Current Therapy of the Right Ventricle Myocardial Infarction

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Background. Acute myocardial infarction of the right ventricle (AMI-RV) is a separate subgroup within the scope of inferoposterior infarction of the left ventricle. It still represents the population of patients at high risk due to numerous, often hardly predictable complications and high mortality rate. Methods. In fifteen-year period (1987–2001) 3 765 patients with the acute myocardial infarction (AMI) of different localizations of both sexes – 2 283 males and 1 482 females of the average age 61.4 ± 4.6 years were treated in our institution. Anterior myocardial infarction was diagnosed in 2 146 (56.9%) patients, inferior in 1 619 (43.1%) patients, out of whom right ventricular infarction (RVI) was confirmed in 384 (23.7%). Thrombolytic therapy was administered in 163 (42.4%) patients with RVI, and in 53 (41.7%) of these patients balloon dilatation was performed with coronary stent implantation in 24 (45.2%). Results. Favorable clinical effect of the combined thrombolytic therapy and percutaneous transluminal coronary angioplasty (PTCA) was achieved in 51 (96.1%), and in only 2 (3.9%) of patients the expected effect wasn’t achieved. Myocardial revascularization was accomplished in 6 (3.6%) and 1 patient died. In 3 (3.4%) patients primary balloon dilatation with the implantation of intracoronary stent was performed within 6 hours from the onset of anginal pain. In the other group of 221 (57.5%) patients with RVI who did not receive thrombolytic therapy, or it had no effect, 26 (11.7%) patients died, which indicated the validity and the efficacy of this treatment (p<0.01). In the whole group of patients with myocardial infarction of the right ventricle 31 (8.1%) died; in the group that received thrombolytic therapy and PTCA 5 (3.1%) died, while in the group treated in a conservative way 26 (11.7%) died. Conclusion. Combined therapy was successful in the treatment of patients with RVI and should be administered whenever possible, since it was the best prevention of life-threatening complications and the decrease in the mortality of those patients.

Key words: myocardial infarction; ventricular dysfunction, right; fibrinolytic agents; balloon dilatation; angioplasty, transluminal, percutaneous coronary; stents; combined modality therapy; treatment outcome.

Introduction

Current treatment of AIM comprises volume compensation due to the reduced minute volume, combined thrombolytic, antiaggregation and anticoagulant therapy, together with primary or delayed (elective) percutaneous transluminal coronary angioplasty (PTCA) and intracoronary stent implantation, if necessary (1–6).

According to many previously published studies the incidence of AMI-RV ranged from 13 to 56%, depending on population, clinical, ECG, hemodynamic or pathoanatomic criteria. Mortality rate ranged from 20 to 50% (7–12). The results of the GUSTO IIb study showed that PTCA alone led to 45% of new restenoses during the four month follow-up period and therefore the effect of such therapy was practically annulled, although in the first act

it resulted with the complete potency of the infarcted artery (13–15). Owing to this, new studies – CADILLAC before all, as well as the others, suggested the administration of direct inhibitors of the platelet glycoprotein IIB/IIIa (abciximab) together with intracoronary low-molecular heparin. This modified therapy proved itself much more effective not only in infarction size and mortality rate reduction, but also in the lowered incidence of the complications such as myocardial reinfarction, restenosis, cerebrovascular accidents, during the hospital treatment, but also during one-year follow-up period after patients were discharged from the hospital (16–17). The application of any of these individual treatment methods or of their combination was aimed for primary preservation of the myocardium, as well as for the management of reocclusion and restenosis (18–19). Widely accepted thrombolytic therapy together with more and more frequent PTCA generally used in the treatment of myocardial infarction and particularly in patients with AMI-RV, started a new era of interventional cardiology, as well as of the active approach in the treatment of these patients (20–24).

The aim of this study was to present our results with combined fibrinolytic therapy achieved in the treatment of patients with AMI-RV, using accelerated tissue-type plasminogen activator protocol and primary or delayed PTCA together with intracoronary stent implantation, if necessary. Obtained results within one month intrahospital period were correlated with the clinical, ECG, echocardiographic and scintigraphic (SPECT) findings when necessary, radionuclide ventriculography (RV) and coronarography, or autopsy findings in patients who died.

