Changing characteristics and in-hospital outcome in patients admitted with acute myocardial infarction

Observations from 1982 to 1994


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Background During the past decade, various new treatments have become available for patients with acute myocardial infarction. The effects of these treatment modalities have been studied extensively in selected patient groups. These studies indicate that early diagnosis, risk stratification and prompt initiation of treatment are of crucial importance for optimal benefit. However, it is not known whether prognosis changed in all patients admitted with an acute myocardial infarction. Also, the characteristics of the infarct population may have changed over time because of new medication regimens, invasive interventions and awareness of the importance of risk factors.

Methods We studied all patients admitted with acute myocardial infarction in 1982, 1988 and 1994. Information on baseline characteristics, clinical variables and all interventions was collected.

Findings In those 3 years 223, 227 and 235 patients were admitted because of an acute myocardial infarction. Patients admitted in 1994 were older, more often female and less often had a previous cardiac history. More patients admitted in that year had previous balloon angioplasty and coronary bypass grafting. Smoking habits decreased during the past decade. In-hospital mortality was 38 (17%) in 1982, 23 (10%) in 1988 and 22 (9%) in 1994 (P<0.05). Variables related to high risk for in-hospital death in 1982 were higher age, low systolic blood pressure, atrial fibrillation, absence of accelerated idioventricular rhythm, sustained ventricular tachycardia and signs of left ventricular dysfunction; in 1988 the occurrence of non-sustained ventricular tachycardia, Killip class more than I, the absence of thrombolytic therapy, percutaneous transluminal coronary angioplasty or coronary artery bypass grafting were independently related to in-hospital death. In 1994, high risk variables for in-hospital death were dyspnoea on admission, sustained ventricular tachycardia, female gender, higher creatinine on admission, and a previous cardiac history.

Interpretation In-hospital mortality for unselected patients admitted with an acute myocardial infarction decreased between 1982 and 1988 and remained the same between 1988 and 1994, in spite of further ageing of the population. In the study period there has been a change in baseline characteristics and high risk variables for in-hospital death after myocardial infarction.

Key Words: Myocardial infarction, hospital, prognosis, mortality, morbidity.

Introduction

The reported decline in mortality from coronary heart disease has been explained by a decreased incidence and prevalence because of changes in lifestyle (diet, smoking, exercise) resulting in a decrease in risk factors, better pharmacological control of hypertension and new modes of treatment in the acute and chronic stage of ischaemic heart disease1-7. The in-hospital outcome of patients admitted with acute myocardial infarction has been the subject of many studies during the past 30 years. A meta-analysis from our group and data from other studies showed that the hospital outcome improved during the 1960s, 1970s and 1980s6,8. This decline in mortality has been related to different factors in each decennium10. In the 1960s (hospital mortality 22-29%) the widespread use of coronary care units and
the development of defibrillators reduced early mortality by about 5%[11]. In the 1970s (hospital mortality 17–21%) the use of the Swan–Ganz catheter and the introduction of different pharmacological treatments reduced mortality by approximately 4%. During the 1980s inhospital mortality rates decreased further to 13–16% related to the introduction of thrombolytic therapy and the widespread use of antplatelets and anticoagulant drugs, beta-blockers and the advent of coronary angioplasty[8,9,12–14].

Treatment of patients admitted with acute myocardial infarction has changed considerably during the 1980s. Until the end of the 1970s treatment of acute myocardial infarction consisted of pain relief and management of complications such as arrhythmias, heart failure and persisting ischaemia. In the late 1980s and early 1990s treatment focused on early reperfusion of the infarct related artery, after the use of thrombolytic agents showed improvement in left ventricular function and reduction of mortality[15–20]. Also, balloon angioplasty, coronary bypass grafting and a variety of new drugs were introduced in the acute and chronic phase of coronary heart disease. The purpose of this study has been to investigate a change in patient characteristics and hospital outcome in unselected patients admitted with an acute myocardial infarction.

