Medical history of hypercholesterolaemia adversely affects the outcome of out-of-hospital cardiopulmonary resuscitation

The ‘Shahal’ experience in Israel

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Aims To evaluate the impact selected risk factors for cardiac death may have on the success rate in a large cohort of subscribers to ‘SHAHAL’ who were resuscitated from out-of-hospital cardiac arrest.

Methods and Results In this medical facility currently serving 50,000 subscribers, data were prospectively gathered from between 1987–1998. The information retrieved from the patients’ medical records included a medical history of hypertension, diabetes, hypercholesterolaemia (>220·mg·dl⁻¹) smoking, angina, previous myocardial infarction, and congestive heart failure. A total of 998 patients aged 74±12 years (mean±1 SD) were included. Death was announced at the scene for 659 (66%) victims, while 339 (34%) patients were taken to hospital. Of these 140 (14% of the total cohort) survived and were discharged from the hospital. A comparison of various selected parameters between survivors and non-survivors of resuscitation revealed that survivors were younger, had a higher rate of pulseless ventricular tachycardia/ventricular fibrillation, more were among the arrests witnessed by the ‘SHAHAL’ team, and that more had a shorter time lag to initiation of cardiopulmonary resuscitation than non-survivors. None of the studied risk factors predicted the outcome of cardiopulmonary resuscitation, with the exception of hypercholesterolaemia, which carried a significantly worse prognosis for cardiopulmonary resuscitation (P=0·009).

Conclusions A medical history of hypercholesterolaemia appears to be an important risk factor which adversely affects the outcome of cardiopulmonary resuscitation.

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Key Words: Hypercholesterolaemia, cardiopulmonary resuscitation.

Introduction

The outcome of a patient following cardiac arrest in general and that occurring out-of-hospital in particular has been attributed to many factors. These include the presence of witnesses[1–3], the administration of cardiopulmonary resuscitation by a bystander[3–6], an initial cardiac rhythm indicative of ventricular tachycardia or fibrillation[4,6–8], and early defibrillation[3,5,7–9].

Little, however, is known about the impact of known risk factors for sudden death such as hypertension, diabetes, hypercholesterolaemia, smoking, angina, previous myocardial infarction and congestive heart failure on the success rate of resuscitation, mainly because medical details in such cases are invariably gathered retrospectively. The aim of this study, therefore, was to evaluate the weight of these risk factors on a large patient population of subscribers to ‘Shahal’ who were resuscitated from cardiac arrest.
Methods

The system

‘Shahal’, a medical facility established in 1987 and described previously,[10–13] currently serves 50 000 subscribers. Briefly, it consists of a central operations centre managed exclusively by intensive care nurses, who dispatch mobile intensive care units staffed by physicians and paramedics. When subscribing to Shahal, each applicant is personally interviewed by a physician using a structured interview, the information from which together with various medical documents (including a 12-lead electrocardiogram) comprise a medical record which is stored in a central computer and is continuously updated. All members carry a cardiobeeper (Meridian Medical Technologies Inc. Washington DC, U.S.A.) by which they can transtelephonically transmit a three-lead (I, II, III) or 12-lead electrocardiogram (Meridian Medical Technologies Inc.). In addition, each subscriber is supplied with an automatic intramuscular 300 mg lidocaine injector (Meridian Medical Technologies Inc.) for self-injection when instructed to do so by the monitoring centre. When subscribers call the centre and identify themselves by name or identification number, their medical files are immediately displayed on a computer screen. After obtaining all the necessary facts from the file and from a trans-telephonic anamnesis, and after interpreting the instantly transmitted electrocardiographic data, the centre’s nurse may either: (a) dispatch a mobile intensive care unit to the patient, (b) consult the physician present at the centre or on call or (c) provide the patient with appropriate medical or behavioural instructions. The nurse’s actions and decisions are based on written protocols, and all details of the patients’ calls including timetables and actions carried out by the centre are recorded in full and electronically stored.

The mobile intensive care unit is staffed by a physician, a paramedic and a driver-medic. It is equipped with advanced instrumentation, and available medications include a thrombolytic agent to be administered at the scene if warranted. A cellular-operated fax machine provides the patient’s medical record en route to the patient. The facility provides medical assistance to all callers, whether or not they subscribe to the service.

Lastly, subscribers are instructed to update the centre whenever there is any change in their medical status or there are any alterations in their treatment.

Study location and population

The region covered by the service includes the cities of Tel-Aviv and Haifa (around 1 500 000 inhabitants). All subscribers with out-of-hospital cardiac arrest (unconscious with no pulse) for whom resuscitation was attempted by Shahal personnel were included for analysis in this study.

Data collection

Data were prospectively collected from July 1987 to December 1998. They included, among other details, a medical history of hypertension, diabetes, hypercholesterolaemia, smoking, angina, previous myocardial infarction and congestive heart failure. All these parameters were analysed from information retrieved from the patient’s medical record, and the reporting of pertinent time points was taken from a form designed for precise listing of the sequences of events and actions taken as closely as possible to the moment the patient collapsed. The latter included witnessed vs unwitnessed collapse, the person who initiated cardiopulmonary resuscitation, initial cardiac rhythm (determined by quicklook paddles and a three-lead cable), collapse before or after the arrival of the Shahal mobile unit, location of collapse, and outcome (death, hospital admission and discharge). In the event of asystole, the positions of the leads were routinely changed for confirmation.