Methods

Within the fifteen-year period (1987-2001), 3 765 patients of both sexes, 2 283 (60.6%) males and 1 482 (39.4%) females aged 60.1 ± 4.6 years in average underwent treatment of the acute myocardial infarction (AMI) of various localizations at the Clinic of Emergency Internal Medicine, Military Medical Academy (MMA). Infarction of anterior localization occurred in 2 146 (56.9%) and inferoposterior one in 1 619 (43.1%) of patients, which was confirmed in 384 (23.7%) cases of AMI-RV. Thrombolytic therapy was administered in the first 6–12 hours from the onset of anginous pain, and primary or delayed PTCA 6 hours up to 21 days after the infarction being confirmed clinically. They were performed by ECG, enzyme tests, echocardiography or radionuclidle ventriculography of the myocardium, if necessary, and by autopsy in fatal cases. Selective coronarography was performed in all patients on thrombolytic therapy, aiming to evaluate the obtained effect and to come to decision concerning further treatment. All results were analysed using χ2 test in statistical analysis. During the last three years the modified treatment protocol was used introducing platelet glycoprotein IIB/IIIa inhibitors (abciximab) together with low-molecular heparin – enoxaparin in the dosis of 20 mg intracoronary.

Results

There were 384 patients in the group with AMI-RV, 229 (59.6%) males and 155 (40.4%) females and the average age of the whole group was 60.2 ± 5.8 years. Fibrinolytic therapy was administered to 163 (42.4%) patients and satisfactory reperfusion according to clinical, ECG and enzyme criteria was achieved in 111 (68.1%) patients, but without the expected effect in 52 (31.9%) of patients. In the thrombolytic therapy group in 53 (41.7%) patients delayed or elective PTCA was performed in the later period and complete dilatation only by balloon was achieved in 27 (50.9%) patients. Partial effect of dilatation with remained lower degree stenosis was successfully managed by intracoronary stent implantation in 24 (45.2%) patients. Myocardial surgical revascularisation was done in 2 (3.9%) patients.

Primary percutaneous transluminal coronary angioplasty (PPTCA) was performed in 3 (3.9%) patients (2 females and 1 male) within the first 6 hours from the onset of anginous pain due to threatening cardiogenic shock and marked conduction disorders (AV block I0–III0). Complete effect of thrombolytic therapy combined with PPTCA with coronary stenting was accomplished in 51 (96.1%) of patients with no fatal outcome and no serious clinical complications in the later course. Myocardial revascularization was found in 6 (3.6%) patients, while in the whole group receiving thrombolytic therapy together with primary or delayed PTCA and intracoronary stent 5 (3.1%) patients died – 3 in cardiogenic schock, 1 after a bypass surgery and 1 due to myocardial rupture. Coronary angiography showed pathologic changes in one blood vessel in 28 (22%), two in 36 (28.4%), and three in 47 (37%) patients, while 16 (11.5%) of them had tortuous changes of coronary arteries without significant stenosis.

In the group of 221 patients with AMI-RV who did not receive thrombolytic therapy or it was ineffective, 26 (11.7%) of them died. In the group receiving combined fibrinolytic therapy and PTCA 5 (3.1%) patients died (χ2 test 9.56; p<0.01), and in the whole group of 384 patients with the established AMI-RV 31 (8.1%) patient died, which undoubtedly confirmed the efficiency and justification of fibrinolytic therapy administration combined with PTCA in accordance with the modified protocol.

