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Research article

Incidence of Coronary Embolism in Group of Patients with Atrial Fibrillation and Myocardial Infarction

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Embolic myocardial infarction (EMI) is more common than gets to be diagnosed. EMI is often associated with atrial fibrillation (AF). The incidence of this pathology, prognosis and treatment tactics remain unclear.

AIM: To assess the incidence of EMI among patients with myocardial infarction (MI), genesis of coronary embolism (CE), initial characteristics, treatment and prognosis in group of patients with EMI.

MATERIALS AND METHODS: The group of patients with EMI was selected among 1989 patients with MI admitted to the cardiology department of the North-Western State Medical University named after I.I. Mechnikov between 2013 to December 2019. The CE verification criteria were the SUITA criteria. Statistical data processing was carried out using the SAS program.

RESULTS: 16 cases of EMI were registered (0.8% of all MI and 4.3% of patients with MI and AF). 68.7% (95% CI = 41.5%–88.9%) of patients with EMI had AF. All patients with EMI and AF did not have adequate anticoagulant therapy before admission. Among patients with EMI, men predominated, they were younger, had fewer comorbidities than patients with MI and without AF. 13 of 16 patients with EMI were prescribed anticoagulants. During hospitalization, the composite endpoint (pulmonary embolism + stroke + cardiovascular death) was recorded in 25% (95% CI = 7.3%–52.2%), in the long-term period — in 30% of cases (95 % CI = 6.7–65.2). All these patients had AF. EMI in patients with AF was associated with the development of severe chronic heart failure (CHF) by the time of discharge and with decompensation of CHF in the long-term period.

CONCLUSIONS: EMI often occur in group of patients with AF, always in the absence of adequate anticoagulant therapy. Patients with EMI and AF have a worse prognosis due to recurrent thromboembolic events.

Keywords: anticoagulants; atrial fibrillation; coronary embolism; embolic myocardial infarction; prognosis; thrombaspiration.

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Научная статья

Встречаемость коронарной эмболии у пациентов с фибрилляцией предсердий, перенесших инфаркт миокарда

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Актуальность. Эмбологенный инфаркт миокарда (ЭИМ) встречается гораздо чаще, чем диагностируется. Наиболее распространенными признаны ЭИМ, ассоциированные с фибрилляцией предсердий (ФП). Однако реальная встречаемость данной патологии, прогноз, а также тактика лечения остаются до конца неясными.

Цель — оценить встречаемость ЭИМ среди больных с инфарктом миокарда (ИМ), генез коронарной эмболии (КЭ), исходные характеристики больных с ЭИМ, особенности лечения пациентов с ЭИМ, прогноз.

Материалы и методы. В период с 1 января 2013 по 31 декабря 2019 г. среди 1989 пациентов, поступивших в кардиологическое отделение СЗГМУ им. И.И. Мечникова с диагнозом ИМ, была отобрана группа больных с ЭИМ. Критериями верификации КЭ являлись критерии SUITA. Статистическая обработка данных проведена в программе SAS.

Результаты. Зарегистрировано 16 случаев ЭИМ (0,8% от числа всех ИМ и 4,3% от больных с ИМ и ФП). ЭИМ чаще развивался у пациентов с ФП — в 68,7% случаев (95% ДИ = 41,5%–88,9%). Все больные с ЭИМ и ФП до госпитализации не получали адекватной антикоагулянтной терапии. Среди пациентов с ЭИМ преобладали мужчины, они были моложе, имели меньше сопутствующих заболеваний по сравнению с больными с ИМ без ФП. 13 из 16 пациентов с ЭИМ были назначены антикоагулянты. В ходе госпитализации комбинированная конечная точка (тромбоэмболия легочной артерии + инсульт + сердечно-сосудистая смертность) была зарегистрирована у 25% больных (95% ДИ = 7,3%–52,2%), в отдаленном периоде — у 30% пациентов (95% ДИ = 6,7–65,2). Все эти больные имели ФП. ЭИМ у пациентов с ФП были ассоциированы с развитием тяжелой хронической сердечной недостаточности (ХСН) к моменту выписки, а также с декомпенсацией ХСН в отдаленном периоде.

