Accuracy and Impact of Presumed Cause in Patients With Cardiac Arrest

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Background—International guidelines recommend differentiation between cardiac and noncardiac causes of cardiac arrest. The aim of this study was to find the rate of agreement between primarily postulated and definitive causes of cardiac arrest.

Methods and Results—We retrospectively analyzed the primarily presumed cause of cardiac arrest as determined by the emergency room physician on admission in all patients admitted to the emergency department of one urban tertiary care hospital. This was compared with the definitive cause as established by clinical evidence or autopsy. Within 4 years, the initially presumed cause was unclear in 24 (4%) of 593 patients. In the remaining 569 patients, the presumed cause was correct in 509 (89%) and wrong in 60 (11%) cases. Cardiac origin was presumed in 421 (71%) and the definitive cause in 408 (69%) cases. Noncardiac origin was presumed in 148 (25%) and the definitive cause in 185 (31%) patients. Presumed cardiac cause was sensitive (96%) but less specific (77%). Noncardiac causes such as pulmonary embolism, cerebral disorders, or exsanguination were those most frequently overlooked. Asystole occurred significantly more often in patients in whom presumed cause remained undetermined or differed from the definitive cause.

Conclusions—Cause of cardiac arrest is not as easily recognized as anticipated, especially when the initial rhythm is different from ventricular fibrillation. This might affect comparability of study results, therapeutic strategies, prognosis, and outcome. Patients in whom the presumed cause was confirmed as being correct had significantly better survival and neurological outcome. (Circulation. 1998;98:766-771.)

Key Words: resuscitation ■ epidemiology ■ heart arrest ■ pathology

To ensure comparability of data regarding out-of-hospital cardiac arrest, a uniform reporting style of gathering and presenting such material, the Utstein guidelines have been published. Since 1990 most scientific publications in the field of resuscitation adhere to this de facto standard. In this protocol the differentiation between cardiac and noncardiac causes is obligatory.

The guidelines were developed with the fact in mind that most out-of-hospital cardiac arrests are of cardiac origin. On the other hand, cardiac arrest of noncardiac cause was assumed to be “often obvious and easy to determine,” for example, drowning, drug overdose, and so on. Accordingly, data from those patients who presumably have cardiac arrest from any other cause should not be used for comparison with those whose arrest was of cardiac origin.

Experience shows that the first presumed cause of cardiac arrest is sometimes wrong. This may be explained by the fact that at the time of emergency cardiac care, very little information regarding the patient’s medical history is available. Therefore, any assumption of the cause of cardiac arrest should rather be regarded as a working hypothesis.

To determine the accuracy of the presumed cause in patients with cardiac arrest, we analyzed in a retrospective study the primarily presumed cause of cardiac arrest. This was determined by the emergency room physician on admission in all patients brought to the emergency department of one urban tertiary care hospital within July 1991 and July 1995. We then tried to analyze the cases in which the presumed cause was wrong and to assess the reasons for such misinterpretations. We also tried to find out whether this makes a difference in mortality rate and cerebral outcome and attempted to find common indicators that might function as a warning signal in such cases.

Methods

Between July 1991 and July 1995, all patients admitted to the Department of Emergency Medicine of the University Hospital of Vienna after either in-hospital or out-of-hospital cardiac arrest were documented on arrival according to a specific protocol (Utstein Style). Patients with in-hospital cardiac arrest include mainly patients from our department. In addition, because beds in the intensive care units (ICU) are limited, almost all those patients with cardiac arrest in one of the regular wards or outpatient departments...
are first brought to the emergency department for stabilization before being admitted to an ICU.

The study procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1975, as revised in 1983.

According to the criteria of the American Heart Association, cardiac arrest was defined as sudden collapse followed by loss of consciousness and absence of both spontaneous respiration and pulse that required cardiopulmonary resuscitation. Acute care including basic and advanced cardiac life support performed by the Vienna Ambulance Service and in-hospital emergency medical personnel was in accordance with international guidelines. The Vienna Emergency Medical System is based mainly on the municipal ambulance service founded 1881. Medical emergencies are reported over one emergency telephone number (144) to the central dispatch center, received by a medical technician, processed by computer, and passed on to the dispatcher, who assigns a mobile intensive care unit staffed by a physician and two emergency medical technicians. Patients with cardiac arrest are usually successfully resuscitated or pronounced dead by the ambulance physician. Only patients with special problems such as hypothermia are transported to the hospital under active cardiopulmonary resuscitation.