Discussion

Owing to the size of necrosis affecting the lower wall of both ventricles, distal half of interventricular septum, free wall of the right ventricle, papillary muscles together with the valvular apparatus, as well as cardiac conduction system, the infarction of the left and the right ventricle was in fact combined in patients with AMI-RV. It made their prognosis uncertain and mortality rate was still very high (25–27). The underlying physiopathologic substrate was stenosis or occlusion of proximal one third of the right
coronary artery (RCA), less frequently of the circumflex artery which was always predominant so that both sinus and AV node perfusions could have been compromised. This was clinically manifested as sinus bradycardia, hypotension, high degree AV block (II\(^6\)–III\(^6\)), or as the rapid development of cardiogenic shock (28–30). Current therapy recommends thrombolytic agents together with PTCA as an obligation aiming to open infarcted arteries as soon as possible and to definitely manage occlusion or stenosis (31–32).

More than 15 years had passed before the first communications on thrombolytic therapy administration in AMI-RV resulted in satisfactory reperfusion and increased the ejection fraction together with the less frequent AV blocks in patients with AMI-RV, comparing those in whom the reperfusion effect was not achieved with thrombolytic therapy (33–34). Such observation was also confirmed by the results in later TIMI 2 study in which thrombolytic therapy administered to patients with inferior infarction contributed to the reduced incidence of AMI-RV in patients with diaphragmatic infarction. In those patients satisfactory reperfusion of the dominant RCA was achieved in comparison with those in whom this effect failed. This was an introduction into the new treatment strategy for patients with inferoposterior infarction in whom initial clinical signs or ECG findings suggested possible development of AMI-RV (35–37). The first study on successful primary angioplasty in patients with AMI-RV in whom satisfactory hemodynamic improvement of ejection fraction and rapid clinical recovery were recorded (38) was published at the end of eighties. Our experience and the obtained results in the treatment of these patients within the fifteen-year period were in accordance with many previously similarly designed studies and our attitude was that in all these patients, except for unavoidable fibrinolytic therapy, primary or most often delayed PTCA should be performed whenever necessary and possible, aiming to definitely manage residual stenosis. The effect of this combined therapy was best noticeable in the fact that in our subgroup of 27 patients with AMI-RV treated in this way there were no fatal outcomes during the first month of hospital treatment and that following complications were of no clinical significance. Meta-analysis of 10 world extensive randomised studies showed that primary PTCA reduced mortality rate and non-fatal myocardial infarction for 7.4% in comparison with intravenous administration of fibrinolytic therapy alone with the maintaining maximum TIMI 3 blood flow through the infarcted artery in about 90% of patients (39). Comparing clinical, ECG and coronarographic findings it was noticed that long and repeated anginous pain lasting longer than 40 minutes as the well as development of cardiogenic shock within the first 24 hours were the indicators of the unfavourable outcome, while the elevation of ST segment in V4 R–V5R >2 mV or bradycardia < 50/min were ECG signs suggesting the development of AV block II\(^6\) or the rapid development of cardiogenic shock. Special precaution ought to have been taken in all these patients because these were the early signs suggesting possible lethal outcome. These results were confirmed in other authors' communications and they were the signs of poor prognosis and possible serious complications (40–41). Sufficient knowledge of early clinical and ECG indicators together with echocardiographic follow-up of patients enabled timely undertaken measures for elective balloon dilatation, and our previous experience and the obtained results completely confirmed it. The administration of the modified protocol combined with abciximab and enoxaparin multiply reduced the number of possible complications and the mortality rate (42). However, in about 30% of patients with maintained adequate angiographic blood flow (TIMI-3), there were clinical signs or marked, often irreversible cardiogenic shock, because they did not have the same blood flow on microcirculation level due to possible massive microembolism from the dilated subepicardial artery, or spontaneously developed microvascular thrombosis associated with the spasm and edema of the surrounding infarcted tissue (43, 44). Although angiography revealed completely potent and completely dilated artery, they died in an irreversible cardiogenic shock due to the so called „no-reflow“ phenomenon (45, 46). Thus, in spite of the great progress in the treatment of these patients, there are still many unanswered questions because we do not know why these patients still belong to the group at high risk with the uncertain outcome.

