Resuscitation with full neurologic recovery after thrombolysis in Out-of-hospital cardiac arrest

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Citation

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Abstract

We report the case of a 54-year-old man with out-of-hospital ventricular fibrillation (VF) due to acute myocardial infarction. After 15 minutes of unsuccessful cardiopulmonary resuscitation (CPR), thrombolysis was initiated, followed by restoration of spontaneous circulation (ROSC). The patient survived the incidence with full neurologic recovery.
In this case, the early use of thrombolytic therapy is thought to have had a major contribution in survival without sustained neurologic disability.

INTRODUCTION

Out-of-hospital sudden cardiac arrest (SCA) is a leading cause of mortality in many civilized countries with an estimated incidence of about 100 / 100.000 population per year in the United States. [1] Myocardial infarction due to coronary artery disease counts for the majority of these SCA cases.[2,19] Survial rates are varying between 5 and 70 percent depending on immediate and appropriate treatment. [3,4] If thrombolysis during prolonged CPR shows additional benefit for patients with myocardial infarction is still under investigation, whereas according to latest European Resuscitation Council (ERC) guidelines a clear indication for thrombolysis in patients undergoing CPR due to suspected pulmonary embolism exists. [1,2,4,17] We report the case of successful thrombolytic therapy during prolonged CPR in a 54-year-old man with SCA due to acute myocardial infarction and discuss who might benefit from thrombolysis in out-of-hospital CPR.

CASE REPORT

In November 2005, the emergency medical service (EMS) was called to a 54-year-old man because of reported acute dyspnea with severe retrosternal chest pain. On arrival at the site of the emergency, five minutes after the emergency call, the EMS team found the patient with agonal gasps and absence of central pulses. The ECG showed ventricular fibrillation (VF) as initial rhythm. Bystander CPR by the present wife had not been initiated.

Cardiopulmonary resuscitation was immediately started according to the year 2000 ERC guidelines with a ventilation to compression ratio of 2/15. Defibrillations were performed every minute, starting two times with 200 Joule and proceeding later on with 360 Joule. Only one defibrillation was performed in each CPR cycle because the patient responded to each shock with a phase of pulsless electrical activity, returning to VF during ongoing cardiac massage. During the first minutes of CPR, the airways were secured by endotracheal intubation and an i.v. line was inserted. 1 mg adrenaline (every 3 minutes with a cumulative dose of 5 mg), 300 mg amiodarone (3nd cycle) and 40 IU of vasopressin (3nd cycle) were administered. Despite these measures the patient remained 15 minutes after beginning of CPR in VF.

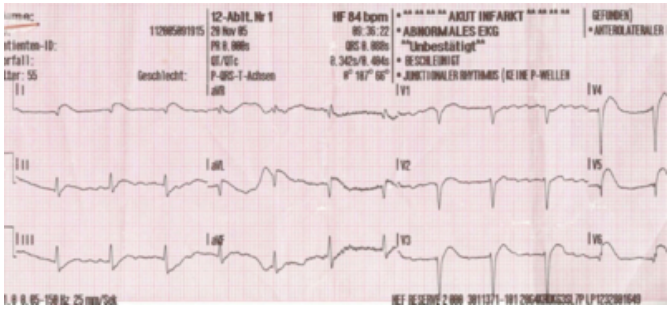
A case history with the patient's wife revealed that the patient, - a heavy smoker (40 pack/years) - , suffered for a few days from recurrent chest pain with radiation to the left arm. This day the pain lasted for about 60 minutes before onset of SCA. Because of unsuccessful ongoing resuscitations attempts and a history suggesting fulminant myocardial infarction as underlying disease, thrombolysis was considered.

Five minutes after administration of 10.000 IU tenecteplase (20 minutes after CPR start) it was able to terminate VF with the second “post thrombolysis” defibrillation and the patient regained spontaneous circulation. At this time the electrocardiogram (ECG) showed ST elevations in leads I, aVL and V2-V6 (ST elevation vector of 22mm) and the ST segment deviation vector pointed toward lead aVL

suggesting extensive anterolateral infarction due to proximal LAD or CX stenosis (Fig. 1).