Заключение. ЭИМ чаще развивается у пациентов с ФП, всегда при отсутствии адекватной антикоагулянтной терапии. Пациенты с ЭИМ и ФП имеют неблагоприятный прогноз, обусловленный рецидивирующими тромбоэмболическими событиями.

Ключевые слова: антикоагулянты; коронарная эмболия; прогноз; тромбаспирация; фибрилляция предсердий; эмбологенный инфаркт миокарда.

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LIST OF ABBREVIATIONS:

VKA — vitamin K antagonist
AC – anticoagulant
ATT — antithrombotic therapy
CI — confidence interval
MI — myocardial infarction
CA — coronary artery
CAG — coronary angiography
CEP — composite endpoint
CE — coronary embolism
OCT — optical coherence tomography
DOAC — direct oral anticoagulant
PE — pulmonary embolism
FC — functional class
AF — atrial fibrillation
CHF — chronic heart failure
PCI — percutaneous coronary intervention
EMI — embologenic myocardial infarction

INTRODUCTION

Embologenic myocardial infarction (EMI) is traditionally considered a rare pathology. According to the results of individual studies, EMI account for 0.8–13% of all cases of myocardial infarction (MI) [1–4]. However, the incidence of EMI in real clinical practice is currently unknown, due to the fact that there are few large studies on this topic [5]. In addition, scientists studying this problem agree that EMI happens more common than gets to be diagnosed [3, 4].

EMI is type 2 MI according to the Fourth Universal Definition [6]. It is caused by embolism in the coronary arteries (CA). The causes of coronary embolism (CE) can be in atrial fibrillation (AF), vegetations during infective endocarditis, valvular pathology (mitral and aortic stenosis, prosthetic heart valves), paradoxical embolism through an atrial septal defect due to venous thrombosis, tumors, dilated and hypertrophic cardiomyopathy, hypercoagulable conditions. Currently, AF-associated EMI are recognized as the most common [3, 4, 7].

Literature review shows that patients with EMI have an unfavorable long-term prognosis [2, 3, 8]. However, published studies have not compared prognosis for EMI with and without AF. Currently, there are also no clear recommendations on antithrombotic therapy (ATT) in patients with EMI, there are no unequivocal data on the appropriateness and optimal methods of percutaneous coronary intervention (PCI) in this group of patients.

AIM

To assess the incidence of EMI among patients with MI, as well as those with MI and AF according to the data of the cardiology department of a multi-specialty hospital, to establish the genesis of CE, the initial characteristics of EMI patients, the features of ATT and PCI in patients with EMI, hospital and long-term prognosis.

MATERIALS AND METHODS

Between January 1, 2013 and December 31, 2019 (2013-2019, inclusive), a group of patients with EMI was selected among all patients admitted to the cardiology department of the North-Western State Medical University named after I.I. Mechnikov of the Ministry of Health of Russia with MI diagnosis [9]. MI was diagnosed on the basis of the clinical picture, anamnesis, and laboratory and instrumental data according to Russian recommendations [10–12]. The CE verification criteria were the SUITA criteria [3]. Major criteria for CE include: angiographically proven CE without an atherosclerotic component, simultaneous embolism of several coronary arteries, concomitant systemic embolism without thrombosed left ventricular aneurysm. Minor criteria for CE are: a confirmed source of CE based on the results of transesophageal or transthoracic echocardiography, computed tomography or magnetic resonance imaging, the presence of risk factors for embolism, such as AF, a prosthetic valve, infective endocarditis, and others. CE is considered probable when 1 major criterion and 1 minor criterion are combined or 2 minor criteria are present; CE is proven when 2 major criteria, 1 major criterion and 2 minor, 3 minor criteria are combined. The diagnosis of EMI should be excluded in cases where atherosclerotic plaques are detected in the infarct-related coronary artery, narrowing the lumen of the vessel by more than 25%, unstable atherosclerotic plaques are observed, or ectasia of the coronary arteries occurs. [3].

All patients with EMI signed an informed consent before participation in the study. The study protocol was approved by the local ethics committee.

A standard examination of patients was performed according to Russian recommendations for the diagnosis and treatment of MI [10–12]. It included coronary angiography (CAG), and in controversial cases, optical coherence tomography (OCT).

