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The analysis of standard pharmacotherapy by emergency medical services (the so-called MONA scheme) in myocardial infarction with ST-segment elevation

Analiza standardowej farmakoterapii (tzw. schemat MONA) przez zespoły ratownictwa medycznego w zawale serca z uniesieniem odcinka ST

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Abstract

Introduction. Myocardial infarction is a directly life-threatening condition, which is the most frequent consequence of diseases and deaths in highly developed countries. In Poland there are almost hundred thousand of myocardial infarction cases each year and the morbidity increases. The issue of a huge number of myocardial infarctions is meaningful in many countries all over the world. About 30% of all the myocardial infarctions are the ones with ST-segment elevation (ACS STEMI). The purpose of this paper is to analyse how the pre-hospital care has used a standard pharmacological treatment (the so-called MONA scheme) in the area of Szczecin. This medical care was performed by Emergency Medical Service in case of patients who have ACS STEMI, were hospitalised in Pomeranian Medical University's (PMU's) Department of Cardiology, survived this period and were discharged from hospital.

Material and methods. Data apply to 603 (68 died, 535 survived) patients, who had acute coronary syndrome (ACS) with ST-segment elevation (STEMI) and were referred to the Department of Cardiology in PMU Clinical Hospital No 2 in Szczecin. It concerns all the patients who were treated during cardiological accident and emergency in years 2009–2011. Patients who died were excluded from the study.

Results. In the analysed group of patients, morphine was administered to 402 patients (75.5%), oxygen was administered to 515 patients (96.8%), nitroglycerine was administered to 393 patients (74.0%) and acetylsalicylic acid was administered to 493 patients (92.5%), after taking into account the primary transport (taking patients directly to the Department of Cardiology) and the secondary transport.
Morphine administration has increased over the years ($p = 0.0028$). In particular years it varied as follows: in 2009 — 67%; in 2010 — 79%; in 2011 — 81%. Oxygen supply has increased as follows: in 2009 — 92%; in 2010 — 98.7%; VII–XII 2011 — 100% ($p = 0.00008$). The supply of nitroglycerine has decreased: in 2009 — 38%; in 2010 — 17.2%; in 2011 — 24.4% ($p = 0.00001$).

Conclusions. 1. Realisation of MONA scheme in case of ACS STEMI is frequent, regardless of the kind of intervening paramedics team. 2. The supply of medication from MONA scheme, with the exception of nitroglycerine, is not satisfactory for patients with ACS STEMI. 3. In case of inferior wall myocardial infarction diagnosis or in case of uncertainty about the myocardial infarction's placement, paramedics team should resign from nitroglycerine administration during pre-hospital phase. 4. ECG teletransmission performance in ACS STEMI should be a standard procedure in case of patients with sudden pain in the chest, suggesting recent myocardial infarction, and regardless of a presence of a doctor in a paramedics team.

Key words: STEMI, pharmacotherapy, MONA scheme, pre-hospital care

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Introduction

Myocardial infarction is a directly life-threatening condition, which is the most frequent consequence of diseases and deaths in highly developed countries. In Poland there are almost one hundred thousand of myocardial infarction cases each year and the morbidity increases. The issue of a huge number of myocardial infarctions is meaningful in many countries all over the world. About 30% of all the myocardial infarctions are the ones with ST-segment elevation (ACS STEMI). It is estimated, that the prevalence of myocardial infarction will double in years 1990–2030 [1].

The development of Emergency Medical Services and its eligibility connected with pharmacotherapy resulted in the same pattern of management in case of ACS STEMI for every EMS team ('S' — specialised and 'P' — standard). Most of rescue teams in Europe and all over the world have technical possibility to make teletransmissions and are also able to make medical consultations with a specialist from an Interventional Cardiology Centre due to the team's appropriate equipment and implementation of ECG transmission system. In case of myocardial infarction, the dispatcher should give an order to a specialised 'S' team with a specialist, due to the fact that it is a directly life-threatening condition, which can effect in serious cardiac disorders, including cardiac arrest. The intervention can be performed by a standard 'P' team consisting of paramedics (which is the only kind of Emergency Medical Service in some countries) when patient's medical history is not explicit or if the dispatcher cannot send the specialised 'S' team to the patient.

