Direct percutaneous transluminal coronary angioplasty in acute myocardial infarction

Predictors of short-term outcome and the impact of coronary stenting

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Background Direct percutaneous transluminal coronary angioplasty (PTCA) is widely accepted in the treatment of acute myocardial infarction since excellent results had been reported from several small randomized trials. Less favourable results were observed in large-scale registries. In particular, the use of stents in acute myocardial infarction has become common practice without documented evidence of clinical efficacy.

Methods Data were analysed from a registry of all consecutive percutaneous transluminal coronary angioplasty procedures from 62 centres in Germany, including 2331 direct percutaneous transluminal coronary angioplasty in acute myocardial infarction from July 1994 to April 1997.

Results The overall angiographic success rate of percutaneous transluminal coronary angioplasty, defined as complete antegrade perfusion of the infarct vessel, was 87%. In-hospital mortality was 11.2%. The most important predictor of death was the presence of cardiogenic shock in 15% of patients, of whom 52% died. Mortality in patients without shock was 3.9%. Failed percutaneous transluminal coronary angioplasty was associated with a mortality of 36%. Further independent predictors of death were older age, multivessel disease, and anterior myocardial infarction. Stents were used in 4.1% of the procedures in 1994, increasing to 53% in 1997. However, this was not accompanied by improved clinical outcome. Mortality with coronary stenting was 9.9% vs 11.6% without stents (ns).

Conclusions Direct percutaneous transluminal coronary angioplasty is a valuable treatment strategy in acute myocardial infarction, although the results are less exceptional than reported from some highly specialized centres. Failed percutaneous transluminal coronary angioplasty seems to be harmful, thus outweighing much of the benefit from successful procedures. Stents did not improve the clinical outcome significantly, despite technically successful placement in 98%. Mortality from cardiogenic shock continues to be excessively high despite direct PTCA.

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Key Words: Acute myocardial infarction, percutaneous transluminal angioplasty, mortality, reperfusion, cardiogenic shock, coronary stenting.

Introduction

Direct percutaneous coronary angioplasty (PTCA) in acute myocardial infarction has become a widely accepted strategy to achieve reperfusion of the infarct...
is made to the possible impact of coronary stenting on outcome after direct PTCA in the patients of this registry.

**Structure of the registry**

The registry of the Arbeitsgemeinschaft Leitender Kardiologischer Krankenhausärzte (ALKK) includes all PTCA procedures that have taken place in 62 centres in Germany since October 1992. All but two of these centres are community hospitals; 16 centres have an on-site cardiac surgery department. The organization of the registry has been published elsewhere[8]. Since July 1994 a sub-registry was opened to include all PTCA procedures in acute myocardial infarction (≤ 24 h from symptom onset) in more detail than in the general registry. The procedures of this sub-registry until 30 April 1997 are analysed. We included all procedures without prior thrombolytic treatment and without a PTCA procedure within the previous two weeks.

**Statistical methods**

Univariate analysis of possible predictors of in-hospital death was performed with chi-square tests, the possible influence of the time to reperfusion was analysed with the Mann-Whitney U-test. Multivariate analysis was done with logistic regression. The multivariate analysis included the following factors: age, gender, shock, PTCA success, multivessel disease, infarct-related artery, coronary stenting, time from admission to reperfusion, and the year of the intervention. Possible trends over the years since 1994 were analysed with the chi-square statistic for trend. All statistical calculations were made with the CSS STATISTICA software package by STATSOFT. Time intervals are given as median values and 25th to 75th percentile.

