Short Communication

Zahedan Journal of Research in Medical Sciences

Journal homepage: www.zjrms.ir

The Diagnostic Agreement of Original and Faxed Copies of Electrocardiograms

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Article information

Article history:
Received: 30 Oct 2011
Accepted: 10 Feb 2012
Available online: 28 Oct 2012
ZJRMS 2013; 15(2): 102-10

Keywords:
Telemedicine
Telecardiology
Tele-Electrocardiogram

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Abstract

***Background*:** General practitioners working in remote and rural areas sometimes need consultation with cardiologists. One practical and cost-effective way is transmission of patients' electrocardiographic images via ordinary fax machine to the cardiologists, but there is an important question that how much agreement exists between the diagnoses made by reading an original electrocardiogram and its copy transmitted via fax.

***Materials and Methods*:** In this cross-sectional study, 60 original electrocardiographic images were given to cardiologists for diagnosis. In the next step those electrocardiographic images were faxed to the hospital through a simple cheap fax machine, one month later the same cardiologist was asked to put his diagnosis on the copied versions of electrocardiographs, and the results were compared.

***Results*:** In 59 studied cases, the two method of diagnoses were exactly the same and only in one case the diagnoses were different. Therefore, Kappa agreement coefficient was calculated as 96%.

***Conclusion*:** According to the results of this study, general practitioners working in deprived areas can be certainly recommended to send patients' electrocardiographic images to the cardiologists via fax in the case of needing consultation.

Introduction

Every day a great number of patients refer to general practitioners in remote and rural areas due to different complaints related to cardiovascular diseases. Electrocardiogram (ECG) is one of the diagnostic tools in cardiovascular diseases and most general physicians working in rural areas have access to electrocardiograph device and use it frequently, but sometimes interpretation of electrocardiographic images is difficult and requires consultation with a specialist.

In many countries around the world, telemedicine is used to provide medical services for people living in deprived areas. For example, according to a 9-year study in Italy, approximately 27,000 medical teleconsultations had been performed [1]. In a structured review on telecardiology by Hailey et al (2005), positive results have been observed [2]. But implementation of a telecardiology system requires highly specialized communication technology and a broadband internet [2, 3].

It seems that instead of using advanced expensive systems for the transmission of electrocardiographic images, more cost-effective and practical systems can be used [3]. In Iran, most clinics are facilitated with electrocardiogram device, phone line and fax machine. Therefore, general practitioners working in these areas can record patients' electrocardiogram, divided it into pieces and stick them on an A paper, send it by fax to a specialist and get the result via phone call. The aim of this study was to find the agreement between diagnoses made by reading the original electrocardiographic images and the copied versions transmitted via fax.

Materials and Methods

This cross-sectional study was performed during the spring and summer of 2011. First, 60 original electrocardiographic images recorded from patients hospitalized in the Cardiology wards of two hospitals affiliated to Kerman University of Medical Sciences were collected. Sample volume was determined by a biostatistics specialist and electrocardiograms were randomly extracted from patients' files after obtaining the permission from wards chiefs. The electrocardiograms were previously cut into pieces, stuck on an A paper and put in patients' files by nurses. It should be mentioned that electrocardiographic images belonged to patients who had been under the control of different cardiologists.

The selected electrocardiographic images were given to a faculty member of Kerman University of Medical Sciences with cardiology subspecialty certificate and he was asked to put his diagnosis on each electrocardiogram and determine whether it is normal or not and whether any therapeutic intervention or referral is needed.

Then, the electrocardiograms were transmitted via an ordinary fax machine to the same ward in the hospital and

the faxed copies were collected. After 30 days, being insured that the cardiologist has forgotten the primary diagnoses, they were given to him to put his diagnosis again. Data were analyzed through SPSS-18 and using Kappa agreement test.

Results

Electrocardiograms belonged to 60 patients (3 males and 17 females) with mean age of 62±5 years. According to the obtained results, the diagnostic agreement of the original electrocardiograms and faxed copies was very high and approximately 96%. In fact, only in one case from 60 cases the two diagnoses were different and 59 ones had exactly the same diagnosis in the two trials (Table 1).

Table 1. Compared identify according to orginal ECG and faxed ECG to calculate kappa agreement coefficients

		The Fax ECG		
		Normal	Anormal	Total
Original ECG	Normal	38	1	39
	Abnormal	0	21	21
	Total	38	22	60

Kappa Agreement = 0.0964 p=0.0001

Discussion

Based on the results of this study, physicians working in the deprived areas and also health guardians of the society can be assured of transferring electrocardiograms via ordinary fax machines to specialists for consultation purposes as a practical measure. This is against the belief saying that using telemedicine for patients in deprived areas is expensive and not practical.

The present study aimed to answer whether general practitioners could be recommended to fax the electrocardiographic images to specialists for consultation purposes or not? In order to answer this question, first it was necessary to prove that the quality of electrocardiographic images faxed via ordinary inexpensive machines is as good to lead the specialist to the correct diagnosis; In other words, it was important to show that there is no significant difference between the quality of the original image and its faxed copy.

Thousands of physicians working in deprived areas should visit patients with cardiovascular diseases every day and sometimes these cases are very urgent and time has an essential role in saving these patients lives. According to the present study, by using a very simple practical and inexpensive way, a telecardiology system for cardiovascular consultation can be implemented. This system, provided that be supported by university and state centers, could play an essential role in improving the quality of health care services. There has been already no study about using fax for transmission of electrocardiographic images and only Bertazzoni et al in Italy have performed a study on transmission of ECG signals and receiving their copies. In the mentioned study, 0 centers that did not have any electrocardiologist or electrocardiology facilities were selected and facilitated with cardiophone and fax machine. They transmitted ECG signals and received their copies. From a total of 807 transmitted cases, 3% were normal and 57% were suspicious of urgent states. Among suspicious cases, in 25% the presence of one abnormality was confirmed [5]. In a study entitled *The telecardiology revolution* by Backman et al, telecardiology services project in north west of England was successful and telecardiology could fill the gap between primary and secondary cares [1].

Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

No conflict.

Funding/Support

Kerman University of Medical Sciences.

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Please cite this article as: Hajesmaeel-Gohari S, Hajimohammadhasani-Ravari M, Ghasemzadeh-Kahnooei M, Asadi F, Bahaadinbeigy K. The diagnostic agreement of original and faxed copies of electrocardiograms. Zahedan J Res Med Sci (ZJRMS) 2013; 15(2): 102-103.