The purpose of this paper is to analyse how the pre-hospital care has used a standard pharmacological treatment (the so-called MONA scheme) in the area of Szczecin. This medical care was performed by Emergency Medical Service in case of patients who have Acute Coronary Syndrome with ST-segment elevation myocardial infarction, were hospitalised in Pomeranian Medical University's (PMU's) Department of Cardiology, survived this period and were discharged from hospital.

Material and methods

Data apply to 603 patients, who had acute coronary syndrome (ACS) with ST-segment elevation (STEMI) and were referred to the Department of Cardiology in PMU Clinical Hospital No 2 in Szczecin. It concerns all the patients who were treated during cardiological accident and emergency in years 2009, 2010, 2011. Patients who died were excluded from the study.

I have analysed the documentation concerning the paramedics intervention with regard to primary transport (first patient transport from the pre-hospital scene directly to the Department of Cardiology) and secondary transport (inter-hospital transport between two hospitals — to another Emergency Department or The Hospital Emergency Ward without the possibility of making PCI and then to the Department of Cardiology) in terms of psychical examination and standard pharmacological management undertaken by medical services in case of ACS STEMI, the so-called MONA scheme (morphine, oxygen, nitroglycerine and acetylsalicylic acid [ASA]). Furthermore, the in-hospital records were also analysed.

Results

The average age of the patients from the analysed group was about 63.4 years (the youngest patient was 31-year-old and the oldest patient was 91-year-old, standard deviation [SD] 11,4). The group consisted of 173 (32.5%) female patients and 362 (67.5%) male patients. The average age of women was about 67.4 years and in case of men it was 61.6 years. On average, women were six years older than men ($p = 0.00001$).

Emergency Medical Service intervened 220 times throughout the analysed period by performing the primary transport (the direct one) to the Department of Cardiology. During the intervention, in 97 cases (44.1%) the standard 'P' ambulances were used (in 2009 — 28 times, in 2010 — 41, in 2011 — 28 times), while in 123 cases (55.9%) the specialised 'S' ambulances were used (in 2009 — 33 times, in 2010 — 59, in 2011 — 31 times) (Table 1).

Medical documentation analysis has shown that administration of medication based on the so-called MONA scheme for patients with ACS was done with a similar frequency, regardless of the kind of paramedics team.

In the analysed group of patients, morphine was administered to 402 patients (75.5%), oxygen was administered to 515 patients (96.8%), nitroglycerine was administered to 393 patients (74.0%) and ASA was administered to

Table 1. Primary and secondary transport of patients to the Department of Cardiology with the aim of interventional treatment

The observed variable	The amount	Percentage [%]
The requested services and transport	535	100
EM transport/reported in person	315	58.9
EMS	220	41.1 (100.0)
'P' ambulance	97	18.1 (44.1)
'S' ambulance	123	23.0 (55.9)

EM — Emergency Department; EMS — Emergency Medical Service ('S' and 'P' teams altogether); 'P' ambulance — the standard one with two paramedics; 'S' ambulance — specialised ambulance with a doctor

Table 2. Types of medication used by paramedics and in Emergency Departments of hospitals, which take part in transferring patients with a need of interventional treatment

Medication	The amount	%/change/p
Morphine	402	75.5 ↑ (0.0028)
Oxygen therapy	515	96.8 ↑ (0.00008)
ASA	493	92.5 ↔
Nitroglycerine	393	74.0 ↓ (0.00001)

ASA — acetylsalicylic acid

493 patients (92.5%), after taking into account the primary transport (taking patients directly to the Department of Cardiology) and the secondary transport.

Morphine administration has increased over the years (p = 0.0028). In particular years it varied as follows: in 2009 — 67%; in 2010 — 79%; in 2011 — 81%. Oxygen supply has increased as follows: in 2009 — 92%; in 2010 — 98.7%; VII–XII 2011 — 100% (p = 0.00008). The supply of nitroglycerine has decreased: in 2009 — 38%; in 2010 — 17.2%; in 2011 — 24.4% (p = 0.00001) (Table 2).

Discussion

Emergency Medical Services are very important in the treatment of a patient during pre-hospital stage. During this phase, the biggest time delays are noted (including the patient's reaction). It happens repeatedly, that preliminary steps taken by paramedics have a big impact not only on the patient's survival, but also on the effects of his treatment, which will be undertaken later.