Figure 1

Figure 1: ECG recorded short after ROSC showing large anterolateral myocardial infarction with ST elevations in leads I, aVL and V2-V6

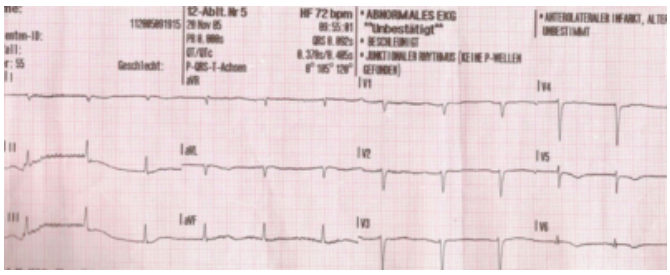


Now the patient presented with severe cardiogenic shock and pulmonary edema (blood pressure 80/50 mm Hg, heart rate 100/min) necessitating the administration of vasopressors (dopamine perfusor with 10-15 µg/kg/min) and furosemide (40mg i.v.).

The patient was transported to the next coronary care unit (CCU) with percutaneous coronary intervention (PCI) facility and an affiliated department for cardiac surgery. During the transport to the hospital a marked improvement in patient's condition was observed resulting in decreasing vasopressor demand and full resolution of ST segment elevation. 30 minutes after administration of thrombolysis, the patient was admitted to the CCU with a stable blood pressure of 120/80 mm Hg and a near normal ECG showing no ST elevation but terminal T wave inversion in the anterolateral leads as direct signs of reperfusion (Fig. 2).

Figure 2

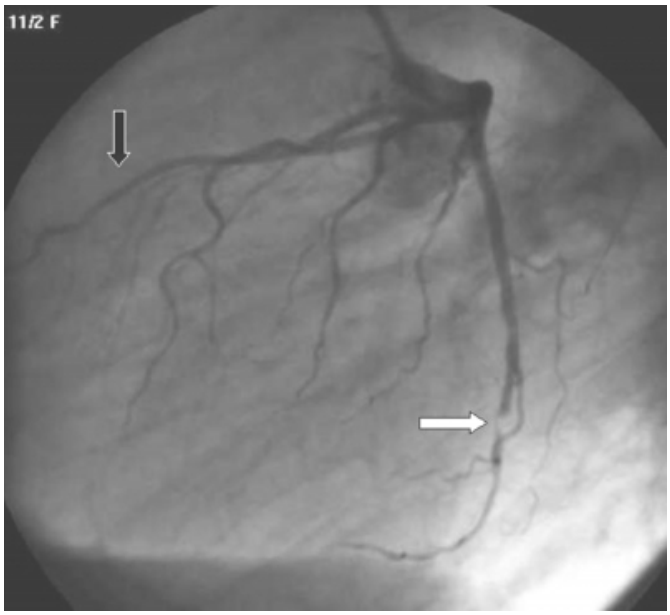
Figure 2: ECG recorded 30 minutes after rescue thrombolysis showing full resolution of ST elevation with terminal T wave inversion in leads V5, V6



Therapeutic hypothermia was not performed and no bleeding complications occurred the following days. PCI showed single vessel disease with significant CX stenosis (Fig. 3) and treatment was performed with the placement of a drug eluting stent.

Figure 3

Figure 3: Coronary angiography showed single vessel disease with near total occlusion of the CX (white arrow) with TIMI flow grade 1. Perfusion of the LAD (black arrow) and RCA (not shown) were without pathological findings.



Because of aspiration pneumonia resulting in acute respiratory distress syndrome, the hospital stay was prolonged.

Despite the initially poor prognosis (no bystander CPR, unknown time of hypoxia, prolonged CPR), the patient finally showed full neurologic recovery assuming that in this case, thrombolytic therapy during out-of-hospital CPR might have contributed to the favourable outcome.

DISCUSSION

In our case of out-of-hospital cardiac arrest, restoration of spontaneous circulation occurred after administration of thrombolysis in a patient suffering from cardiac arrest due to acute myocardial infarction.

A potential benefit of thrombolysis in cardiac arrest has been shown in several case series ([5,6,7]) and a retrospective out-of-hospital analysis ([8]). In this study, 24h-survival-rate was higher in patients receiving thrombolysis during CPR, compared to patients without this intervention. These data have been confirmed by a prospective study, which also found higher short-time survival rates in patients undergoing out-of-hospital cardiopulmonary resuscitation when they were treated with thrombolysis and heparin. ([9]) In the TICA-trial, ROSC was more often seen in patients receiving 50 mg

of tenecteplase during ongoing CPR. ([10]) However, the number of patients enrolled in this study was not enough to show any significance in short- or long-term survival.

