Factors Influencing Outcome in Patients Admitted to a Medical Intensive Care Unit After Successful Cardiopulmonary Resuscitation

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P. Kaufmann, K. H. Smolle, R. Gasser

Cardiopulmonary resuscitation is often unsuccessful or subsequently associated with a high mortality rate. We therefore wished to evaluate risk factors which could influence outcome. Out of 411 adult patients admitted to a medical intensive care unit (ICU) after cardiac arrest, 52% survived to be discharged from the ICU, and 33% were discharged from hospital. Nonsurviving patients included a high percentage of elderly persons (≥75 yrs), patients with coronary heart disease (38% vs. 18% and 77% vs. 67%, respectively), and patients with chronic diseases (6 = median vs. 4; p < 0.001). In addition, severe acute organ diseases such as coronary heart disease (CHD), cardiomyopathy, chronic pulmonary disease, chronic renal failure, liver cirrhosis, malnutrition, immunosuppression, physical limitation as a result of stroke, rheumatoid arthritis, gallstone disease etc. Patients were classified as having CHD if they had a history of myocardial infarction and/or stable angina pectoris and/or signs of CHD in the electrocardiogram. In addition, CHD was diagnosed in patients admitted with acute coronary syndrome or acute myocardial infarction.

Severity of Illness
Severity of illness was estimated on the day of admission using the Acute Physiology Score (APS) [8]. APS is a part of the APACHE-III score (APACHE = Acute Physiology And Chronic Health Evaluation) where points are given for 16 physiologic variables (vital signs and laboratory abnormalities). Greater deviations from normal result in a higher score.

Statistical Analysis
The chi-square test was used to compare age groups and diagnostic categories. Distribution fitting of metric data was achieved with the Kolmogorov-Smirnov test. Since the data of age, plasma-lactate levels and APA scores were not normally distributed, they were summarized using the median and the interquartile range (25th to 75th percentile). Statistical comparison was done with the Kruskal-Wallis test. Differences at a level of p < 0.05 were considered to be significant.

Results
The clinical characteristics of the patients are summarized in Table 1. Mortality rate in the ICU was 48% and in hospital 67%. Survivors were significantly younger and their total number of chronic diseases was significantly lower. Cardiovascular diseases were predominant in the whole study population. Death, however, was not related to the diagnostic category responsible for cardiac arrest.

As shown in Figure 1, APA scores were higher in patients who did not survive during the hospital stay (93 median, 33 interquartile range vs. 67, 21; p < 0.01). The proportion of patients with coronary heart disease was high in all resusc-
tated patients, but was significantly higher in patients who died. In this group the levels of plasma lactate were higher than those of the survivors.

Table 1. Characteristics of patients after cardiopulmonary resuscitation (CPR)

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>CPR Patients total (n = 411)</th>
<th>Survivors (n = 151)</th>
<th>Not survived (n = 260)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 (18)</td>
<td>64 (21)**</td>
<td>71 (16)**</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>18**</td>
<td>38**</td>
<td></td>
</tr>
<tr>
<td>Sex (% male/female)</td>
<td>59/41</td>
<td>62/38</td>
<td>58/42</td>
</tr>
<tr>
<td>Diagnoses category (n; %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>300; 72</td>
<td>104; 76</td>
<td>196; 73</td>
</tr>
<tr>
<td>Respiratory</td>
<td>41; 9</td>
<td>16; 11</td>
<td>25; 9</td>
</tr>
<tr>
<td>Neurologic</td>
<td>27; 7</td>
<td>3; 2</td>
<td>2; 4</td>
</tr>
<tr>
<td>Metabolic</td>
<td>10; 3</td>
<td>5; 4</td>
<td>5; 2</td>
</tr>
<tr>
<td>Trauma</td>
<td>8; 2</td>
<td>2; 1.5</td>
<td>6; 2</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>7; 2</td>
<td>3; 2</td>
<td>4; 1.5</td>
</tr>
<tr>
<td>Renal</td>
<td>7; 2</td>
<td>3; 2</td>
<td>4; 1.5</td>
</tr>
<tr>
<td>Systemic</td>
<td>7; 2</td>
<td>2; 1.5</td>
<td>5; 1.8</td>
</tr>
<tr>
<td>Haemato logic</td>
<td>2; 0.5</td>
<td>–</td>
<td>2; 0.2</td>
</tr>
<tr>
<td>Psychiatric</td>
<td>2; 0.5</td>
<td>1; –</td>
<td>1; –</td>
</tr>
<tr>
<td>Chronic diseases (n)</td>
<td>5 (4)</td>
<td>4 (3)**</td>
<td>6 (4)**</td>
</tr>
<tr>
<td>Coronary disease (%)</td>
<td>72**</td>
<td>67**</td>
<td>77**</td>
</tr>
<tr>
<td>Lactate (mmol/l)</td>
<td>7.2 (6.4)</td>
<td>5.3 (4)**</td>
<td>8 (6.2)**</td>
</tr>
<tr>
<td>Days of intensive care in hospital</td>
<td>4 (7)</td>
<td>4 (7)**</td>
<td>3 (7)**</td>
</tr>
<tr>
<td>Days of in hospital</td>
<td>10 (19)</td>
<td>22 (19)**</td>
<td>5 (13)**</td>
</tr>
</tbody>
</table>

