 (10%) and dyspnoea in 86 (19%).

None of the 27 patients re-examined 1, 3 and 12 h after the first examination presented with a CE. One of three patients with typical chest pain, a normal ECG and a moderate to high probability of acute myocardial infarction showed ECG abnormalities during hospitalization suggestive of myocardial ischaemia.

The GP suspected a CE in 134 patients and therefore included them in the CE+ group. The remaining 322

patients were assigned to the CE- group. After teleconsultation the cardiologists considered that 50 of the GPs' 134 patients in group CE+ (37%) and 56 of the GPs' 322 patients in group CE- (17%) were actually CE+ and needed hospitalization.

There were significant differences in the proportions of patients assigned to the CE+ and CE- groups by the GPs and the cardiologists for the whole sample of patients ($P=0.02$) (Table 1), as well as for the atypical chest pain subgroup ($P=0.004$) (Table 2) and for the dizziness/syncope subgroup ($P=0.014$) (Table 3). There were no significant differences for the typical chest pain subgroup (Table 4) and palpitations subgroup (Table 5). The absence of false positives (i.e. patients wrongly assigned to the CE+ group) in the dyspnoea subgroup (Table 6) prevented the calculation of the McNemar statistic. It is important nonetheless to note that in

Table 1 Comparison between the cardiologists' and the GPs' diagnoses for the whole patient group ($n=456$)

Cardiologists	GPs	
	CE+	CE-
CE+	50	56
CE-	84	266

CE+, cardiac event diagnosed; CE-, cardiac event not diagnosed.
 $P=0.022$.

Table 2 Comparison between the cardiologists' and GPs' diagnoses for patients presenting with atypical chest pain ($n=192$)

Cardiologists	GPs	
	CE+	CE-
CE+	6	20
CE-	44	122

CE+, cardiac event diagnosed; CE-, cardiac event not diagnosed.
 $P=0.004$.

Table 3 Comparison between the cardiologists' and GPs' diagnoses for patients presenting with dizziness/syncope ($n=46$)

Cardiologists	GPs	
	CE+	CE-
CE+	10	4
CE-	16	16

CE+, cardiac event diagnosed; CE-, cardiac event not diagnosed.
 $P=0.014$.

Table 4 Comparison between the cardiologists' and GPs' diagnoses for patients presenting with typical chest pain ($n=46$)

Cardiologists	GPs	
	CE+	CE-
CE+	16	12
CE-	16	2

CE+, cardiac event diagnosed; CE-, cardiac event not diagnosed.
 $P > 0.05$.

Table 5 Comparison between the cardiologists' and GPs' diagnoses for patients presenting with palpitations ($n=86$)

Cardiologists	GPs	
	CE+	CE-
CE+	16	6
CE-	8	56

CE+, cardiac event diagnosed; CE-, cardiac event not diagnosed.
 $P > 0.05$.

Table 6 Comparison between the cardiologists' and GPs' diagnoses for patients presenting with dyspnoea ($n=86$)

Cardiologists	GPs	
	CE+	CE-
CE+	2	14
CE-	0	70

CE+, cardiac event diagnosed; CE-, cardiac event not diagnosed.
 P value not calculated.

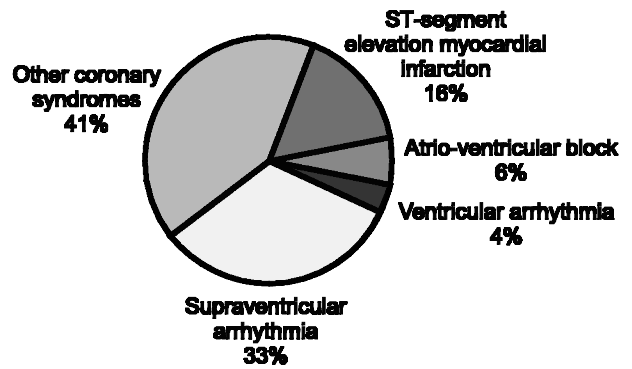


Fig 4 Kinds of cardiac events in 104 of the 106 patients sent to the hospital emergency department. Two of the patients referred had no cardiac event.