After discharge from the hospital, patients visited the clinic once a year, whenever the visits were impossible, telephone surveys were carried out. Five patients didn't visit and refused to participate in the telephone surveys. The follow-up period for patients with EMI was 2.32(2.55) years, median (Me) = 2.06.

The study dealt with the incidence of EMI among patients with MI, as well as those with MI and AF, the initial characteristics of patients with EMI (gender, age, comorbid pathology), the composition of ATT, and the characteristics of PCI in this group of patients. In addition, the following in-hospital and long-term events in patients with EMI were assessed: relapse/re-MI, stroke, pulmonary embolism (PE), cardiovascular and overall mortality, composite endpoint (CEP) 1 (relapse/re-MI + stroke + cardiovascular mortality),

CEP 2 (PE + stroke + cardiovascular mortality)), functional class (FC) of chronic heart failure (CHF) at the time of discharge, hospitalization due to CHF decompensation after discharge, small and large bleeding. The TIMI group criteria were used to assess bleeding volume [13].

Statistical data processing was carried out using the SAS program (SAS Institutes Inc., USA). In a normal distribution, quantitative traits are described using the arithmetic mean and standard deviation (M(SD)); with an abnormal distribution — the arithmetic mean, standard deviation and median with an interquartile range (M(SD)/Me(IQR)). The prognosis, due to the descriptive nature of this work, is described with the number of events, the proportion of the event, and the 95% exact confidence interval (CI) of Clopper-Pearson, adjusted for the small sample size.

RESULTS

From January 1, 2013 to December 31, 2019 (2013-2019, inclusive) 1989 patients with MI were admitted to the department, of which 372 patients had AF. During the observation period, 16 cases of EMI were registered, which accounted for 0.8% of all patients with MI and 4.3% of patients with MI and AF. In accordance with the SUITA criteria [3], EMI diagnosis was proven in 8 cases and considered probable in the rest of the patients.

AF was registered in 11 out of 16 patients with EMI, which accounted for 68.7% of cases (95% CI = 41.5% – 88.9%). In 10 of 11 cases, there was a pre-existing AF. In 1 patient, the cause of EMI was hereditary thrombophilia, another 1 patient underwent EMI together with dilated cardiomyopathy with a pronounced effect of spontaneous contrast enhancement according to echocardiography. In 3 patients, the genesis of EMI was not detected.

Among patients with EMI, there were more men compared with patients with myocardial infarction and atrial fibrillation (10 of 16 patients — 62.5% (95% CI = 35.4% – 84.8%) vs. 47.6%, respectively. The mean age was 64.3 (15.1) years and 75.2 (10.1) years, respectively.

14 out of 16 patients with EMI had hypertension, 3 patients suffered from diabetes mellitus. In 3 of the 16 cases EMI patients had a history of a previous MI, and 6 had a stroke. Patients with EMI did not have severe dyslipidemia, were overweight (body mass index (M(SD)) = 26.0 (4.7) kg/m^2), had moderate decrease in renal function (glomerular filtration rate (M(SD)) = 60.0 (21.8) ml/min/1.73 m^2). All patients with EMI and AF had a high risk of thromboembolic complications according to the CHA2DS2-VASc scale (3.6(1.6) points) and did not take anticoagulants (ACs) before hospitalization due to MI or used them inadequately (incorrect doses or irregular intake).

Upon admission patients with EMI most often complained of intense pain in the chest (in 12 of 16 cases of EMI), less often of choking (4 cases), pain in the epigastric region (1 patient). Loss of consciousness was registered in 1 case. In 10 out of 16 cases of EMI, ST elevation MI occurred. Hemodynamically significant arrhythmias (sinoatrial and atrioventricular blockades, ventricular fibrillation) were not registered in patients with EMI. The mean ejection fraction (M(SD)/ Me(IQR)) was 50.4 (14.3)/53.5 (14.0)%.

According to CAG data, CAs were intact in 4 cases. These patients underwent an additional OCT, and signs of atherosclerotic lesions and coronary dissection were excluded. 10 patients had embolic occlusion of 1 CA; 2 patients had embolic occlusion of 2 CAs. Most often (in 6 cases), the infarct-related coronary artery was the circumflex artery, less often it was due to the right coronary artery (2 cases) and the anterior interventricular artery (2 cases). In 2 patients, CE was verified simultaneously in the circumflex artery and the anterior interventricular artery. Distal CE occurred in 6 cases. 1 patient had a proximal lesion of one CA and a distal lesion of the other. In the rest of the patients, CE was detected in the proximal parts of the arteries.