At the emergency department, a physician stated the presumed cause of cardiac arrest mainly on the basis of the initial perceptions of the ambulance physician. In addition, if available, the patient history, including previous physician reports, bystander information, preclinical run sheets, and ECG was used. He had to select one of the following possible causes: cardiac, respiratory, cerebral, near drowning, hypothermia, drug overdose, metabolic, trauma, sepsis, exanguination, others, or unknown cause of cardiac arrest.

Respiratory cause includes pulmonary embolism as well as asphyxia by upper airway obstruction, status asthmaticus, and pneumonia. Cerebral cause includes cerebrovascular accident and intracerebral or subarachnoidal hemorrhage. Atraumatic exsanguination includes gastrointestinal bleeding as well as ruptured aortic aneurysm. No patients with trauma are managed in our department because there is an independent Department of Traumatology for special problems such as hypothermia.

Definitive cause of cardiac arrest in nonsurvivors was determined from autopsy in almost all cases. Cardiac dissection was performed according to standard procedures. The coronary artery tree was examined by transverse cuts at 0.25-cm intervals to localize significant stenosis of coronary arteries as well as thrombotic events. Ischemic damage of the myocardium was evaluated by macroscopic appearance of coagulation necrosis and by staining with nitroblue tetrazolium. As required by law, persons without relevant medical history before cardiac arrest were examined by the Department of Forensic Pathology. In the survivors, we examined hospital records including the patient’s history, clinical examination, and additional investigations after admission, for example, laboratory examinations, repeated 12-lead ECGs, radiographs and computed tomography scans, abdominal ultrasound, transthoracic and transesophageal echocardiography, selective coronary angiography, and electrophysiological stimulation study. Acute myocardial infarction was diagnosed by 12-lead ECGs showing ST-segment elevation >0.2 mV in two precordial leads or >0.1 mV in 2 limb leads and subsequent development of Q waves within the hospital stay. All surviving patients with cardiac cause and good neurological outcome underwent coronary angiography. Additionally, patients in whom a primary rhythm disorder was suspected underwent electrophysiological examination.

We assigned the patients to one of two groups: The first group (group 1) consisted of the patients in whom the presumed cause was later confirmed as being correct. The second group (group 2) consisted of patients in whom the presumed cause was not determined by the emergency physician or differed from the definitive cause. The patients in these two groups were compared for common denominators such as sex, age, location of cardiac arrest (out-of-hospital versus in-hospital); initial ECG rhythm observed by any rescue worker, distinguishing between ventricular fibrillation, pulseless ventricular tachycardia, asystole, or pulseless electric activity/electromechanical dissociation (PEA/EMD); lack or presence of bystander cardiopulmonary resuscitation; and estimated time until restoration of spontaneous circulation. For the time interval from cardiac arrest to start of basic and/or advanced life support, we presumed sufficient systemic blood flow to be absent (no flow). The time interval from start of life support until return of spontaneous circulation we presumed to be representative for reduced systemic blood flow (low flow).

Mortality and cerebral function were assessed prospectively on arrival and at regular intervals within 6 months after return of spontaneous circulation in terms of the cerebral performance categories (CPC 1 to 5). Definitions are CPC 1, conscious and alert with normal function or only slight disability; CPC 2, conscious and alert with moderate disability; CPC 3, conscious with severe disability; CPC 4, comatose or in a persistent vegetative state; and CPC 5, brain death. The best CPC score achieved within 6 months was used for the analysis. A CPC score of 1 or 2 was considered as favorable and a CPC score of 3, 4, or 5 was considered as unfavorable functional neurological outcome. The investigator assessing the CPC score was blinded to data concerning resuscitation as well as to other medical data.

According to the Utstein Style, data are expressed as median and interquartile range (IQR). Percentages were determined for dichotomous variables. We used the Mann-Whitney U test for the comparison of groups and the χ² test for comparison of proportions. We reviewed the accuracy of presumed cause of cardiac arrest by comparing the number of cases in which presumed cause was correct or wrong, calculating sensitivity and specificity of each factor. A value of P<0.05 was considered statistically significant.