According to the analysed medical documentation, 603 patients were transferred to the Department of Cardiology with ACS STEMI diagnosis. Five hundred and thirty-five patients survived myocardial infarction, while 68 died — respectively 88.7% and 11.3%. The numbers of deaths are running from 6 to 14% in in-hospital mortality interval observed in the countries which are members of ESC and are holding the registers [2]. The average age of the patients from the analysed group was around 63.4 ± ± 11.4 years, which is similar to PL — ACS register, where the average age is around 63,5 ± 12.2 years [3].

The observed period was characterised by a slight upward trend in the number of occurring ACS STEMI. This trend in the territory of Szczecin agglomeration needs to be explained in comparison with the trend included in ESC guidelines, in which the number of ACS STEMI was lower in years 1997–2005 (121–77) in the European scale [4].

Possibly it happens due to the free Emergency Medical Services system in Poland — even in cases of the so-called unjustified call-outs. Consequently, patients do not have to bear additional financial consequences. It is therefore possible that it is the result why they notify the Emergency Medical Services system faster in cases of distressing symptoms. It is worth pointing out, that in some of the European Union countries you have to pay for emergency ambulance service intervention in each case, regardless of having an insurance or not.

While analysing the prevalence of MONA scheme implementation in ACS STEMI treatment, it was observed that management equally concerned the specialised teams (with a doctor) and the standard teams (only paramedics). Not all of the patients were taking all medications from the scheme. The most used one was oxygen and the least used was nitroglycerine. The use of oxygen and morphine has increased in the particular years. The administration of acetylsalicylic acid (ASA) in case of ACS has reached 92.5%. The frequency of medication use in other countries was similar, *e.g.* Czech Republic 95.0% [5] and The United Kingdom 85.0% [6].

The issue of nitroglycerine use in ACS STEMI

The frequency of medication use was similar, except nitroglycerine, in relation to all the analysed group (however, the results are not satisfactory). This medication was administered almost three times more in the secondary transport than in the primary transport. It seems that those situations may be caused by the following factors. Nitroglycerine has several contradictions, which exclude its application and may be relevant to patients with myocardial infarction. Ten per cent of the patients from the analysed group was diagnosed with hypotonia, which should be taken into consideration. A separate problem is inferior wall myocardial infarction. Due to the fact, that this kind of myocardial infarction is followed by right ventricular myocardial infarction (RV), the application of nitroglycerine increases left ventricular's failure. In RV myocardial infarction you cannot administer nitroglycerine [7]. It is worth noting, that inferior wall myocardial infarction (classical changes in ECG leads — II, III and aVF) represents almost a half of all of the myocardial infarctions, while inferior wall myocardial infarction is followed by right ventricular myocardial infarction. Right-sided ECG should be performed in order to diagnose right ventricular myocardial infarction after diagnosing inferior wall myocardial infarction. Changes in V3R and V4R correspond to the occurring disease. In this context, it should be mentioned that those ECG changes continue to exist relatively short. In Kumar et al.'s examination, 59% patients with inferior wall myocardial infarction were diagnosed with RV myocardial infarction [8]. In their own examinations, 60.1% of cases were connected with inferior myocardial infarction (infarct-related artery — 43.7% RCA and 16.4% Cx). Serbian examinations have shown the following results: 31.0% RCA and 15.5% Cx [9]. In case of right ventricular myocardial infarction, nitroglycerine

administration may result in deterioration of the heart's haemodynamics and, in consequence, in deterioration of patient's condition. Perhaps less frequent nitroglycerine administration in the primary transport was caused by a failure to perform teletransmission and/or the correct interpretation of ECG recordings and defining the placement of myocardial infarction. It is possible, that Emergency Medical Services team did not administer nitroglycerine to the point, where myocardial infarction's placement was defined by a doctor in Emergency Department. Such situation would be an explanation of the increased prevalence of medication administration in the secondary transport. However, this condition is not a good explanation of this huge divergence.

