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Development of ECG teletransmission in pre-hospital management of patients with acute coronary syndrome (ACS) – Polish experience

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РЕЗЮМЕ, ABSTRACT

Telemedical services in Poland are continuously developing, especially in interventional cardiology. ECG teletransmission has already been proved to be effective in the management of patients with acute coronary syndrome. In this article we review the Polish experience at the implementation of ECG teletransmission in this particular field and the development of necessary infrastructure. In Poland there are two major providers of 12-led ECG transmission capable defibrillators and receiving stations. Presently Poland reached satisfactory saturation of cath labs. The majority of territory is covered by one of two emergency ECG transmission systems which are still expanding. However, there are two obstacles for further development. The first one is lack of uniform standards of ECG transmission, which allows incompatibility of the two systems. The second one is lack on direct coverage of telemedical procedures from the National Health Fund. Therefore, to make emergency ECG transmission reimbursed, studies or registries proving its cost-effectiveness are still required (Ukr.z.telemed.med.telemat.-2010.-Vol.8,№1.-P.55-60).
Key words: telemedicine, acute coronary syndrome, ECG teletransmission, transportation of patients

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ВНЕДРЕНИЕ ТЕЛЕ-ЭКГ НА ЭТАПЕ ДОГОСПИТАЛЬНОЙ ПОМОЩИ ПАЦИЕНТАМ С ОСТРЫМ КОРОНАРНЫМ СИНДРОМОМ (ОКС) – ПОЛЬСКИЙ ОПЫТ
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Телемедицинские службы в Польше интенсивно развиваются, особенно в сфере интервенционной кардиологии. Теле-ЭКГ – уже доказанный метод в организации процесса лечения пациентов с острым коронарным синдромом. В Польше существуют два основных провайдера 12-канальных кардиографов, дефибрилляторов и приемных станций. Большинство территории страны покрыто данными сервисами, которые продолжают расширяться, однако есть два препятствия. Первое – недостаток формальных стандартов передачи ЭКГ и несовместимость двух систем. Второе – отсутствие прямого финансирования телемедицинских процедур из Национального фонда здоровья. По-прежнему требуют изучения экономические и организационные аспекты теле-ЭКГ (Укр.журнал телемедицины и мед.телематики.-2010.-Т.8,№1.-С.55-60).
Ключевые слова: телемедицина, острый коронарный синдром, теле-ЭКГ, транспортировка

M. Karlinska[1], M. Karliński[2], A Kosik[3], R. Rudowski[1]
ВПРОВАДЖЕННЯ ТЕЛЕ-ЕКГ НА ЕТАПІ ДОГОСПІТАЛЬНОЇ ДОПОМОГИ ПАЦІЄНТАМ З ГОСТРИМ КОРОНАРНИМ СИНДРОМОМ (ГКС) - ПОЛЬСЬКИЙ ДОСВІД
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Телемедичні служби в Польщі інтенсивно розвиваються, особливо в сфері інтервенційної кардіології. Теле-ЕКГ – уже доведений метод в організації процесу лікування пацієнтів з гострим коронарним синдромом. У Польщі існують два основних провайдери 12-канальних кардіографів, дефібриляторів і приймалних станцій. Більшість територій країни покрито даними сервісами, які продовжують розширюватися, однак є дві перешкоди. Перша - недолік формальних стандартів передачі ЕКГ і несумісність двох систем. Друга - відсутність прямого фінансування телемедичних процедур з Національного фонду здоров'я. Як і раніше вимагають вивчення економічні й організаційні аспекти теле-ЕКГ (Укр.журнал телемедицини та мед.телематики.-2010.-Т.8,№1.-С.55-60).
Ключові слова: телемедицина, гострий коронарний синдром, теле-ЕКГ, транспортування пацієнта

Telemedical services in Poland are continuously developing. However, the progress is relatively slow due to certain obstacles, regarding economic and formal issues, as well as

mentality of medical staff and decision makers. One of the most successful areas is telecardiology in patients suffering from acute coronary syndrome (ACS), i.e. unstable angina and myocardial infarction, that are qualified for interventional procedures.