Considering intact CAs, as well as extremely distal CEs, revascularization was not recommended for 7 patients with EMI. Thrombolysis performed in only 1 case had no significant effect. Thrombaspiration was performed in 9 patients with EMI, that is, it was the most common tactic of PCI. In 5 cases it was combined with infarction-associated artery angioplasty, in 2 cases stenting was also applied.

During admission, 13 out of 16 patients with EMI took AC, of which 3 patients were prescribed triple ATT (acetylsalicylic acid + clopidogrel + AC), 8 patients received double ATT (clopidogrel + AC). The volume of ATT was determined depending on the ratio of ischemic and hemorrhagic risks. Triple ATT was prescribed for a period of 1 month, with a further transition to double ATT for up to 12 months; 1 year after the endured EMI, permanent intake of AC only was recommended. In 12 out of 13 cases, direct oral ACs (DOACs) were prescribed as ACs, and in 1 case it was a vitamin K antagonist (VKA). AC was not prescribed to 3 patients with a probable diagnosis of EMI and unknown etiology of CE. After 1 year, all patients who remained under observation (10 people) took AC, 3 of them — irregularly and / or in incorrect doses.

Noteworthy is the high incidence of both in-hospital (table 1) and out-of-hospital (table 2) thromboembolic events in patients with EMI. Moreover, during hospitalization, all of them were registered in patients on the first day of AF-associated EMI.

The only death during hospitalization was associated with massive PE.

By the time of discharge from the hospital, patients with EMI often developed severe CHF(FC III): in 5 out of 15 discharged patients. 7 patients had CHF II FC, 3 of them had I FC. It should be noted that all cases of severe CHF at discharge, and later episodes of decompensated CHF, occurred in patients with AF-associated EMI.

All events in the long-term period also had a thromboembolic origin and were registered in patients with

Table 1. In-hospital Events in Patients with embolic myocardial infarction

In-hospital event	EMI patients (*n* = 16), abs. (%)	%, 95% CI
MI recurrence	0 (0)	–
Cardioembolic stroke	2(12.5)	1.6–38.3
PE	3(18.7)	4.1–45.6
Major bleeding	1(6.25)	0.2–30.2
Minor bleeding	1(6.25)	0.2–30.2
Mortality	1(6.25)	0.2–30.2
CEP 1	3(18.7)	4.1–45.6
CEP 2	4(25.0)	7.3–52.2

Table 2. Long-term events in patients with embolic myocardial infarction

Long-term event	EMI patients (*n* = 10)*, abs. (%)	%, 95% CI
Reoccurring EMI	1(10.0)	0.2–44.5
Cardioembolic stroke	2(20.0)	2.5–55.6
PE	0(0)	–
Major bleeding	0(0)	–
Minor bleeding	2(20.0)	2.5–55.6
Mortality	2(20.0)	2.5–55.6
Admissions due to decompensation of CHF	4(40.0)	12.2–73.7
CEP 1	3(30.0)	6.7–65.2
CEP 2	3(30.0)	6.7–65.2

Note: * Patients who died during admission, as well as those who dropped out of the study after admission, were excluded from the study.

AF-associated EMI 1.9–6.9 years after admission.All cases were happening while withdrawal or inadequate intake of AC. In the long term, 2 patients died. The cause of death in 1 case was cardioembolic stroke. The mechanism of death of the second patient could not be reliably deduced. Both patients, who died in the long-term period, suffered massive PE simultaneously with EMI during admission.

In patients with EMI, the number of bleedings both during admission (table 1) and in the long-term period (table 2) was small. There were only 4 episodes during the entire follow-up period, of which only 1 major bleeding was associated with PCI during hospitalization (post-puncture hematoma of the thigh) in a patient taking multicomponent ATT. The remaining bleedings were minor, occurred in presence of taking AC and were registered in patients with predisposing factors (microhematuria associated with exacerbation of chronic pyelonephritis, gingival bleeding in a patient with periodontal disease, minor gastrointestinal bleeding associated with erosive gastritis).