**Patients and methods**

The study was performed at the Department of Cardiology of the Academic Hospital of Maastricht, the Netherlands. This is the only hospital in an area with approximately 180 000 inhabitants and therefore serves this area as a primary hospital for acute ischaemic heart disease. All patients from the area with signs of acute ischaemic heart disease are brought to this hospital. Only rarely are patients from the area admitted to other hospitals. The hospital records of all patients originating from the Maastricht area, admitted in 1982, 1988 or 1994 with myocardial infarction, unstable angina pectoris or possible acute ischaemia were reviewed. As a rule, the patients were admitted to the coronary care unit and only exceptionally to the general cardiology department of our hospital or to another hospital in the region. The admission diagnosis of acute myocardial infarction was made if there was a history of typical chest pain of more than 30 min duration, accompanied by ST-segment elevation of more than 0.1 mV in at least two inferior leads or three anterior leads and no contraindications. Aspartate aminotransferase and lactic dehydrogenase above the upper limit of normal.

Clinical variables were collected with emphasis on medical and invasive treatment. The use of various medications was registered on admission and during hospital stay. All interventions such as thrombolytic therapy, percutaneous transluminal coronary angioplasty (PTCA) and coronary artery bypass grafting (CABG) were registered. To evaluate the role of thrombolytic therapy, we introduced a variable in the patient groups; 'eligible for thrombolytic therapy'. For all three time periods the same criteria for this variable were used: chest pain of less than 6 h duration, ST-segment elevation of more than 0.1 mV in at least two inferior leads or three anterior leads and no contraindications for thrombolytic therapy.

**Statistical analysis**

The data were analysed by using the Statistical Package of the Social Sciences[21] and the SAS program[22]. Bivariate analysis was performed with the Student t-test to compare groups with continuous variables and chi-square for groups with discrete variables. To correct for cells with an expected count less than 5, the likelihood ratio chi-square was used and Fisher’s exact test. Variables reaching significance in the bivariate analysis, together with other relevant variables, were used in a multiple regression analysis. For these variables sensitivity, specificity and positive predictive accuracy were also calculated. The independent importance of different variables was calculated for in-hospital death. Data are presented as mean ± standard deviation.

**Changes in treatment between the study years**

Treatment in 1982 consisted of admission to the coronary care unit, continuous arrhythmia monitoring, intravenous pain relief with morphinimetics, prophylaxis of ventricular fibrillation by lidocaine unless contraindicated and when indicated haemodynamic monitoring using a Swan–Ganz catheter. Cardiac failure was treated with i.v. diuretics and sympathicomimetic drugs if needed. Beta-blockers, calcium antagonists, coumarin derivatives, oral nitrates and antiplatelet drugs were not prescribed routinely but only given for specific indications (Table 2). Thrombolytic therapy, PTCA and CABG were applied in a very small number of patients.
In 1988 and 1994 patients with acute myocardial infarction were admitted to the coronary care unit and treated with intravenous heparin and nitroglycerin if not contraindicated. Thrombolytic therapy was started when no contraindications were present and the duration of chest pain was less than 6 h. Primary PTCA was performed in patients with a contraindication for thrombolytic therapy, patients with a changing pattern of ST-segment elevation and severity of chest pain and also in the case of impaired haemodynamics.

Coronary arteriography followed by rescue PTCA was performed when no reperfusion occurred, as assessed by non-invasive signs of reperfusion, disappearance of chest pain, ST-segment normalization or occurrence of reperfusion arrhythmias. Coronary arteriography could also be performed in the setting of study protocols. Late coronary arteriography was performed in cases of ischaemia in rest or during exercise testing. PTCA or CABG were performed in cases of residual ischaemia and in patients with marked abnormalities at coronary arteriography, as judged by the attending clinician. Medical treatment at discharge consisted mostly of beta-blockers, aspirin and nitrates.

In 1994, patients with anterior myocardial infarction resulting in a diminished left ventricular function were treated with ACE inhibitors resulting in 24% of patients discharged on these drugs. Most patients were included in study protocols evaluating the safety and efficacy of new thrombolytic agents. In the absence of non-invasive signs of reperfusion, all infarction patients were referred for acute coronary angiography and if indicated followed by balloon angioplasty or coronary bypass grafting. In the cases of severe multivessel disease an intra-aortic balloon pump was inserted frequently as a bridge to CABG. Also in patients with a large infarction after reperfusion therapy an aortic balloon pump was inserted.