**Patients and overall outcome**

The cohort analysed comprised a total of 2331 direct PTCA procedures for acute myocardial infarction from July 1994 to April 1997, representing 2.7% of all procedures in the general registry during this time period. The catheterization laboratory data forms in the general registry are 98.5% complete, and the hospital discharge forms 95.0% complete. The patients' ages averaged 61 ± 12 years; 26% were female. Cardiogenic shock was diagnosed by the local operator in 15%. The angiogram showed multivessel disease in 54%, and in 40% the infarct-related vessel was the left anterior descending coronary artery. The median time interval from symptom onset to hospital admission was 2 h 30 min in 2070 patients (1:30-4:40, 25th-75th percentile); 261 patients were already in hospital when the acute myocardial infarction symptoms began. The median time from admission to the start of coronary angiography was 55 (31-90) min, and the duration of the diagnostic and interventional procedure was 27 (15-41) min until the final result was achieved. The final result was thrombolysis in myocardial infarction (TIMI) grade 3 perfusion (as judged by the local operator) of the infarct-related vessel in 87%[8]. Coronary stenting was attempted in 23.5%; the stents could be delivered successfully in 98%. Overall in-hospital mortality was 11.2%; 2.9% suffered reinfarctions, of which 34% were fatal.

**Predictors of in-hospital mortality**

The most important predictor of in-hospital death was the presence of cardiogenic shock in 15% of the patients. Mortality was 51.6% vs 3.9% in patients with and without shock (P < 0.001). The procedure failed in 13% of the patients, resulting in the infarct-related artery having a TIMI perfusion grade of <3. Mortality after failed PTCA was 35.5%, as opposed to 7.6% after successful procedures (P < 0.001). Forty percent of the patients were older than 65 years, of whom 18.5% died vs 6.7% of those under 65 (P < 0.001). 14.6% of patients with multivessel disease died compared with 7.1% of those with single-vessel disease (P < 0.001). Of the patients with the left anterior descending coronary artery identified as the infarct-related artery 12.5% died, compared with 10.3% of those with other infarct vessels (P = 0.10). Coronary stenting had no significant impact on mortality, which was 9.9% with and 11.6% without stents (P = 0.27). There were no significant differences in the time from admission to the catheterization laboratory between survivors and deceased patients (55 vs 60 min, P = 0.09), but the median duration of the procedure was slightly shorter in survivors (25 vs 30 min, P < 0.001). In multivariate analysis, the predictors of in-hospital death were the presence of shock (P < 0.001), failed PTCA (P < 0.001), older age (P < 0.001), multivessel disease (P < 0.002), and the infarct-related artery being the left anterior descending coronary artery (P = 0.040) (Fig. 1). Gender, coronary stenting, time from admission to reperfusion, and the year of the intervention were not significantly correlated to in-hospital death in multivariate analysis.

**Trends 1994–1997**

There were no significant changes in the patients' characteristics in 1994-1997 (Fig. 2). The time intervals from symptom onset to admission, admission to catheterization laboratory, and duration of the procedure were also almost constant (Fig. 3). The only major trend over time was a marked increase in the use of stents, which were attempted in only 4.1% in 1994, increasing to more than 50% in 1997 (P < 0.001). This obvious change in treatment strategy was not, however, associated with a higher
The registry data over the past 3 years demonstrate that direct PTCA is a valuable treatment option in acute myocardial infarction, which should not be restricted to a few highly specialized centres. The overall mortality was clearly higher than reported from randomized trials\cite{1,3,5-9,15}, but this was mainly due to a significant proportion of patients in cardiogenic shock. In patients without shock, mortality was only 3.9%, which compares well with randomized studies and with other registries or observational data\cite{1-3,5-9,15}.

The success rate of 87%, as defined by complete reperfusion of the infarct vessel, is significantly lower than reported from small scale randomized trials\cite{1-3,5-9}. The large-scale GUSTO IIb trial\cite{60} and the registry of the myocardial infarction triage and intervention group\cite{59} reported primary angiographic success rates of 88% and 89%, respectively, which is similar to our data.

**Discussion**

The registry data over the past 3 years demonstrate that direct PTCA is a valuable treatment option in acute myocardial infarction, which should not be restricted to a few highly specialized centres. The overall mortality was clearly higher than reported from randomized trials\cite{1,3,5-9}, but this was mainly due to a significant proportion of patients in cardiogenic shock. In patients without shock, mortality was only 3.9%, which compares well with randomized studies and with other registries or observational data\cite{1-3,5-9,15}.