DISCUSSION

Previously, it was believed that CE was impossible for a number of reasons: coronary filling occurs in diastole, the presence of differences between the diameters of the aorta and the CA, the deviation of the CA from the aortic root at a right angle, high volume and velocity blood flows in this part of the aorta [4, 7]. However, in 1978, K.R. Prizel et al., in a post-mortem study of 419 cases of MI, showed that CE occurred in 13.0% of them. Moreover, AF occurred in 24.0% of patients with CE [4]. The work of K.R. Prizel with co-authors gave the foundation for further research into the EMI problem.

EMI occur in real clinical practice. According to the literature, this type of MI is considered a rather rare pathology [1–4]. This may be due not only to their low prevalence, but also to the following difficulties that arise when verifying the diagnosis of EMI: the absence of clinical features compared to the “classic” case of MI, the need to identify the source of CE, and also exclusions of atherosclerotic plaque rupture in an infarction-related KA.

In the present study, EMI was 0.8% of all MIs. The diagnosis was verified using the SUITA criteria [3], which were also used in most of the large works devoted to the problem of EMI [1, 2, 8]. In doubtful cases due to the absence of typical angiographic signs, OCT was performed to rule out an atherosclerotic lesion in the infarct-related coronary artery and to confirm the embolic nature of MI.

In the present study, in most cases (68.7%), EMI was associated with AF, which corresponds to the literature data [3, 4, 7]. Moreover, EMI developed in those AF patients who had high risks of thromboembolic complications according to the CHA2DS2-VASc scale and did not take adequate anticoagulants. As in most large studies [2–4], in our study, patients with EMI were dominated by men, they were younger, and had fewer comorbidities compared with patients with type 1 MI.

As previously mentioned, there are currently no guidelines for the treatment of patients with EMI. The existing literature suggests, there are only data from individual authors, according to which thromboaspiration is the preferred method of PCI in patients with EMI [2, 3, 8]. In the present study, thromboaspiration was most often performed in combination with angioplasty; rarely, if this tactic was not effective enough, stenting was performed. In all cases, a satisfactory angiographic result was obtained. In a number of patients with EMI, given the angiographic picture, there was no need for revascularization.

The question of the volume of ATT during EMI remains open. Some experts believe that it is necessary to take AC with one antiplatelet agent, while others believe that only AC is sufficient [1, 14, 15]. In the case of coronary artery stenting in AF-associated EMI, recommendations for patients with AF who have undergone MI and PCI should be followed. In the present study, when prescribing ATT, the current recommendations for the treatment of patients with acute coronary syndrome and recommendations for the treatment of patients with AF [16–18] were used. Most of our patients had clear indications for the AC administration (AF, thrombophilia, the effect of spontaneous contrast enhancement). Despite the multicomponent nature of ATT (antiplatelet agents + AC) in most of the patients in the study, the number of bleedings was small. An unfavorable prognosis was associated only with a violation of the prescribed ATT regimens, namely with inadequate intake or withdrawal of AC.

In this study, in 25.0% of patients with EMI during admission, CEP (PE + stroke + cardiovascular mortality) was registered, which echoes the results of the SUITA study, in which concomitant EMI systemic embolism occurred in 23.0% of patients [3]. In most studies, EMI was associated with poor long-term prognosis after hospital discharge due to repeated EMI and strokes [2, 3, 8]. In the present work, the majority of thromboembolic events, all deaths, both during admission and in the long-term period, occurred in patients with AF-associated EMI. In the long-term period, those patients died in whom CE was initially combined with systemic embolism of other localizations, as well as after repeated thromboembolic episodes, and always in the presence of withdrawal or inadequate intake of AC.

CONCLUSION

Patients with EMI and AF are at the highest risk because of poor long-term prognosis due to recurrent thromboembolic events.

At the moment, there are still questions related to the treatment of patients with EMI: the feasibility and methods of PCI, the amount of ATT, which require further study in order to optimize the tactics of treating such patients.

Due to constant increase in the number of patients with AF, an increase in the prevalence of EMI should be expected. In this regard, it is necessary to remember about this diagnosis, apply the SUITA criteria, perform CAG and (in controversial cases) OCT in order to keep this pathology in focus.

ADDITIONAL INFORMATION

Conflict of interests. All authors declare no conflicts of interest.

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