**Results**

**Baseline characteristics**

Table 1 shows demographic characteristics of all patients. The number of patients remained the same in the three study years; in 1982, 223; in 1988, 227 and in 1994, 235 patients were admitted with an acute myocardial infarction. However, the mean age increased and patients admitted in 1994 were significantly older. In 1982, 125 had inferior myocardial infarction (33 with right ventricular involvement) and 98 had anterior myocardial infarction. In 1988 there were 146 with inferior myocardial infarction (49 with right ventricular involvement) and 81 with anterior myocardial infarction. Finally in 1994, 148 had inferior myocardial infarction (50 with right ventricular involvement) and 87 had anterior myocardial infarction (Table 5). Table 1 also shows that differences were found for delay time between onset of symptoms and the admission time, smoking, and gender. Seventy five percent were admitted within 2.5 h in 1994, whereas this required 3-5 h in 1988 and 6 h in 1982 (P<0.05). Smoking was less frequent in 1988 and 1994 (48% vs 61% in 1982, P<0.01). Patients admitted in 1994 had significantly more frequent previous PTCA or CABG as compared to 1982. Heparin and nitroglycerin was the initial treatment in about 70% of the 1988 and 1994 patients.

In 1988 an acute intervention was performed in 43% (27% thrombolytics, 12% thrombolytics followed by rescue PTCA, 4% primary PTCA). In 1994, 51% underwent an acute intervention (29% thrombolytics, 11% thrombolytics followed by PTCA, 11% acute PTCA) (Table 1). As shown in Table 2, oral drug treatment varied significantly between the years, reflecting new insights because of the results of clinical trials with various new drugs. Aspirin, beta-blockers, calcium antagonists and ACE inhibitors were more often prescribed in the 1988 and 1994 patients whereas the use of nitrates, diuretics, coumarins and digoxin was more frequent in 1982.

**In-hospital mortality and morbidity**

Table 3 shows baseline characteristics of survivors versus non-survivors. In 1982, 38 (17%) patients died in hospital. None of these patients had received thrombolytic therapy, PTCA or CABG. The number of patients over the age of 70 years was 84 (38%) (of whom 26 (31%) died).

In 1988, 23 (10%) patients died in hospital (P<0.05). Of those, four had received thrombolytic therapy, primary PTCA in one, rescue PTCA in one, and CABG in one. In 1988, 70 (31%) patients were over the age of 70 years of whom 13 (19%) died. In 1994, 22
decrease in the number of arrhythmic deaths (13%-9%-
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failure in all 3 years. However, there was an increase in
anterior myocardial infarction admitted in 1982, 26% vs
5%). In 1994, fewer patients died of recurrent infarction.
In 1982, 125 patients had inferior (33 with right
ventricular involvement) and 98 anterior myocardial
infarction. Mortality was highest in patients with
previous myocardial infarction with right ventricular involvement decreased from 15% in 1982 to
10% in 1988 and 12% in 1994. The difference between
the number of right ventricular infarctions in all years
(33 vs 49 and 50) could be explained by the fact that
right precordial recordings were not performed routinely
in 1982 (Table 5).

The causes of death are listed in Table 4. It is
shown that the most frequent cause of death was pump failure in all 3 years. However, there was an increase in
patients dying from pump failure (40%-48%-66%) and a
decrease in the number of arrhythmic deaths (13%-9%-5%). In 1994, fewer patients died of recurrent infarction.

### Table 2. Drugs before admission, and at discharge in 1982 and 1988 and 1994. Figures are percentages. For all drugs
there is a significant difference in the number of prescriptions between the years

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Beta-blockers</td>
<td>13</td>
<td>29</td>
<td>30</td>
<td>53</td>
<td>26</td>
<td>58</td>
</tr>
<tr>
<td>Nitrates</td>
<td>28</td>
<td>79</td>
<td>27</td>
<td>50</td>
<td>5</td>
<td>21</td>
</tr>
<tr>
<td>Aspirin</td>
<td>4</td>
<td>5</td>
<td>11</td>
<td>73</td>
<td>24</td>
<td>72</td>
</tr>
<tr>
<td>Calcium antagonists</td>
<td>6</td>
<td>28</td>
<td>15</td>
<td>46</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Diuretics</td>
<td>26</td>
<td>59</td>
<td>18</td>
<td>19</td>
<td>18</td>
<td>16</td>
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<tr>
<td>Coumarins</td>
<td>9</td>
<td>37</td>
<td>7</td>
<td>19</td>
<td>4</td>
<td>16</td>
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<tr>
<td>ACE inhibitors</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td>Digoxin</td>
<td>11</td>
<td>46</td>
<td>7</td>
<td>10</td>
<td>4</td>
<td>10</td>
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### Table 3. Baseline characteristics of survivors and non-survivors