Results

Of the 612 patients admitted between July 1991 and July 1995, 19 had to be excluded because we were unable to establish any cause of cardiac arrest (Figure). Of the remaining 593 patients, 193 (33%) were female, the median age was 62 years (IQR 51 to 71), and cardiac arrest occurred out-of-
hospital in 424 (72%) patients. Within the observation period of 6 months after cardiac arrest, 435 (74%) of 593 patients
died. Autopsy was performed on 398 patients (91%), 40 of
those at the Department of Forensic Pathology and the rest at
the Department for Clinical Pathology.

The emergency physician stated the reason for the cardiac
arrest to be undetermined in 24 (4%) of 593 cases (Figure).
We were able to establish a definitive diagnosis in all of these
patients. The cause was of cardiac origin in 11 patients,
cerebral in 4, and respiratory in another 4 patients. In 3 patients
the underlying cause was metabolic, in 1 patient it
was sepsis, and in 1 it was exsanguination.

In the remaining 569 (96%) of 593 patients, a presumed
cause of cardiac arrest could be stated by the emergency
physician. The presumed causes of cardiac arrest and their
specific subcategories are listed together with the definitive
cause in Table 1. Noncardiac causes were primarily underes-
timated. The presumed cause was correct in 509 (89%) cases
and wrong in 60 (11%) cases. Data for subgroups and sensitivity
and specificity of presumed cause in patients with
cardiac arrest of cardiac or noncardiac origin are shown in
Table 2.

Cardiac arrest was described to be of cardiac origin in 421
of these patients. This assumption was correct in 382 and
wrong in 39 patients. Noncardiac origin was suspected in 148
patients. This was correct in 127 and wrong in 21 patients
(Figure and Table 2).

The definitive cause was of cardiac origin in 408 (69%) and
noncardiac origin in 185 (31%) patients (Table 1). Of those 408 patients, acute myocardial infarction was the most
common cardiac cause of cardiac arrest [255 (63%)]. Of the
remaining 153 patients (37%), sudden cardiac death was the
result of a primary electric event in 116 (28%) patients and
the result of hypoxia caused by cardiac pulmonary edema in
37 (9%) patients. In this group of 153 patients without acute
myocardial infarction, coronary artery disease was found in
50 (12%), dilated cardiomyopathy in 33 (8%), ischemic cardiomyopathy in 28 (7%), and hypertensive cardiomyopa-
thy in 11 (3%) patients. Other cardiac causes were established
in 31 (8%) cases, including 4 with idiopathic ventricular fibrillation and 2 with complete heart block degenerating into
ventricular fibrillation.

We grouped the patients who had a cardiac arrest of
noncardiac origin (n=185) into subcategories according to
the most frequent cause, as presented in Table 1. Of 59
patients with cardiac arrest of respiratory origin, 27 had
cardiac arrest after pulmonary embolism (23 of them had
deep vein thrombosis) and 12 after status asthmaticus. Of 27
patients with cardiac arrest caused by exsanguination, 17 had
ruptured aortic aneurysm (13 abdominal and 4 thoracic).

Presumed cardiac cause was highly sensitive (95%) but
less specific (77%). In comparison, specificity for the differ-
ent noncardiac causes was 98% and better. Most often,
presumed diagnoses failed to consider exsanguination, cere-
breal disorder, respiratory disease, sepsis, and metabolic dis-
order as cause of cardiac arrest. In Table 3, we show the
distribution of erroneously presumed causes within the defin-
teive causes. We found that in 39 cases in which a cardiac
origin had been primarily suspected, 14 patients had cardiac
arrest from respiratory origin (10 pulmonary embolisms), 10
because of exsanguination after a ruptured aortic aneurysm (2
thoracic, 5 abdominal) and 7 for cerebral reasons. Of 12 cases
with suspected respiratory origin of cardiac arrest, 9 were in
fact of cardiac origin (6 acute myocardial infarction).