Myocardial infarction remains one of the leading causes of death worldwide. It is estimated that annually more than 3 million people experience an acute ST-elevation myocardial infarction (STEMI), and more than 4 million have a non-ST-elevation myocardial infarction (NSTEMI). Therefore, in recent decades the management of these patients became one of the most important health challenges. International guidelines have been systematically published by the European Society of Cardiology (ESC), and American Heart Association and American College of Cardiology (AHA/ACC) since year 2000.

In ACS, especially STEMI, the first choice treatment is Percutaneous Coronary Intervention (PCI) with stent implantation. The delay between onset of symptoms and the procedure should be minimal, and the time from the first contact with medical staff to introduction of the catheter in cath lab should not exceed 90 min. It is advised, that to achieve optimal management of STEMI patients pre-hospital care and Intensive Cardiac Care Unit (ICCUs) should be organized in regional networks using a common protocol [1].

According to current guidelines, all emergency ambulances and helicopters should be equipped with 12-lead ECG recorders, which unfortunately is difficult to achieve in everyday practice. The recording of an ECG prior to hospital admission can greatly accelerate in-hospital management and increase the probability of successful reperfusion therapy. Therefore, ambulance staff should be able to record an ECG for diagnostic purposes and either interpret it or transmit it so that it can be reviewed by experienced staff in an ICCU or elsewhere [2].

Ambulances should be able to reach the great majority of chest pain patients within 15 min from the call, but subsequent chain of life depends on a swift and correct diagnosis. As mentioned before, the decision about direct transfer to a facility with cath lab should be based on symptoms and 12-lead ECG interpretation. However, not all ambulances have a trained physician on board, and the general trend is to minimize the number of physician-manned ambulances. Therefore, implementation of telemedical solutions seems to be the most obvious choice. After reaching the patient emergency team makes clinical assessment. If ACS is suspected, 12-ECG is performed and instantly transmitted to an experienced interventional cardiologist on duty. Integrated medical device does it automatically and guarantees security and reliability of the transmission. The cardiologist makes voice contact with the emergency team to ask additional questions if necessary. Then he makes a decision about patient's eligibility for PCI and helps with supervising transportation. Positive qualification for PCI results in direct transfer to a cath lab, without delays for confirmatory diagnosis at the Emergency Department of the nearest local hospital or even a hospital with a cath lab. Moreover, the cath lab team has enough time to cancel elective PCIs and prepare for the upcoming intervention Additional benefit is that the emergency team leader, if he is a physician, may develop own skills by confronting his ECG interpretation with the interpretation of a specialist [3,4].

Such approach means less involvement of local health care units in the acute phase, when every minute counts. It may be of special benefit in rural areas, but requires certain organizational changes in medical transport [5].

According to the guidelines, target delay times should nor exceed: 10 min for ECG transmission, 5 min for tele-consultation, 30 min for ambulance arrival to start fibrinolytic therapy, 120 min for ambulance arrival to first balloon inflation [6].

There is a lot of published evidence proving that ECG transmission facilitates decision making and shortens time-to-PCI, especially in those suspected of STEMI, and therefore allows more effective implementation of international guidelines [7-12]. For example, Sejersten et al. report that out of 168 patients qualified with telemedicine, which posed 30% of all admitted patients, 87% underwent instant PCI. When compared to historical control, mean call-to-PCI time was significantly shorter (74 vs 127 min), and so was door-to-PCI time (34 vs 97 min) [8].