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</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>71.8</td>
<td>61.6***</td>
<td>71.5</td>
<td>61.7***</td>
<td>74.6</td>
<td>65.3***</td>
<td>74.6</td>
<td>65.3***</td>
<td>74.6</td>
<td>65.3***</td>
</tr>
<tr>
<td>&gt;70 years</td>
<td>26 (68)</td>
<td>(31)**</td>
<td>13 (57)</td>
<td>57 (28)*</td>
<td>15 (68)</td>
<td>74 (35)**</td>
<td>15 (68)</td>
<td>74 (35)**</td>
<td>15 (68)</td>
<td>74 (35)**</td>
</tr>
<tr>
<td>Male</td>
<td>20 (53)</td>
<td>131 (71)*</td>
<td>13 (57)</td>
<td>153 (75)</td>
<td>6 (27)</td>
<td>140 (66)**</td>
<td>140 (66)</td>
<td>140 (66)</td>
<td>140 (66)</td>
<td>140 (66)</td>
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<tr>
<td>Positive family history</td>
<td>28 (74)</td>
<td>116 (63)</td>
<td>11 (48)</td>
<td>114 (56)</td>
<td>5 (22)</td>
<td>86 (44)</td>
<td>86 (44)</td>
<td>86 (44)</td>
<td>86 (44)</td>
<td>86 (44)</td>
</tr>
<tr>
<td>Smoking</td>
<td>16 (42)</td>
<td>119 (64)*</td>
<td>8 (35)</td>
<td>105 (51)</td>
<td>5 (22)</td>
<td>108 (51)*</td>
<td>108 (51)</td>
<td>108 (51)</td>
<td>108 (51)</td>
<td>108 (51)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>8 (21)</td>
<td>25 (14)</td>
<td>2 (9)</td>
<td>15 (7)</td>
<td>3 (14)</td>
<td>18 (8)</td>
<td>18 (8)</td>
<td>18 (8)</td>
<td>18 (8)</td>
<td>18 (8)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>16 (42)</td>
<td>73 (39)</td>
<td>11 (48)</td>
<td>64 (31)</td>
<td>12 (55)</td>
<td>72 (34)</td>
<td>72 (34)</td>
<td>72 (34)</td>
<td>72 (34)</td>
<td>72 (34)</td>
</tr>
<tr>
<td>Previous CVA</td>
<td>4 (11)</td>
<td>14 (6)</td>
<td>2 (9)</td>
<td>10 (5)</td>
<td>5 (23)</td>
<td>7 (3)**</td>
<td>7 (3)**</td>
<td>7 (3)**</td>
<td>7 (3)**</td>
<td>7 (3)**</td>
</tr>
<tr>
<td>Previous angina</td>
<td>20 (53)</td>
<td>81 (44)</td>
<td>10 (43)</td>
<td>79 (39)</td>
<td>9 (41)</td>
<td>48 (23)</td>
<td>48 (23)</td>
<td>48 (23)</td>
<td>48 (23)</td>
<td>48 (23)</td>
</tr>
<tr>
<td>Previous MI</td>
<td>11 (29)</td>
<td>51 (28)</td>
<td>8 (35)</td>
<td>44 (22)</td>
<td>8 (38)</td>
<td>41 (19)</td>
<td>41 (19)</td>
<td>41 (19)</td>
<td>41 (19)</td>
<td>41 (19)</td>
</tr>
<tr>
<td>Previous PTCA</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2 (1)</td>
<td>1 (5)</td>
<td>10 (5)</td>
<td>10 (5)</td>
<td>10 (5)</td>
<td>10 (5)</td>
<td>10 (5)</td>
</tr>
<tr>
<td>Previous CABG</td>
<td>0</td>
<td>3 (2)</td>
<td>1</td>
<td>4 (1)</td>
<td>11 (5)</td>
<td>12 (6)</td>
<td>12 (6)</td>
<td>12 (6)</td>
<td>12 (6)</td>
<td>12 (6)</td>
</tr>
</tbody>
</table>

