

## Diagnostic problems of acute coronary syndrome in ambulance service.



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### ABSTRACT

**INTRODUCTION:** Acute coronary syndromes are one of the leading causes of death due to cardiovascular diseases. The diagnosis is made on the basis of the clinical picture, ECG record and laboratory tests. Diagnosis of critical myocardial ischemia in pre-hospital conditions is a challenge for emergency medical teams.

**MATERIAL AND METHODS:** In order to determine the level of knowledge and the ability to recognize and deal with patients with acute coronary syndrome tests were carried out among fifty employees of the emergency medical service (doctors, nurses and paramedics) in the region of central Poland. Statistical analysis was carried out using the normality test of the Shapiro-Wilk distribution and non-parametric chi-square test of independence. The results were considered significant at the level  $p < 0,05$ .

**RESULTS:** In the field of diagnostics, doctors obtained the result of 73.20% (SD  $\pm$  32.23), paramedics: 52.00% (SD  $\pm$  24.51), and nurses: 30.00% (SD  $\pm$  13.75). Correct treatment was best implemented by paramedics who obtained an average of 51.11% (SD  $\pm$  34.98). In turn, doctors gave 49.33% (SD  $\pm$  39.05) correct answers, and nurses 43.22% (SD  $\pm$  34.17). There was no statistical dependence of the test results on the profession ( $\chi^2 = 1.13$ ;  $p > 0.05$ ), nor being the head of the emergency medical team ( $\chi^2 = 0,43$ ;  $p > 0,05$ ).

**CONCLUSIONS:** The level of preparation of ambulance service personnel in the field of identifying and dealing with patients with suspected acute coronary syndrome is insufficient. Further research is indicated indicating the greatest substantive deficiencies of emergency doctors, paramedics and emergency nurses to implement the necessary professional development.

**KEY WORDS:** myocardial infarction, emergency medical service, ECG, diagnostics, treatment.

## INTRODUCTION

Cardiovascular diseases are the main cause of mortality in Poland, accounting for almost half of sudden deaths [1]. Coronary heart disease is defined as a condition of insufficient blood supply to the myocardium regardless of the pathomechanism that caused it [2]. One of the causes is coronary heart disease described as a set of pathologies occurring as a result of changes localized in the coronary arteries. It includes stable and acute coronary syndromes (ACS), among which, based on ECG recording, we distinguish: ACS with elevation of the ST segment (STEMI – ST elevation myocardial infarction) or ACS without elevation of the ST segment (NSTEMI – non-ST elevation myocardial infarction).

Polish nationwide Registry of Acute Coronary Syndromes PL-ACS POLKARD run by the Silesian Center for Heart Diseases in Zabrze is the largest ACS registry in Europe. It presents the results of research covering the period from 2006 to 2008 conducted on a group of over 14,000 hospitalized patients due to ACS in 106 centers [3]. Among them, 42.2% were diagnoses of unstable coronary heart disease, 31.2% STEMI and 26.6% NSTEMI. Independent risk factors for death in patients with conservative treatment were age, confirmed cardiogenic shock, chronic obstructive pulmonary disease and diagnosed STEMI infarction. [4].

The main complaint reported by 80% of patients with ACS is severe pain located in the chest. The precise indication of the place of pain by the patient is sometimes difficult and is reported to a retrosternal pain or in left part of the chest [5]. It often radiates to the lower jaw, neck, left shoulder and arm and to the wrist and fingers along the radial nerve. In addition, the infarction of the lower wall may cause similar ailments in the area of the upper abdomen with simultaneous nausea and vomiting. The pain in ACS is choking, squeezing or stinging, occasionally imitating pleural. It happens that instead of it there are equivalents - masks, i.e. dyspnea, abdominal pain, fatigue, nausea. It can be caused by physical exertion, exposure on cold, a hearty meal, emotional stress.

The ECG picture of myocardial infarction is dynamic, changes with the advance change. The first recorded deviation relates to the T wave, which is inverted. In the second place, elevation of the ST segment appears. It can take the form of Parde's wave or run horizontally. The acute phase of infarction

ends with the appearance of a Q wave. On the basis of leads in which characteristic features of the infarction appear, one can estimate which heart structures it affects, as shown in Table 2. [6]

**Table 1.** Location of heart ischemic changes on the basis of selected ECG leads

ECG lead	Location of changes
V <sub>1</sub> , V <sub>2</sub> , V <sub>3</sub> , V <sub>4</sub>	The front wall, intraventricular septum, heart apex
I, aVL, V <sub>5</sub> , V <sub>6</sub>	Lateral wall, heart apex
II, III, aVF	Lower wall
V <sub>1</sub> , V <sub>2</sub> , V <sub>3</sub> , V <sub>7</sub> , V <sub>8</sub> , V <sub>9</sub>	Back wall
V <sub>3R</sub> , V <sub>4R</sub>	Right ventricle

We diagnose a fresh myocardial infarction based on the clinical picture and the concentration of biomarkers, in particular, cardiac troponins, if at least one of their values exceeds 99 percentile of the reference interval [7]. At the same time, there must be at least one evidence for heart ischemia. It belongs to them:

- Symptoms characteristic of myocardial ischemia
- Changes in ECG indicating about new ischemia (changes in ST - T or newly recognized left bundle branch block) and pathological Q waves
- Changes in imaging studies in favor of a new loss of myocardial viability or impairment of cardiac wall movements.