However, only some of the studies consider hard end points (e.g. mortality). A work by Zanini et al. involving a group of 399 patients submitted to PCI (263 qualified conventionally and 136 with the use of telemedicine) shows a significant difference in overall mortality, 8.7% and 3.0% respectively. Qualification with ECG transmission proved to be a protective factor even if adjusted for age, severity of heart failure (Killip class), coronary blood flow prior to inter-

vention (TIMI score) and time from onset to PCI [13]. Ortolani et al. report that patients qualified with ECG transmission less frequently developed heart failure with EF≤35% (29% vs 54%, respectively), showed a 68% decrease in in-hospital mortality (9,2% vs 36,5%; OR 0,32, 95%CI: 0,14-0,77), and more importantly higher annual survival rate (74% vs 52%) [11]. Therefore, clinical effectiveness of emergency ECG transmission may be considered evidence based.

Our aim was to review the Polish experience at the implementation of ECG teletransmission in pre-hospital management of patients with acute coronary syndrome and the development cath lab network.

Material and methods

We reviewed available literature from indexed and non indexed Polish journals related to cardiology. Due to the fact, that the number of papers on the topic of ECG transmission in Poland is scarce and to obtain the most recent data, we decided to rely also on on-line reports, conference materials and information supplied by the device manufacturers (Medtronic, ZOLL). Additional information was derived from a questionnaire based study performed by one of the authors (Karlinska). It addressed the issue of information infrastructure and level of implementation of telemedecial solutions in Polish local hospitals, including availability of ambulances capable of data transfer and use of ECG transmission. Study methods and results were described in details elsewhere [14-17]. Responses from 144 of 348 health care units were obtained in July 2006.

Intensive Cardiac Care Units and cath labs in Poland

According to the most recent data in Poland (population 38.1 mln, 122 citizens/km^2) at the end of 2008 there were 109 cath labs with 134 angiographs, and mean number of 10 intensive care beds. Ninety two of them were working on a 24-hour basis, including 67 labs operating 24/7. It gives the satisfactory mean saturation of 2.41 labs per 1 million citizens. However, until the late 90' there were only approximately 30 labs, performing 20 fold less procedures than presently (e.g. 131/mln in 1996). Noteworthy, the distribution of cath labs is not equal and depending on a region varies from 1.5 to 3 labs per million citizens [18,19].

In 2008 there were in total 90 238 PCIs (80% with stent implantation), which gives the ratio of 2 350 per million citizens. Almost half of them (49.2%) were performed in acute myocardial infarction. The exact number of reported PCIs in ACS was 56 998 (including 27 272 primary angioplasty in STEMI and 17 082 in NSTEMI patients) [20]. The constant increase of PCI number in past decade is presented is presented below [Fig 1].

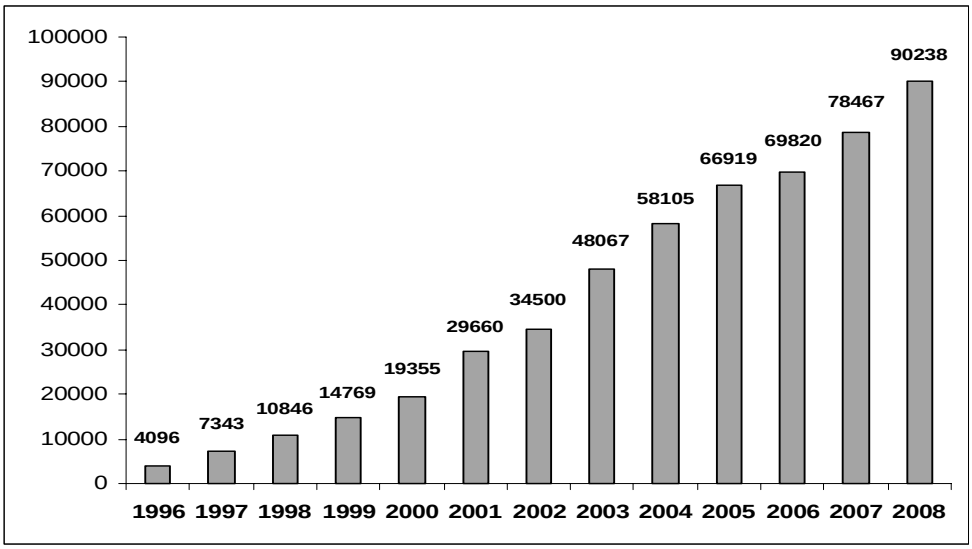

Figure 1. Percutaneous coronary interventions in Poland 1996-2008 [20]

ECG teletransmission in Poland

Equipment for ECG transmission is provided in Poland by 4 different manufacturers. All the devices operate on a similar basis, but they are not compatible with each other.