*P<0.05 **P<0.01 ***P<0.001, differences within one year.
CABG=coronary bypass grafting; MI=myocardial infarction; CVA=cerebrovascular accident; PTCA balloon angioplasty; Positive
family history=positive family history of coronary heart disease. Percentages within brackets.

### Eligibility for thrombolytic therapy

In 1982, 115 patients were eligible for thrombolytic therapy of whom 16 (14%) died; only three actually
received this kind of treatment and all survived. In 1988,
124 patients were eligible for thrombolytic therapy of
whom nine (7%) died; 89 (39%) received the drug on
admission and 10 (4%) later during admission because of
 recurrent infarction. Of the 99 patients who received
 thrombolytic therapy, four died in hospital. In 1994,

### Table 4. Causes of death (percentages between brackets)

<table>
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<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Arhythmic</td>
<td>5 (13)</td>
<td>2 (9)</td>
<td>1 (5)</td>
<td></td>
</tr>
<tr>
<td>Recurrent infarction</td>
<td>7 (18)</td>
<td>6 (26)</td>
<td>1 (5)</td>
<td></td>
</tr>
<tr>
<td>Pump failure</td>
<td>15 (40)</td>
<td>11 (48)</td>
<td>14 (66)</td>
<td></td>
</tr>
<tr>
<td>Other cardiac disease</td>
<td>9 (24)</td>
<td>3 (13)</td>
<td>3 (12)</td>
<td></td>
</tr>
<tr>
<td>Non-cardiac disease</td>
<td>2 (5)</td>
<td>1 (4)</td>
<td>3 (12)</td>
<td></td>
</tr>
</tbody>
</table>

*P<0.05 difference in total mortality between 1982 and 1988/1994.

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Table 5  Location of infarction in relation to mortality in-hospital

<table>
<thead>
<tr>
<th></th>
<th>1982</th>
<th></th>
<th>1988</th>
<th></th>
<th>1994</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Death</td>
<td>%</td>
<td>n</td>
<td>Death</td>
<td>%</td>
</tr>
<tr>
<td>Inferior</td>
<td>92</td>
<td>8</td>
<td>9</td>
<td>97</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Inferior+RVI</td>
<td>33</td>
<td>5  15</td>
<td></td>
<td>49</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Anterior</td>
<td>98</td>
<td>25  26</td>
<td>81</td>
<td>13</td>
<td>16</td>
<td>87</td>
</tr>
<tr>
<td>All*</td>
<td>223</td>
<td>38  17</td>
<td>227</td>
<td>23</td>
<td>10</td>
<td>235</td>
</tr>
</tbody>
</table>

*P<0.05 (difference in total mortality between 1982 and 1988/1994). RVI = inferior myocardial infarction with right ventricular infarction.

Table 6  Admission variables of prognostic importance for in-hospital death

<table>
<thead>
<tr>
<th>Variable</th>
<th>1982</th>
<th></th>
<th>1988</th>
<th></th>
<th>1994</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt;70 years</td>
<td>&lt;0.001</td>
<td>0.74 0.68</td>
<td>0.33</td>
<td>0.0031</td>
<td></td>
<td></td>
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<tr>
<td>Sustained VT</td>
<td>&lt;0.001</td>
<td>0.21 0.96</td>
<td>0.53</td>
<td>0.0090</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>&lt;0.001</td>
<td>0.29 0.92</td>
<td>0.44</td>
<td>0.0026</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No AIVR</td>
<td>0.088</td>
<td>0.95 0.16</td>
<td>0.19</td>
<td>0.0605</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic BP &lt;100</td>
<td>&lt;0.05</td>
<td>0.32 0.89</td>
<td>0.37</td>
<td>0.0500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart failure</td>
<td>&lt;0.001</td>
<td>0.76 0.62</td>
<td>0.29</td>
<td>0.0023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Killip &gt;I</td>
<td>&lt;0.001</td>
<td>0.46 0.66</td>
<td>0.21</td>
<td>0.0514</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSVT</td>
<td>&lt;0.05</td>
<td>0.45 0.71</td>
<td>0.14</td>
<td>0.0310</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Killip &gt;I</td>
<td>&lt;0.001</td>
<td>0.61 0.87</td>
<td>0.35</td>
<td>0.0001</td>
<td></td>
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<tr>
<td>No intervention</td>
<td>&lt;0.05</td>
<td>0.74 0.84</td>
<td>0.16</td>
<td>0.0285</td>
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</tbody>
</table>