Not survived: death in hospital; intergroup differences are indicated by the same number of asterisks (*p < 0.001, *p < 0.05); percentages are given from column totals; data for age, lactate and days are given as median and (interquartile range).

Discussion

This study shows that advanced age, a high number of chronic diseases and the presence of coronary heart disease are risk factors for death in adult patients admitted to intensive care after successful cardiopulmonary resuscitation. In addition, severe deviations of physiologic parameters from normal and high plasma lactate levels contribute to a fatal outcome.

The high ICU and hospital mortality of the study patients is consistent with previous investigations [4, 5]. Nevertheless, it should be emphasized that after ICU discharge the proportion of deaths during hospitalization further increased by 19%. This is a higher percentage when compared to the mortality of the whole patient population in ICUs (5–15%) [9]. An explanation is that many of the resuscitated patients require a high level of nursing care after discharge from the ICU, mainly due to impaired neurologic control of swallowing and airway management. The staff of standard hospital wards may be overworked and often there are no intermediate-care facilities. In addition, triage procedures in ICUs and the decision not to resuscitate in futile patients may contribute to further deaths.

As in the general population of industrialized countries, the proportion of elderly patients requiring intensive care is increasing. They are more likely to have chronic diseases and poor prior health, diminishing physiological reserves and a predisposition for multiorgan failure [10]. Age and comorbidities have been shown to be independently related to mortality rate and recovery of neurologic function [11]. Unfortunately, physiological reserves cannot be measured directly and therefore information on risk factors and pre-admission health status had to be obtained from patient history. This was completed by ultrasound images of the heart and abdo men to confirm preexisting information or find additional diagnosis (eg, left ventricular hypertrophy or diminished kidney size) [12]. However, the mere total of risk factors and chronic diseases may be used as a rough measure of the ability to recover from acute illness. Further studies are necessary to evaluate an impact hierarchy of risk factors (from the strongest to the weakest) and comorbidities on physiological reserve.

Although the primary diagnosis of the patient is important for subsequent therapeutic management, we were not able to find an impact on hospital mortality in the subgroup of ICU patients after cardiac arrest. This may in part be due to a statistical problem. As Table 1 shows, there is a predominance of neurologic, sepsis, non-operative trauma and haematologic patients in the group of non-survivors, but patient numbers are too small to reach statistical significance. In contrast, the severity of the disease itself, as estimated by the APS score, influences outcome. These findings are supported by Bastos et al. [13], who have demonstrated that a severe impairment of consciousness after admission to the ICU is associated with a poor prognosis. These findings are supported by biochemistry: patients who did not survive to hospital discharge had significantly higher plasma lactate levels when compared to survivors. This reflects prolonged systemic hypoperfusion and tissue hypoxia until the onset of cardiopulmonary resuscitation [14].

Although death during hospitalization is the most immediate and readily discernible outcome, it is only a limited measure of the effectiveness of intensive care [26]. The objective in the ICU is not simply to keep the patient alive in the hospital. Quality of life after dismissal from hospital was not evaluated. An objective estimation of the patient’s clinical course after hospitalization would be necessary to interpret outcomes after cardiac arrest.
References


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