According to data from the study performed by one of the authors (Karlinska) in 2006 at least one emergency ambulance capable of ECG transmission was available in only 15,9% of local hospitals. In Mazovia Voivodship, where information was collected from 97% of local

hospitals, there were 7 such ambulances, but only 4 of them actually performed ECG transmission. Fortunately, since 2006 Polish interventional telecardiology has made a substantial progress. It should be at least partially attributed to National Cardiovascular Disease Prevention and Treatment Program (POLKARD), which was launched in 2003. Among its objectives there were:

- Bringing up the equipment availability in cardiology, cardiac surgery and neurology centers and access to health care procedures in the area of cardiovascular diseases to a level matching average rates for Europe
- Supporting intensive development of new diagnostic and therapeutic methods

One of the manufactures of the emergency ECG transmission equipment is Medtronic. Provided by the company LifePak defibrillators (~10 500 euro) and receiving stations (~12 500 euro + 90 euro/year) are organized in Lifenet network. Data is stored in pdf format and the transfer takes approximately 1.5 min. Based on a 12-lead ECG an interventional cardiologist from the reference unit decides about the PCI and designates a particular cath lab to perform the procedure [21]. Consultations are most frequently requested by the emergency ambulances, but also by Emergency Departments and General Practitioners. The system was introduced in 2005. Initially it involved 30 defibrillators, but developed very dynamically. Their number increased to 264 in 2006, 360 in 2007, 447 in 2008 [Fig 2]. According to the company, at the end of 2009 there were 573 active LifePak defibrillators and 48 receiving stations [Fig 3]. Approximately 50% of ECG transmissions results in PCI.