During the analysis of patient's condition, it is recommended to consider nitroglycerine administration in case of ACS STEMI with particular focus on inferior wall myocardial infarction, which may occur. Due to the fact, that paramedics team may have problems with the placement of myocardial infarction, it is recommended to consider performing the ECG teletransmission as a mandatory procedure in pre-hospital system, regardless of the kind of the intervening team. It is worth noticing that just the act of performing teletransmission does not affect the time of medical rescue procedure, and the time that it takes ranges from two to three minutes. The studies which were carried out on ECG teletransmission in various countries have shown, that duration of medical interventions during pre-hospital stage, as well as during highly specialised phase, has decreased [10, 11]. Therefore, in case of a myocardial infarction diagnosis or confirmation, it is recommended to resign from nitroglycerine administration as a standard treatment and also the realisation of the MONA scheme. The possibility of excluding right ventricular myocardial infarction may occur only after performing 12-lead right-sided ECG, which seems not to be a right kind of management and also may cause delay during pre-hospital phase. It is worth noting, that Polish paramedics do not learn about such diagnostic examination during their course of study.

Conclusions

1. Realisation of MONA scheme in case of ACS STEMI is frequent, regardless of the kind of intervening paramedics team. 2. The supply of medication from MONA scheme, with the exception of nitroglycerine, is not satisfactory for patients with ACS STEMI. 3. In case of inferior wall myocardial infarction diagnosis or in case of uncertainty about the myocardial infarction's placement, paramedics team should resign from nitroglycerine administration during pre-hospital phase. 4. ECG teletransmission performance in ACS STEMI should be a standard procedure in case of patients with a sudden pain in the chest, suggesting recent myocardial infarction, and regardless of a presence of a doctor in a paramedics team.

Conflict of interest(s)

The author declares no conflict of interest.

Streszczenie

Wstęp. Zawał serca to stan bezpośredniego zagrożenia życia i najczęstsza przyczyna chorobowości i zgonów w krajach wysokorozwiniętych. W Polsce odnotowuje się około 100 tys. zawałów serca rocznie i obserwuje się wzrost chorobowości. Ogromna liczba zawałów serca jest poważnym problemem w wielu krajach na całym świecie. Około 30% zawałów serca stanowią zawały z uniesieniem odcinka ST (ACS STEMI).

Badanie przeprowadzono w celu przeanalizowania, czy podczas świadczenia opieki przedszpitalnej na terenie Szczecina stosowano standardowe leczenie farmakologiczne (tzw. schemat MONA). Oceniano postępowanie zespołów ratownictwa medycznego w przypadku chorych z ACS STEMI hospitalizowanych w Klinice Kardiologii Pomorskiego Uniwersytetu Medycznego (PUM) w Szczecinie, którzy przeżyli okres hospitalizacji i zostali wypisani ze szpitala.

Materiał i metody. Dane dotyczyły 603 chorych (68 zmarło, 535 przeżyło), u których wystąpił ostry zespół wieńcowy (ACS) w postaci zawału serca z uniesieniem odcinka ST (STEMI) i których przyjęto do Kliniki Kardiologii Szpitala Klinicznego nr 2 PUM. Obejmowały one wszystkich pacjentów, którym udzielono pomocy medycznej w związku ze zdarzeniami i nagłymi stanami kardiologicznymi w latach 2009–2011. Chorych, którzy zmarli, wykluczono z badania.

Wyniki. W analizowanej grupie chorych, przewożonych zarówno bezpośrednio z miejsca zdarzenia do Kliniki Kardiologii, jak i między placówkami medycznymi, morfinę podawano 402 osobom (75,5%), tlen — 515 osobom (96,8%), nitroglicerynę — 393 osobom (74,0%), kwas acetylosalicylowy — 493 osobom (92,5%).

Stwierdzono zwiększenie częstości podawania morfiny (p = 0,0028). W poszczególnych latach odsetek chorych, u których stosowano morfinę, wynosił: w 2009 roku — 67%, w 2010 roku — 79%, w 2011 roku — 81%. Zwiększyło się również stosowanie tlenoterapii; w 2009 roku tlen podawano 92% chorych, w 2010 roku — 98,7% chorych, a w okresie VII–XII 2011 roku — 100% chorych (p = 0,00008). Zmniejszył się natomiast odsetek chorych, którym podano nitroglicerynę; w 2009 roku nitroglicerynę stosowano u 38% chorych, w 2010 roku — u 17,2%, w 2011 roku — u 24,4% (p = 0,00001).