Phenomenon (1982) = accelerated idioventricular rhythm; BP = blood pressure; Intervention = thrombolysis, PTCA, CABG or combination; NSVT = non-sustained VT; VT = ventricular tachycardia. P (final column) >t (multivariate), P (first column) = probability of chi-square/Student's t-test. PPV = positive predictive accuracy.

119 patients were eligible for thrombolytic therapy of whom seven (6%) died; 93 (40%) patients received thrombolitics of whom four died.

**Morbidity**

Morbidity was assessed in terms of residual angina pectoris and dyspnoea at discharge according to the criteria of the New York Heart Association. In 1988 and 1994 more patients had angina pectoris functional class I and/or dyspnoea functional class I prior to discharge as compared to 1982 (87%-72%). Due to the worse pre-admission functional class of the patients in 1982, more improvement was found in this group than in 1988.

**Bivariate analysis and multiple regression analysis (Table 6)**

In 1982, nine variables were bivariately related to in-hospital death: higher age, female gender, no smoking, signs of left ventricular dysfunction, atrial fibrillation, absence of accelerated idioventricular rhythm, right bundle branch block, sustained ventricular tachycardia, and Killip class >I. Independently related variables, identified with multiple regression were: signs of left ventricular dysfunction, atrial fibrillation, higher age, sustained ventricular tachycardia, low systolic blood pressure on admission, Killip >I, absence of accelerated idioventricular rhythm.

In 1988, six variables were bivariately related to in-hospital death; dyspnoea on admission, pulmonary rales, Killip class >I, not receiving thrombolitics, PTCA or CABG, the occurrence of non-sustained ventricular tachycardia and a longer delay time before admission. When stepwise multiple regression analysis was used, Killip more than I, absence of an intervention (thrombolitics, PTCA, CABG), and the occurrence of non-sustained ventricular tachycardias were independently related to in-hospital death.

In 1994 bivariate analysis showed 10 variables to be related to in-hospital death; previous cerebrovascular accident, dyspnoea on admission, signs of heart failure.
during admission, sustained ventricular tachycardia, atrial fibrillation, female gender, absence of an intervention, elevated creatinine on admission, a previous cardiac history. Multivariate analysis identified five variables independently related to in-hospital death: elevated creatinine on admission, a cardiac history, sustained ventricular tachycardia, female gender and dyspnoea on admission.

Discussion

The main findings of this study are that mortality and morbidity during hospital stay improved for unselected patients admitted with myocardial infarction during the past decade and that interventions such as thrombolytic therapy, PTCA or CABG were independently related to a better outcome in 1988. There were significant differences in some baseline characteristics between the years. Patients admitted in 1994 were significantly older and more often female; also the time between the onset of complaints and admission was shorter. In 1982, 75% of patients were admitted within 6 h after the start of chest pain whereas this was 3-5 h for the 1988 group and 2.5 h for 1994. This earlier admission to hospital might be related to an increased awareness by the public and health workers of the importance of urgent admission to the hospital in cases of acute chest pain. Also, the finding that more patients admitted in 1988 and 1994 have previous PTCA and CABG may have increased the awareness of symptoms among individuals. It was of interest to see that significantly fewer patients of 1988 were smokers. Although it is well known that smoking increases the risk of coronary artery disease, we observed a better outcome after myocardial infarction in smokers. This may suggest a more severe course in non-smoking individuals who succumb to coronary heart disease, as reported previously.