We then compared group 1 (n=509), which consisted of
the patients in whom the presumed cause was later confirmed
as being correct, with group 2 (n=84), which consisted of 24
patients with undetermined and 60 patients with erroneous
presumed first diagnosis regarding various parameters at the
time of resuscitation. We did not observe a statistically
significant difference between the two groups regarding the
location of cardiac arrest (out-of-hospital versus in-hospital),
whether or not the cardiac arrest was witnessed, the presence
or the lack of bystander CPR, and the sex of the patients, as
shown in Table 4. When comparing the most frequently
documented initial rhythms, we found a significant difference
between the two groups for ventricular fibrillation and asyst-
tole as described in Table 4. In group 2, asystole was found
as the initial rhythm in 50% of the cases compared with 20%
in group 1. The times of no flow and low flow were not different in the two groups. For all groups, the median no-flow time was 1 minute (IQR 0 to 7 minutes) and the low-flow time was 10 minutes (IQR 3 to 20 minutes).

The rate of no restoration of spontaneous circulation was significantly higher in group 2 (34%) than in group 1 (20%), as seen in Table 5 (P<0.003). Of all patients who achieved restoration of spontaneous circulation initially, 306 (52%) died within 6 months, with a median survival of 1 day (IQR 1 to 8) [group 1, 2 days (IQR 1 to 8) and group 2, 7 days (IQR 2 to 35)]. Out of all patients, 158 (26%) were discharged alive. When comparing the two groups, group 1 had a significantly better outcome (P<0.001). Of all surviving patients, 138 patients (87%) had a good neurological outcome with a CPC score of 1 or 2. Those patients in whom the presumed cause was later confirmed as being correct had a significantly better neurological outcome than patients with undetermined or erroneous presumed first diagnosis (<0.001) (Table 5).

### Discussion

Comparing the initial assumption regarding the cause of cardiac arrest with the definitive diagnosis, the first presumed cause of cardiac arrest is disproved in 11% of the studied cases. In another 4% of the patients the emergency physician could not reach a conclusion regarding the cause of cardiac arrest. In our study, cardiac arrest of cardiac origin is most common (69%) and is recognized with a sensitivity of 95%. This might be explained by the fact that in most patients with ventricular fibrillation as the first documented rhythm, a cardiac cause is the most likely cause of cardiac arrest.4 The relatively low specificity of 77% reflects those patients who were erroneously assumed to have suffered cardiac arrest of cardiac origin, although it was actually of noncardiac origin. When we examined the real cause for this group of patients, we found that especially pulmonary embolism, ruptured aortic aneurysm, and neurological disorders such as intracerebral and subarachnoidal hemorrhage were erroneously classified as cardiac arrest of cardiac origin. Silvfast2 and Kuiska and Alspää7 came to similar proportions in their studies. The reason might be that although these diseases are not uncommon, the patients rarely have cardiac arrest as first manifestation. Because of this, there might be a lack of experience in interpreting the possible prearrest clinical symptoms cor-

<table>
<thead>
<tr>
<th>Definitive Cause</th>
<th>Cardiac (n=39)</th>
<th>Respiratory (PE) (n=12)</th>
<th>Neurological (n=2)</th>
<th>Drug Overdose (n=1)</th>
<th>Exsanguination (n=2)</th>
<th>Metabolic (n=4)</th>
<th>Total (n=60)</th>
</tr>
</thead>
<tbody>
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<td>1</td>
<td>2</td>
<td>2</td>
<td>15</td>
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<td>Respiratory (PE)</td>
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<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Cerebral</td>
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<td>1</td>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Drug overdose</td>
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<td>1</td>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Exsanguination</td>
<td>10</td>
<td>...</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Metabolic</td>
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<td></td>
<td>...</td>
<td></td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Sepsis</td>
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<td></td>
<td></td>
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<td>3</td>
</tr>
<tr>
<td>Near drowning</td>
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<td></td>
<td></td>
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<td></td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
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<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

PE indicates pulmonary embolism.

### Table 3. Distribution of Erroneous Presumed Cause Within Definitive Cause of Cardiac Arrest

<table>
<thead>
<tr>
<th>Definitive Cause</th>
<th>Cardiac (n=39)</th>
<th>Respiratory (PE) (n=12)</th>
<th>Neurological (n=2)</th>
<th>Drug Overdose (n=1)</th>
<th>Exsanguination (n=2)</th>
<th>Metabolic (n=4)</th>
<th>Total (n=60)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>...</td>
<td>9 (8)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Respiratory (PE)</td>
<td>14 (10)</td>
<td>...</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Cerebral</td>
<td>7</td>
<td>1</td>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Drug overdose</td>
<td>2</td>
<td>1</td>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Exsanguination</td>
<td>10</td>
<td>...</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>11</td>
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<tr>
<td>Metabolic</td>
<td>2</td>
<td></td>
<td>...</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Sepsis</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Near drowning</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
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</tbody>
</table>