Wnioski. 1. W przypadku chorych z ACS STEMI często stosowano schemat MONA, niezależnie od rodzaju zespołu ratownictwa medycznego prowadzącego interwencję. 2. Stosowanie leków według schematu MONA u chorych z ACS STEMI jest niewystarczające, pomijając nitroglicerynę. 3. W przypadku rozpoznania zawału ściany dolnej serca lub braku pewności co do lokalizacji ogniska zawałowego ratownicy powinni zrezygnować z podawania nitrogliceryny na etapie opieki przedszpitalnej. 4. Teletransmisja zapisu EKG powinna być standardową procedurą w przypadku podejrzenia ACS STEMI u chorych z nagłym bólem w klatce piersiowej sugerującym ostry zawał serca, niezależnie od obecności w lekarza w zespole ratownictwa medycznego.

Słowa kluczowe: STEMI, farmakoterapia, schemat MONA, opieka przedszpitalna

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References

1. Dłużniewski M. Kardiologia w praktyce — wybrane zagadnienia. Volume II. 2nd edition. Czelej Publishing House, Lublin 2007.
2. Mandelzweig L, Battler A, Boyko V, et al. Euro Heart Survey Investigators. The second Euro Heart Survey on acute coronary syndromes: characteristics, treatment, and outcome of patients with ACS in Europe and the Mediterranean Basin in 2004. Eur Heart J. 2006; 27(19): 2285–2293, doi: 10.1093/eurheartj/ehl196, indexed in Pubmed: 16908490.
3. Polish ACS Registry. http://www.rejestrozw.republika.pl (12.11.2016).
4. Roger VL, Go AS, Lloyd-Jones DM, et al. American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Executive summary: heart disease and stroke statistics — 2012 update: a report from the American Heart Association. Circulation. 2012; 125(1): 188–197, doi: 10.1161/CIR.0b013e3182456d46, indexed in Pubmed: 22215894.
5. Widimsky P, Zelizko M, Jansky P, et al. CZECH investigators. The incidence, treatment strategies and outcomes of acute coronary syndromes in the "reperfusion network" of different hospital types in the Czech Republic: results of the Czech evaluation of acute coronary syndromes in hospitalized patients (CZECH) registry. Int J Cardiol. 2007; 119(2): 212–219, doi: 10.1016/j.ijcard.2007.02.036, indexed in Pubmed: 17442424.
6. Bakhai A, Iñiguez A, Ferrieres J, et al. APTOR trial investigators. Treatment patterns in acute coronary syndrome patients in the United Kingdom undergoing PCI. EuroIntervention. 2011; 6(8): 992–996, doi: 10.4244/EIJV6I8A171, indexed in Pubmed: 21330248.
7. Pfisterer M. Right ventricular involvement in myocardial infarction and cardiogenic shock. Lancet. 2003; 362(9381): 392–394, doi: 10.1016/S0140-6736(03)14028-7, indexed in Pubmed: 12907014.
8. Kumar A, Abdel-Aty H, Kriedemann I, et al. Contrast-enhanced cardiovascular magnetic resonance imaging of right ventricular infarction. J Am Coll Cardiol. 2006; 48(10): 1969–1976, doi: 10.1016/j.jacc.2006.05.078, indexed in Pubmed: 17112986.
9. Krstic N, Pavlovic M, Koracevic G, et al. Predictive markers for one-year outcome in patients with STEMI trated with primary Parcutaneus Coronary Intervention (PCI). HealthMED. 2012; 6(3): 916–925.
10. Clemmensen P, Schoos MM, Lindholm MG, et al. Pre-hospital diagnosis and transfer of patients with acute myocardial infarction — a decade long experience from one of Europe's largest STEMI networks. J Electrocardiol. 2013; 46(6): 546–552, doi: 10.1016/j.jelectrocard.2013.07.004, indexed in Pubmed: 23938107.
11. Rasmussen MB, Frost L, Stengaard C, et al. Diagnostic performance and system delay using telemedicine for prehospital diagnosis in triaging and treatment of STEMI. Heart. 2014; 100(9): 711–715, doi: 10.1136/heartjnl-2013-304576, indexed in Pubmed: 24637516.