Chest pain is not always a sign of ACS. Different causes should be considered in differential diagnosis. These include pericarditis, aortic aneurysm, embolism or pulmonary hypertension [8]. Also important are non-cardiac causes, i.e. oesophagitis, pathologies related to the musculoskeletal system, mediastinum diseases and pleural diseases, neuralgia and radiation of pain from the spine and organs located in the abdominal cavity.

In pre-hospital conditions, ACS diagnosis is limited, and the initial diagnosis is based mainly on the symptoms reported by the patient [9]. In the physical examination deviations from the norm may be absent. In the first place, an ECG test with twelve leads should be performed or, if there are indications, using

additional right-ventricle electrodes. The interpretation of ECG belongs to the head of the emergency medical service (EMS), who in Poland may be a doctor, paramedic or nurse. There is scientific evidence of the efficacy of diagnosing ischemic lesions in ECG by the average staff [10]. However, if it has not been properly trained in the interpretation of the ECG record, it is possible to make an incorrect diagnosis. The EMS staff uses teletransmission of ECG records from the ambulance level to the cardiologist on duty. This is to select patients who need immediate PCI (percutaneous coronary intervention). However, it is not always possible to consult with a specialist (eg due to technical problems), therefore emergency rescue personnel should demonstrate a high level of knowledge and ability to recognize and manage ACS.

The aim of the study is to assess the ability to diagnose and pre-hospital treatment in the case of acute coronary syndrome among employees of emergency medical service (emergency doctors, emergency nurses & paramedics).

## **MATERIAL AND METHODS**

The research was conducted among fifty employees of the EMS staff (doctors, nurses and paramedics) in the region of central Poland. The research method was a diagnostic survey conducted in March 2017. The tool was an authorial questionnaire containing some of the sociodemographic questions and substantive questions (ECG records, teletransmission, patient status descriptions, pharmacological procedures). Statistical analysis was performed using the normality test of the Shapiro-Wilk distribution and the non-parametric chi-square independence test (significance level for  $p < 0.05$ ).

## **RESULTS**

### **Characteristics of the test group**

A total of 50 employees of the EMS participated in the study, including 20 women and 30 men. They were representatives of three professional groups: doctors ( $n = 9$ ), nurses ( $n = 6$ ) and paramedics ( $n = 35$ ). Over half of the study participants ( $n = 31$ ) have been working in emergency medical teams for more than 5 years, including nearly 30% - more than 10 years. Most doctors (90%), nurses (51%) and paramedics

(54%) at least once take medical interventions in a patient with ACS. Most of the respondents, as many as 64% (n = 32) were people with work experience between 5 and 10 years. Almost 30% of paramedics and nurses are the head of the basic EMT.

### **Assessment of knowledge and skills of ECG interpretation**

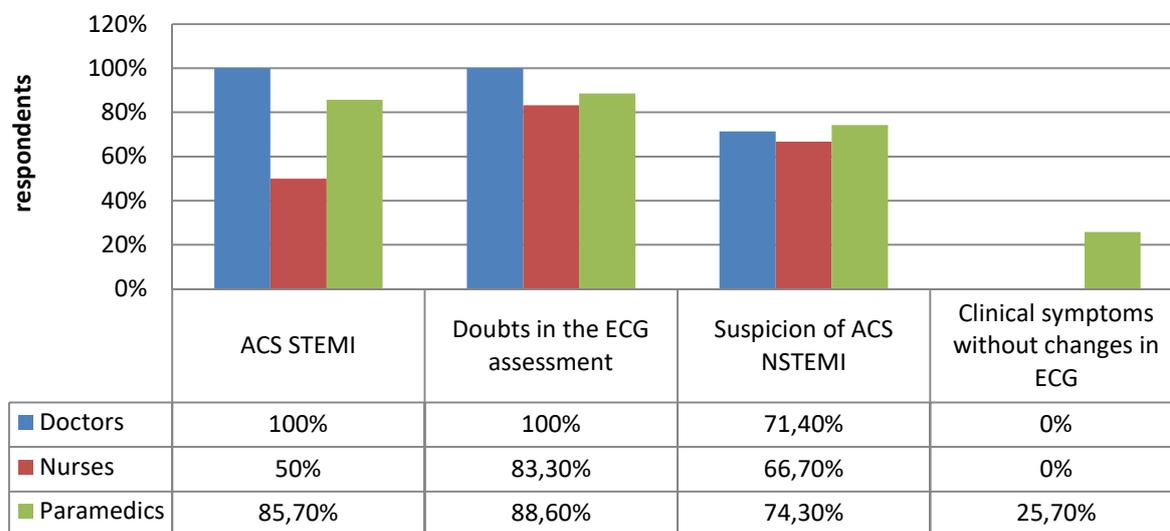
The average results for individual professional groups in the part of the test on diagnostic skills of ACS are clearly differentiated and amount to: doctors 73.20% (SD  $\pm$  32.23), paramedics 52.00% (SD  $\pm$  24.51), nurses 30,00% (SD  $\pm$  13.75). The characteristics of predisposing factors for coronary pain were unmistakably determined by all doctors (100%), but only 60% of paramedics and 33% of nurses. Correct knowledge of the topography of the ischemic area of the myocardium on the basis of individual ECG leads was demonstrated by the majority of doctors (89%). Lower results were obtained by paramedics (60%) and nurses (17%).