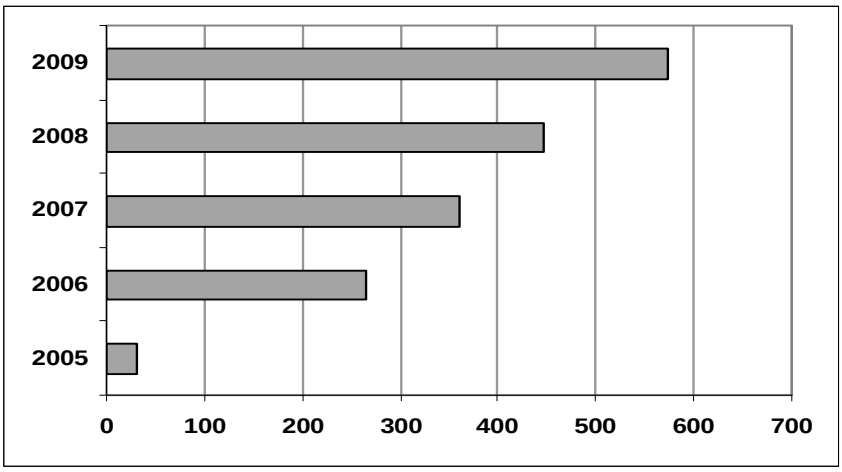

Figure 2. Total number of active LifePak-12 defibrillators in years 2005 - 2009

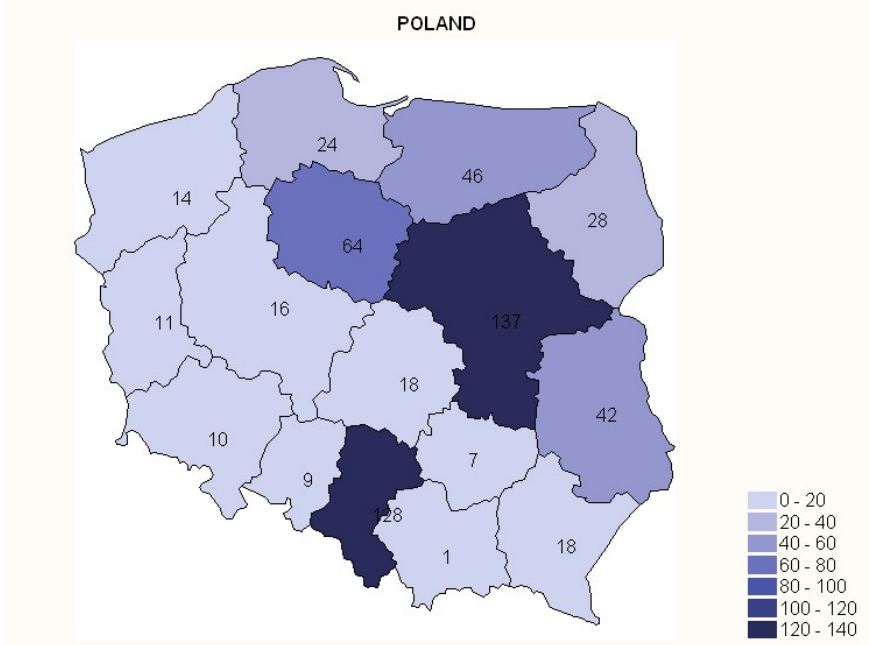

Figure 3. Number of active LifePak-12 defibrillators in year 2009 by voivodships

ZOLL Data Relay System (ZDRS) enables GSM based transmission from M Series and E Series ZOLL defibrillators (cost of 10 000 to 11 250 euro) to one of 12 stations (3 750 to 5 000 euro + 500 to 750 euro/year) situated in 7 Voivodships. The information is stored in pdf format. It is also possible to redirect the data to predefined e-mail account or fax number.

In 2008 the company ASPEL introduced a telemedical platform called AsCOMMTEL, which also enables ECG transmission. There is no reliable data about the number of functioning devices and area covered by the system. Therefore, it may be assumed that the participation of this system in overall market is marginal.

A device capable of real time ECG transmission (PP05v12 electrocardiograph) is manufactured by PRO-PLUS. However, there are no reports about its implementation in emergency ambulances.

ECG transmission in Mazovia

In Mazovia Voivodship (population 5.2 mln, 35 600 km^2, 146 citizens/km^2) at the end of 2008 there were 121 emergency ambulances and 20 Emergency Departments, and 15 cath labs, 8 of them in Warsaw. There were in total 13 385 PCIs due to ACS (3670 in STEMI and 4209 in NSTEMI patients). Almost every cath lab operates 24/7, which enables achieving recommended time limits for the patient transfer in the whole region. Every cath lab is also equipped with a receiving station for emergency ECG transmission [22]. According to Medtronic virtually all Mazovia citizens are covered by Lifenet system composed of 137 active LifePak defibrillators. The total number of ECG transmissions from the moment of introducing Lifenet in Mazovia exceeded 8 000.

Conclusions

In patients with ACS emergency ECG teletransmission to an interventional cardiologist facilitates decision making, helps with organizing pre-hospital and in-hospital care, as well as results in significant shortening of time from first call to PCI, and improving patient's outcome. In recent year Polish cath lab network and emergency ECG teletransmission have been dynamically developing and catching up with Western European standards.

However, it is still suboptimal and needs further improvement, which may be slowed down by both technical and economic issues. The first one is lack of uniform standard of data transmission, which allows incompatibility of devices form different manufacturers. The other is lack of direct funding for the teleconsultation system. In the year 2010 the National Health Fund does not intend to cover telemedical services in cardiology. As a major reason the Fund states insufficient evidence on cost-effectiveness of such procedures and inability to compare it with conventional consultation received by a patient from a health professional. Therefore, well designed studies or registries are needed to derive evidence from what seems logical.

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