**Conclusion**

Our results showed that thrombolytic therapy combined with PTCA in a modified treatment protocol reduced the incidence of complications and mortality rate in patients with AMI-RV. This method of treatment undoubtedly reduced the size of necrosis and soon preserved the remained portion of the myocardium in the blood supply area of the infarcted artery which was shown to be the best prevention of the life threatening complications and the best way to reduce the mortality rate in these patients. Interventional cardiology also reduced the number of patients requiring additional myocardial revascularization risks related to this intervention and significantly lowered treatment costs. Thrombolytic therapy combined with PTCA most often resulted in rapid and complete potency of the infarcted artery, fast clinical recovery and favourable clinical course even after patients were discharged from the hospital. Out of 384 with AMI-RV thrombolytic therapy was administered patients to 163 (42.4%) of them, while the delayed PTCA together with intracoronary stent implantation was performed in 53 (29.6%) of patients. Complete clinical effect of this combined treatment was achieved in 51 (96.1%) patients without the fatal outcome and serious clinical complications in the further course. PPTCA and intracoronary stent implantation were performed in 3 patients and their later clinical course and recovery were also without complications.
Unfortunately, in spite of the most up-to-date methods of treatment, mortality rate in these patients was still 4–5 times higher comparing to the ones with common infero-posterior left ventricle infarction in which this aggressive approach was neither necessary, nor recommendable.

The development of interventional cardiology thus introduced a new strategy in the treatment of these patients and our previous results, as well as the experience, completely confirmed this method as a very reliable one.

**REFERENCES**

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Апстракт


SAVREMENA TERAPIJA INFARKTA MIOKARDA DESNE KOMORE

Увод. Акутни инфаркт миокарда десне коморе (AIM-DK), посебна подгрупа у оквиру inferoposteriornog infarkta leve коморе, представља веома ризничку болест због бројних, често тешко предвидљивих компликација и високог морзалитета. Методе. У периоду од 15 година (1987–2001) укупно је од акутног инфаркта миокарда (AIM) различитих локализација, лечено 3 765 болесника оба пола, 2 283 мућника и 1 482 жена, prosečne старости 61,4 ± 4,6 g. Инфаркт предњег зида имало је 2 146 (56,9%) болесника, inferiorni инфаркт је имало 1 619 (43,1%) болесника, од кога је код 384 (23,7%) bio dokazan инфаркт десне коморе. Тромболитичку терапију добило је 163 (42,4%) sa AIM-DK, а код 53 (41,7%) ових болесника urađena je balon dilatacija, уз имплантацiju intrakoronarnог стента код 24 (45,2%). Резултати. Потпун клинички ефекат премен комбиноване trombolitičke терапије и перкутане translumenske коронарне angioplastike (PTKA) postignut je код 51 (96,1%), a očekivani efekat izostao je samo код 2 (3,9%) болесника. Revaskularizacija миокарда урађена je код 6 (3,6%) и код 3 (3,4%) болесника koji су привлачили на болничко лечење у првих 6 сати од почетка anginозних болова урађена je и директна balon dilatacija sa implantacijom intrakoronarnog stenta и postignut потпун клиниčki ефекат. Није bilo ni jedног смртног случаја u grupi koja je лечена kombinovano fibrinolitičком терапијом и PTKA, као ни u grupi u kojoj je применена primarna PTKA. U drugoj grupi од 221 (57,5%) болесника sa AIM-DK koji nisu dobili trombolitičku терапију, ili je ona ostala bez ефекта, umrlо je 26 (11,7%) што коло броје govori о uspešnosti и ефикасности ovог начина лечења (p<0,01). U целој grupi болесника sa AIM-DK umrlo je 31 (8,1%) – u grupi koja je primila trombolitičку терапију и PTKA umrlо je 5 (3,1%), dok je u grupi koja je лечена konzervativном терапијом umrло 26 (11,7%). Заключак. Комуниковане терапије je веома усмена u лечењу болесника sa AIM-DK treba je применити u свим случајевима где je то могуће, jer je to најбоља превенција животно опасних компликација и у смањење смртности ових болесника.

Кључне речи: инфаркт миокарда; срце, disfunkcija десне коморе; fibrinolitici; dilatacija балоном; angioplastika, translumenska perkutana, коронарна; stentovi; lečenje, kombinovano, lečenje, ishod.