ST-segment elevation myocardial infarction and 43 had ST-segment depression myocardial infarction, stable or unstable angina. Three patients (two with ST-segment elevation myocardial infarction and one with ST-segment depression myocardial infarction) died after hospitalization and one patient (with ST-segment elevation myocardial infarction) before hospitalization. Patients with ST-segment elevation myocardial infarction were hospitalized within 1 h in two cases, within 3 h in five cases, within 6 h in four cases and after more than 6 h in five cases (in the remaining case the time was not recorded).

For the group of patients with dyspnoea, a CE was diagnosed in only 16 cases; in the remaining patients the symptom was most commonly due to anxiety (32 patients), lung disease (16) or chronic heart failure (6) that required only drug dose adjustment.

Discussion

The present study demonstrates that clinical examination alone, without an ECG, may lead to misdiagnosis of a suspected CE. Of 134 patients for whom the GP suggested hospitalization, 84 did not present ECG abnormalities and were not hospitalized. Telecardiology therefore reduced hospitalizations by 63% (84/134). Since the average stay in hospital is three days per patient, the total saving amounts to 252 inpatient days. Daily hospitalization costs about \$2000 per patient^{4,5}, so telecardiology resulted in savings of \$504,000 for unnecessary hospitalizations (\$1 is €1.1). On the other hand, 56 of the total sample of 456 patients (12%) required hospitalization (38 for an acute coronary syndrome) because of a CE that had been unrecognized by the GP. According to previous data⁸, if we consider a mortality rate of about 20% in patients with undiagnosed coronary syndrome, the identification of 38 of 456

this last subgroup 14 out of 86 patients (16%) presented a CE that was unrecognized by the GP.

In total, there was agreement between the GP and cardiologist for 316 of the 456 patients (69%) and disagreement for 140 patients (31%). This represents a specificity and sensitivity of the GPs' diagnosis of 76% and 47%, respectively. A CE was found in only 50 of 134 patients (37%) included in the CE+ group by the GP, while one was also found in 56 of 322 patients (17%) in the CE- group. In the 106 hospitalized patients, the CE consisted of an acute coronary syndrome in 62 patients (58%) and of arrhythmia in 42 (40%). Two patients (2%) did not in fact subsequently prove to have a CE (as determined from the discharge files). Fig 4 shows the proportions of the different kinds of CE in these 104 hospitalized patients. In particular, of the 60 patients with acute coronary syndrome, 17 had

patients (8%) affected by an acute coronary syndrome unrecognized by a GP may have resulted in eight saved lives.

An interesting clinical finding in the present study was the high incidence of acute coronary syndromes with atypical symptoms: among 64 cases of acute coronary syndromes diagnosed, 10 patients (15%) did not have as the main symptom typical or atypical chest pain, but presented instead with dyspnoea (6 patients), palpitations (2) or dizziness/syncope (2). As previously reported^{17,18}, atypical presentations are frequent, especially in elderly patients, and are associated with higher mortality¹⁹, so the ECG remains the only way of making an accurate diagnosis.

Previous studies have suggested that telecardiology is useful for managing cardiac emergencies. However, there is little firm evidence for its cost-effectiveness. Our prospective study conducted on 456 consecutive symptomatic patients with a suspected acute CE demonstrated that telecardiology, used to support the decision-making process of a GP, reduced unnecessary hospitalizations and avoided the possibility of a CE remaining undiagnosed. Telecardiology may therefore be considered a safe and cost-saving tool, and may contribute to better medical interventions in primary cardiac care. This can be achieved only by active cooperation between GPs and cardiologists because the correct recording of the ECG and the clinical information provided by the GP are as important as the interpretation of the ECG and the evaluation of symptoms provided by the cardiologist.

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