A posthoc subgroup analysis of an international multicenter trial, comparing vasopressin and adrenaline in out-of-hospital cardiac arrest, showed higher hospital admission rates and a trend towards higher hospital discharge rates in patients with thrombolysis either during or short after cardiopulmonary resuscitation. ([11])

Several analysis of thrombolytic interventions either in out-of-hospital- or in-clinical cardiac arrest showed no higher incidence of severe bleeding associated with thrombolysis. ([13],[14]) Accordingly, none of the above mentioned studies reported major complications caused by thrombolytic therapy during CPR.

The 2005 ERC guidelines on CPR recommend, that ongoing CPR should not be considered as a contraindication for a thrombolytic therapy. ([17])

The TROICA-study (Thrombolysis In Cardiac Arrest), which enrolled more than 1000 patients in many European countries ([12]), has been designed to evaluate the benefit and eventual adverse effects of this intervention.

Possible effects of thrombolysis in cardiac arrest are thought to be present in major vessels and at the level of the microcirculation as well. On the one hand, a breakdown of blood clots in pulmonary and coronary arteries occurs, resulting in restoration of blood flow in these sections. On the other hand, thrombolytic therapy during experimental CPR in cats reduced significantly cerebral no-reflow areas and led to homogenous cerebral reperfusion in the early post-resuscitation period. ([15]) These findings are supported by data demonstrating that, after prolonged CPR, marked activation of blood coagulation with fibrin formation occurs, which is insufficiently reversed by endogenous fibrinolytic mechanisms. ([16])

The 2005 guidelines on CPR recommend the consideration of thrombolytic therapy only in suspected pulmonary embolism. ([17]) Thrombolysis in this subgroup of cardiac arrest patients is deemed to be feasible and safe. ([7],[18]) Before extension of this therapeutic approach on other patients suffering from SCA, a tight algorithm should be established, helping to identify patients who might benefit from this intervention. Variables of such an algorithm may be initial ECG-rhythm, age, medical history, time before initiation of Basic Life Support (BLS), and eventual contraindications for a thrombolytic therapy. (Tab. 1)

Figure 4

Table 1: Patient characteristics showing a trend towards better outcome with thrombolytic therapy during ongoing CPR.

Characteristics	References
initiation of BLS-CPR < 10 min. and / or witnessed collapse	• Fatovic et al [10] • Stadlbauer et al [11] • de Rose et al [21]
refractory VF/VT	• Lederer et al [8] • Fatovic et al [10] • Stadelbauer et al [11] • Schreiber et al [23]
suspected pulmonary embolism or myocardial infarction	• Lederer et al [8] • Stadlbauer et [11] • Janata et al [18] • Scholz et al [24]

Since cardiac arrest caused by thromboembolic diseases is often associated with ventricular fibrillation (VF) ([19]), and thrombolysis during cardiac arrest with pulseless electrical activity has not been effective in one study ([20]), VF or pulseless ventricular tachycardia should be a precondition for thrombolysis during CPR. Exceptions may be appropriate for patients with presumption of pulmonary embolism. Response time should be short (e.g. time interval from collapse to BLS max. 10 minutes) to avoid excessive brain ischemia resulting in adverse neurological outcome after prolonged CPR although thrombolysis might be effective even after long duration of cardiac arrest. ([21]) Medical history of the patient should be taken into account, but it must not be the unique basis for a “thrombolysis or not-decision”. ([2],[19]) In a survey of 136 out-of-hospital cardiac arrest patients, the attending physicians judged the cardiac arrest in 76% of the cases to be of thromboembolic origin and recommended the administration of a thrombolytic in 61% of all patients. ([22])

In order to optimize post-intervention care of patients admitted to the hospital, clear orders for further treatment are helpful for physicians in the emergency department and coronary or intensive care units as well.

Finally, costs for this intervention must be encountered. For EMS-systems, refunding of thrombolytic agents has to be ensured since the administration of a single dose of thrombolysis often exceeds the fees for an EMS intervention.

CONCLUSION

In conclusion, thrombolysis during out-of-hospital CPR might be a valuable treatment option for selected patients, as presented in our case.

CONFLICT OF INTEREST

Hans P. Groechenig has received lecture fees from Boehringer Ingelheim but no financial support for this case report was provided. The other authors (W. Grander, M. Moritz, H.G. Lienhart) declare that they have no conflict of interest.

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