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**Figure 1** Significant predictors of death in univariate as well as multivariate analysis were the presence of cardiogenic shock, failed PTCA, multivessel disease and older age. IRA=LAD—left anterior descending coronary artery is identified as the infarct-related vessel; this characteristic was not a significant predictor of death in univariate, but was in multivariate analysis (P=0.04). Coronary stenting was not associated with short-term mortality in univariate multivariate analysis.

**Figure 2** There were no significant changes in patient characteristics in the years since 1994. Data from 1994 are from July to December, data from 1997 are until 30 April. ■=mean age; ▲=multivessel disease; ■=IRA=LAD (see legend to Fig. 1); △=women; ●=shock.

**Figure 3** The time intervals from symptom onset to hospital admission (△), from admission to the start of the invasive procedure (●), and the duration of the procedure until the final result in terms of the TIMI perfusion grade of the IRA (▲) did not change significantly over the years from 1994. Pre-hospital time is given for 2070 patients coming from outside; the other patients' symptoms of AMI began when they were already in the hospital.

**Figure 4** The only marked change over time was a more than 10-fold increase in the use of stents (●). However, this was not accompanied by significant changes in angiographic success rate (▲) or in clinical outcome, as measured by in-hospital mortality (●) and reinfarction rate (△).
Significant independent predictors of death were the patients’ characteristics, namely age, multivessel disease and anterior myocardial infarction, as has been shown in earlier reports[15,12,14,16,19]. Failed PTCA resulting in incomplete or no reperfusion was associated with an exceptionally high mortality. This was also true for patients without cardiogenic shock, of whom 16-2% died after failed vs 2-5% after successful interventions. A similar difference in survival has been reported from the GUSTO IIb study[6], where only 1-6% of patients with complete reperfusion of the infarct-related artery died, as opposed to 14-3-21-4% of those with no or incomplete reperfusion. It seems, therefore, that failed PTCA exerts an intrinsic negative impact on survival, compensating for much of the benefit from successful procedures. The nature of this unfavourable effect of failed procedures is not clear; among other factors it may be due to the contrast media or the additional mechanical damage to the infarct vessel, precluding possible later spontaneous recanalization.

Originally stents were contraindicated in acute myocardial infarction, since they may promote further thrombosis. From observational reports it became clear, however, that stents can be deployed in infarct vessels with acceptable results[20-22]. As in other indications, the occlusion rate is lower in patients treated with antplatelet drugs than with anticoagulants[23]. These observations led to the widespread use of stents, increasing from 4-1% in 1994 to 53-6% in 1997 of the procedures in the registry. The primary angiographic success rates, as well as the clinical outcome in terms of short-term survival, however, were not improved by this change in intervention strategy. The reintervention rate was similar with and without stents (2-7% vs 3-0%, ns). Thus, while stents might improve the late result of PTCA, by reducing the restenosis rate, it seems unlikely that coronary stenting improves the early outcome of direct PTCA in acute myocardial infarction. A definitive answer to this question can only be given by appropriate randomized trials.

Similar to previous reports, the success rate of PTCA in patients with cardiogenic shock was only 75%, and 42% of those patients died despite complete reperfusion of the infarct-related artery. Only 17/89 patients survived after failed PTCA in cardiogenic shock. Earlier studies had claimed marked benefit from PTCA in cardiogenic shock, but this was based mostly on comparisons of successful with failed procedures[24-26]. The international SHOCK registry, however, reported a better prognosis in those patients with cardiogenic shock who had an angiogram, while additional PTCA had no effect on survival[27]. These data and the figures of our registry do not support the hypothesis, that the general use of PTCA can improve the prognosis of patients in cardiogenic shock. A note of caution may be sufficient to restrict the use of direct PTCA in cardiogenic shock in institutions with great expertise both in interventions and in the management of acute myocardial infarction.

References