The correct diagnosis of ACS STEMI of the lateral wall on the basis of the attached ECG record has placed 9% of paramedics, 33% of doctors and 50% of nurses. In the interpretation of ACS STEMI, the lower wall of the myocardium turned out to be the best in diagnosis were paramedics (71% of correct answers). Physicians (44%) and nurses (33%) had worse results.

The last question from the group of diagnostic problems was unmistakably solved by all doctors (100%). Bigger problems with the interpretation of the surviving ST segment in the V2-V4 leads encountered paramedics (60% of correct answers), and the correct solution was indicated by only 17% of nurses.

### **ECG teletransmission in EMS**

One in three persons admitted that they were carrying out ECG teletransmission when ST segment elevation was diagnosed and in case of doubt about the characteristics of ACS (especially NSTEMI). Paramedics are the only ones who take advantage of this possibility when they find clinical symptoms of a heart attack in the absence of changes in the electrocardiogram (Figure 1).



**Figure 2.**The use of ECG teletransmission in EMS.

### Proceedings at the scene of the incident

The results of the part of the test referring to the treatment of ACS showed the highest efficiency among paramedics who obtained an average 51,11% (SD ± 34,98). In turn, doctors gave 49.33% (SD ± 39.05) correct answers, and nurses 43,22% (SD ± 34,17).

### Analysis of the level of knowledge depending on the profession

Due to the rejection of the hypothesis about the normality of the distribution of variables in the studied groups (Shapiro-Wilk test), the comparison of the results of the substantive test was made with the nonparametric chi-square test. No respondents received a maximum score of 14 points. The independence test for the average results of particular occupational groups was  $\chi^2 = 1,13$  ( $p > 0,05$ ).

### **Analysis of the level of knowledge depending on the function of the manager of EMT**

The average score of participants in questions including knowledge necessary to recognize acute coronary syndrome in pre-hospital conditions was 46.33% (SD  $\pm$  21.88), while in the case of dealing with the patient during ACS was 47.89% (SD  $\pm$  32,32). Analyzing between the level of knowledge and performing the function of the manager of EMS, there was no statistically significant correlation between the variables indicated ( $\chi^2= 0,43$ ;  $p>0,05$ ).

## **DISCUSSION**

Acute coronary syndrome often leads to life-threatening conditions and requires fast diagnosis, on-site proceeding and invasive cardiac intervention. Obtained results indicate that for a large part of the personnel of ambulanceservice this task is difficult. Diagnostic errors occur in particular among nursing representatives. A similar study was conducted in 2013 in Kielce among EMS Świętokrzyskie Medical Rescue Center and Sanitary Transport [11].The authors also noted irregularities in the description of symptomatology and pre-hospital treatment among emergency nurses and paramedics.

Even the right diagnosis is not a guarantee of proper conduct. The analysis of the literature shows that the most common mistakes made in pre-hospital care should be transported to the hospital located in the smallest distance without considering whether the selected unit has the possibility to perform PCI. This results in a waste of time of an average of 60 minutes [10].For this reason, the Main Board of the Polish Cardiac Society and National Specialist Supervision has taken a position in which it grants the EMS manager the right to change the target place of transport from the nearest hospital to the unit where PCI is possible, even if it results in a longer journey time. It is also indicated that there is a delay in the implementation of hospital treatment due to the expectation of staff to receive laboratory tests (troponins) or cardiological consultation.

In the study group, the level of knowledge about the diagnosis of ACS and hospital procedures did not allow to answer most questions. This indicates a significant shortage in the education of emergency ambulance staff.

There are no significant differences in the management of patients with ACS between physicians, nurses and paramedics. The dependency test for the average results of particular occupational groups was  $\chi^2 = 1.13$  (for significance at  $p < 0.05$ ). Analyzing between the level of knowledge and performing the function of the manager of EMS, the statistically significant dependence of the indicated variables was also not shown ( $\chi^2 = 0,43$ ). This means that the knowledge about the recognition and management of ACS is not dependent on taking on the position of the EMS manager.

### **Limitations of the research**

The conducted study is characterized by a not very large research group. At the same time, the number of representatives of individual medical professions is not the same, which significantly hampers a reliable comparison between employees representing various professional groups.

## **CONCLUSIONS**

The knowledge of EMS employees seems to be insufficient. Lack of theoretical knowledge and the ability to interpret ECG records may translate into lower effectiveness when providing medical help to patients with ACS. Further research is recommended to determine the real scale of the problem of preparing medical emergency teams to provide health services to patients with suspected acute coronary syndrome.

### **Disclosure statement**

No potential conflict of interest was reported by the author's.

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