### Table 4. Factors at Time of Resuscitation

<table>
<thead>
<tr>
<th>Factors</th>
<th>Total (n=593)</th>
<th>Group 1* (n=509)</th>
<th>Group 2† (n=84)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>400 (67)</td>
<td>347 (68)</td>
<td>53 (63)</td>
<td>0.38</td>
</tr>
<tr>
<td>Female</td>
<td>193 (33)</td>
<td>162 (32)</td>
<td>31 (37)</td>
<td></td>
</tr>
<tr>
<td>Out-of-hospital arrest</td>
<td>424 (72)</td>
<td>365 (72)</td>
<td>59 (70)</td>
<td>0.782</td>
</tr>
<tr>
<td>In-hospital arrest</td>
<td>169 (28)</td>
<td>144 (28)</td>
<td>25 (30)</td>
<td></td>
</tr>
<tr>
<td>Witnessed arrest</td>
<td>543 (92)</td>
<td>465 (91)</td>
<td>78 (93)</td>
<td>0.684</td>
</tr>
<tr>
<td>Nonwitnessed arrest</td>
<td>50 (8)</td>
<td>44 (9)</td>
<td>6 (7)</td>
<td></td>
</tr>
<tr>
<td>Bystander CPR</td>
<td>160 (27)</td>
<td>134 (26)</td>
<td>26 (31)</td>
<td>0.426</td>
</tr>
<tr>
<td>No bystander CPR</td>
<td>433 (73)</td>
<td>375 (74)</td>
<td>58 (69)</td>
<td></td>
</tr>
<tr>
<td>Ventricular fibrillation</td>
<td>295 (50)</td>
<td>279 (55)</td>
<td>16 (19)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Asystole</td>
<td>142 (24)</td>
<td>100 (20)</td>
<td>42 (50)</td>
<td>&lt;0.001</td>
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<tr>
<td>PEA/EMD</td>
<td>144 (24)</td>
<td>119 (23)</td>
<td>25 (30)</td>
<td>0.217</td>
</tr>
<tr>
<td>Ventricular tachycardia</td>
<td>12 (2)</td>
<td>11 (2)</td>
<td>1 (1)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Values are n (%).

*Patients in whom presumed cause was later confirmed as being correct.
†Patients with undetermined or erroneous presumed first diagnosis.

### Table 5. Outcome of Cardiac Arrest Within 6 Months

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Total (n=593)</th>
<th>Group 1* (n=509)</th>
<th>Group 2† (n=84)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not resuscitated</td>
<td>129 (22)</td>
<td>100 (20)</td>
<td>29 (34)</td>
<td>0.003</td>
</tr>
<tr>
<td>Dead within 6 months</td>
<td>306 (52)</td>
<td>260 (51)</td>
<td>46 (55)</td>
<td>0.557</td>
</tr>
<tr>
<td>Alive</td>
<td>158 (26)</td>
<td>149 (29)</td>
<td>9 (11)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Cerebral performance category 1/2 (of alive patients)</td>
<td>138 (87)</td>
<td>132 (88)</td>
<td>6 (67)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Values are n (%).

*Patients in whom presumed cause was later confirmed as being correct.
†Patients with undetermined or erroneous presumed first diagnosis.
TABLE 6. Outcome of Cardiac Arrest Grouped According to Initial ECG and Misclassification of Cause

<table>
<thead>
<tr>
<th></th>
<th>Ventricular Fibrillation (n=305)</th>
<th>EMD/PEA (n=136)</th>
<th>Asystole (n=128)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correct</td>
<td>Wrong</td>
<td>Correct</td>
</tr>
<tr>
<td>Presumed cardiac</td>
<td>272</td>
<td>11</td>
<td>63</td>
</tr>
<tr>
<td>Survivors, %</td>
<td>159 (58)</td>
<td>2 (18)</td>
<td>8 (13)</td>
</tr>
<tr>
<td>Presumed noncardiac</td>
<td>17</td>
<td>5</td>
<td>56</td>
</tr>
<tr>
<td>Survivors, %</td>
<td>6 (35)</td>
<td>1 (20)</td>
<td>8 (14)</td>
</tr>
</tbody>
</table>

When looking for other factors influencing resuscitation such as age, sex, absence or presence of basic life support, location (in-hospital versus out-of-hospital) of cardiac arrest, as well as the times of no flow and low flow, we did not find significant differences between the two groups of patients when the presumed cause was later confirmed as being correct and patients with undetermined and erroneous presumed first diagnosis. Thus it can be presumed that none of these factors had any influence on sensitivity or specificity for the initial diagnosis.