The in-hospital mortality we found in 1982 is comparable to other studies and the difference with 1988 and 1994 is significant. Of importance is the fact that mortality also decreased in the older age group (>70 years). This finding suggests that there will be more elderly patients with coronary heart disease in the future.

Mortality was highest in patients admitted in 1982 with anterior myocardial infarction; in 1994, mortality in patients with inferior myocardial infarction and right ventricular involvement was the same as for anterior myocardial infarction. However, mortality from inferior myocardial infarction with right ventricular infarction has been reported to be high. As reported previously, patients with signs of left ventricular dysfunction and non-sustained ventricular tachycardias in the coronary care unit represent a high risk group for subsequent death in all three years. We also found that the absence of treatment with either thrombolytics, PTCA or CABG was associated with a high risk for death in-hospital for our unselected patient groups of 1988. In 1994 this variable did not reach significance in the multivariate model. Also in the present study, right bundle branch block and the occurrence of ventricular tachycardias in the subacute phase were an indicator for pump failure and early death, as previously described by our group, although in the multivariate model, right bundle branch block did not reach significance due to the association with pump failure. This finding is important because of its easy recognition on the surface electrocardiogram. The occurrence of accelerated idioventricular rhythm as a sign of reperfusion was independently related to a better outcome for patients admitted in 1982 and is in agreement with results of clinical trials showing a better outcome in patients with an open vessel. The use of beta-blockers, aspirin, ACE inhibitors, nitrates and calcium antagonists may also have contributed to the decreased mortality although its influence is expected more after discharge.

An important variable in this study is ‘eligible for thrombolytic therapy’. This variable is based on the admission ECG and the history. We found the number of eligible patients stable throughout the study years (115 patients in 1982, 124 in 1988 and 119 in 1994). No significant differences in baseline variables were found between the three years. Mortality was significantly lower in 1988 and 1994. The significant decrease in mortality and morbidity can be allocated to the use of thrombolytics and is in agreement with the results of clinical trials. However, a minority of patients with myocardial infarction actually receive these forms of therapy. A study reported a figure of 18% for patients receiving thrombolytic therapy. In 1988 and 1994 the percentage of patients receiving thrombolytics was 39% and 40%. The variable ‘eligible for thrombolytic therapy’ selects the ideal patient for this treatment and within this group 71% and 76% received thrombolytics in 1988 or 1994, which is in agreement with previous studies; the remaining patients had exclusions or reacted well on the initial treatment with heparin and nitroglycerin.

More patients admitted in the early 1980s died of an arrhythmia, whereas more of 1988 and 1994 died of pump failure. This change is probably due to the fact that nowadays more patients with acute myocardial infarction survive the acute phase, but finally develop heart failure. However, the differences in the cause of death only show a trend but are not significant. In 1994 more patients had a previous PTCA or CABG and it is expected that future myocardial infarction patients will more often have a history of previous coronary heart disease, which may result in less favourable mortality figures for the total infarct population.

Limitations

The decrease in mortality over time may not only be explained by the changes in treatment but also by the changes in baseline variables; however, patients admitted during the latter years were older and more often women. Because we studied two patient cohorts...
admitted in the 1980s the advent of new ways of treatment after myocardial infarction such as ACE inhibition, cannot be evaluated. Therefore to answer the question whether this also led to improvement of long-term prognosis we are presently performing an analysis of the same patient cohorts after discharge.

Conclusion and implications

In three unselected patient groups admitted with acute myocardial infarction in 1982, 1988 and 1994, an improved in-hospital survival was observed in 1988 and 1994. Risk factors for in-hospital death have changed over the years with absence of a reperfusion intervention becoming an independent predictor of adverse outcome. Whereas randomized clinical trials are important to prove the value of a given diagnostic or therapeutic strategy, the value of studying unselected patients over time is important to obtain: (1) population-based information (incidence, age distribution, gender differences), (2) insight into how many patients actually receive these treatments, (3) insight into mortality figures of the whole population. When these studies are repeated information is gained on changes in the myocardial infarction population, changes in treatment and resulting changes in prognosis. Careful monitoring of baseline variables, changes in lifestyle, diagnostic workup, treatment and related costs, risk stratification the patients who need a more aggressive approach, related mortality and morbidity will lead to a better insight into the development and impact of the disease in the general population.

References


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