Despite massive efforts, the rate of survival after cardiac arrest has not improved significantly in the last years. Studies have analyzed a multitude of factors influencing the outcome of resuscitation. For obvious reasons, the outcome after cardiac arrest as shown in our data does not adhere to the Utstein template. Therefore it should not be compared uncritically with other published data. The neurological outcome depends largely on the arrest time. We thought that the poor outcome in the group with wrong presumed cause might be explained partly by the fact that 50% of those patients were asystolic and did not achieve restoration of spontaneous circulation as often as the patients in the other group. However, in a post hoc analysis, we noticed two things. The outcome is worse when the first presumed diagnosis is wrong, irrespective of the initial rhythm. If misclassification occurs, mortality rate is almost doubled. In addition, our data once more confirm the well-known fact that patients with ventricular fibrillation have a much better chance to survive than those with asystole or EMD/PEA (Table 6).

The question remains whether reducing the cardiopulmonary resuscitation time by establishing the correct cause of cardiac arrest might improve the primary resuscitation rate and the long-time prognosis of those patients. Therefore we suggest that not only improved diagnostic procedures but also more concern by the treating physicians with regard to the possible definitive cause of cardiac arrest may help to identify the underlying cause in at least some of these patients, thereby allowing earlier origin-dependent advanced treatment.

Unfortunately, there are no reports comparing the efficacy of distinct treatment on the basis of the underlying pathology in cardiac arrest. The knowledge of the origin of the cardiac arrest might directly influence the cause-specific treatment and, because of this, indirectly influence the outcome. For example, fulminant pulmonary embolism associated with cardiac arrest has an extremely high mortality rate. However, previous studies demonstrate that a prompt treatment...
of systemic thrombolysis or embolectomy, even under ongoing resuscitation, may decrease mortality rates. While preoperative cardiac arrest in patients with ruptured or dissecting aortic aneurysm is associated with a high mortality rate, prompt treatment results in significantly better survival. Early sonographic diagnosis of ruptured aortic aneurysm is important, and the patient may be saved even if this necessitates cardiopulmonary resuscitation while on the way to the operating theater.

There is enough evidence that the number of patients discharged from the hospital after cardiac arrest depends in large part on the way that judicious therapeutic decisions are made on the basis of presumed cause. The importance of prehospital medical history-taking, examination, and resuscitation by ambulance physicians in this respect cannot be overstated. Our data corroborate the necessity of using all available means of proving or—even more important—excluding a specific diagnosis by the emergency physician, allowing specific treatment to be initiated. He or she must take into account the prearrest information as well as the present status and the results of clinical monitoring, laboratory examinations, bedside echocardiography, and abdominal ultrasound. These should be performed as soon as feasible to establish a correct diagnosis, possibly even in ongoing resuscitation situations. This implies that after the receipt of the message that the emergency department is about to receive a patient after cardiac arrest, the necessary equipment already will be at the bedside, ready for use on arrival of the patient.

In conclusion, in a significant number of cases particularly of noncardiac cause, origin of cardiac arrest is not as easily recognized as initially anticipated. Asystole as first-recorded ECG rhythm and noncardiac causes such as pulmonary embolism, ruptured aortic aneurysm, and cerebral disorders frequently led to erroneous diagnosis. This might affect comparability of study results, therapeutic strategies, prognosis, and outcome of patients after cardiac arrest. Those patients in whom the presumed cause was later confirmed as being correct had a significantly better survival rate and neurological outcome than patients with undetermined or erroneous presumed first diagnosis. We therefore believe that it is of paramount importance to actively procure all relevant information from bystanders, relatives, and emergency medical service personnel, even before arrival of the patient in the emergency department. In addition, early availability of crucial medical information and past medical history should be provided by an information forwarding service through the dispatch center. In the emergency department itself, all diagnostic equipment should be ready on arrival of the patient, and diagnostic procedures should be performed as soon as feasible.

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