Only for witnessed cardiac arrests were the time from collapse to cardiopulmonary resuscitation, the time from collapse to arrival of the unit and the time of initiation of treatment by the Shahal team at the scene estimated, based on constantly fed information and telephone interviews with bystanders and emergency personnel.

Statistical analysis

Statistical analysis was done using an SPSS package. Student’s t-test was used to compare equality of means, and the chi-square test to compare frequencies.

Results

A total of 998 patients aged 74 ± 12 years (mean ± 1 SD) were included. Death was announced at the scene for the 659 (66%) victims of cardiac arrest, while 339 (34%) patients were taken to hospital. Of these, 140 (14% of the total cohort) survived, underwent appropriate treatment, and were discharged from hospital.

A comparison of the various selected parameters between survivors and non-survivors of resuscitation are presented in Table 1. The survivors were younger and had a higher rate of pulseless ventricular tachycardia/ventricular fibrillation, more of them were among the witnessed arrests by the Shahal team, and more had a shorter time to cardiopulmonary resuscitation than non-survivors. None of the studied risk factors predicted outcome of cardiopulmonary resuscitation with the exception of hypercholesterolaemia, which carried a significantly worse prognosis for cardiopulmonary resuscitation (P=0.009).

Discussion

Survival after out-of-hospital cardiac arrest varies considerably between communities. In a previous study
from Israel which included more than 3500 patients throughout the entire country, 17% of victims of cardiac arrests caused by heart disease were admitted to hospital from which 7% were discharged[1].

In the current study, also conducted in Israel, survival rates were higher, probably due to the fact that the study design did not include rural areas remote from access to facilities of advanced cardiac life support (e.g. defibrillators, etc.). The majority of out-of-hospital cardiac arrests result from cardiac events, usually ventricular fibrillation, in patients with coronary artery disease[13–15]. All well-known variables[1–9] associated with improved outcome in cardiac arrests occurring outside the hospital were also applicable (Table 1). However, we did not find any previous report which looked into the association of hypercholesterolaemia with resuscitation in a large population.

Hypercholesterolaemia increases the risk for fatal cardiac events and may predict a worse survival, probably due to more unstable atherosclerotic plaque and endothelial dysfunction[16]. These abnormalities may further be aggravated when there is a reduced coronary blood flow during cardiopulmonary resuscitation. Measures to reduce cholesterol blood levels were shown to effectively reduce mortality rates of patients with[17] and without[18] a history of coronary artery disease. Although their reported reduced mortality was achieved mainly through the prevention of sudden death, the possibility that the outcome of resuscitation, once cardiac arrest did occur, was better in individuals with low cholesterol levels should not be ignored.

Table 1 Selected epidemiological and clinical parameters of 998 ‘Shahal’ subscribers who were resuscitated for out-of-hospital cardiac arrest

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Survivors n=140</th>
<th>Non-survivors n=858</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>General information</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (mean ± 1 SD) years</td>
<td>70 ± 14</td>
<td>74 ± 11</td>
<td>0·001</td>
</tr>
<tr>
<td>Male/female (%)</td>
<td>74/26</td>
<td>72/28</td>
<td>0·65</td>
</tr>
<tr>
<td>P-VT or VF (%)</td>
<td>46</td>
<td>25</td>
<td>0·0001</td>
</tr>
<tr>
<td>Witnessed arrest (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By layman</td>
<td>39</td>
<td>50</td>
<td>0·03</td>
</tr>
<tr>
<td>By Shahal</td>
<td>33</td>
<td>20</td>
<td>0·001</td>
</tr>
<tr>
<td>By other medical personnel</td>
<td>38</td>
<td>30</td>
<td>0·01</td>
</tr>
<tr>
<td>Time (min) to initiation of CPR (mean ± 1 SD)</td>
<td>5 ± 9</td>
<td>12 ± 10</td>
<td>0·0001</td>
</tr>
<tr>
<td>Total time length (min) of CPR (mean ± 1 SD)</td>
<td>26 ± 16</td>
<td>38 ± 18</td>
<td>0·0001</td>
</tr>
<tr>
<td>Medical history (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anginal syndrome</td>
<td>29</td>
<td>34</td>
<td>0·22</td>
</tr>
<tr>
<td>Hypertension</td>
<td>29</td>
<td>35</td>
<td>0·18</td>
</tr>
<tr>
<td>Hypercholesterolaemia</td>
<td>4</td>
<td>111</td>
<td>0·009</td>
</tr>
<tr>
<td>Smoking</td>
<td>3</td>
<td>4</td>
<td>0·68</td>
</tr>
<tr>
<td>Diabetes</td>
<td>14</td>
<td>18</td>
<td>0·26</td>
</tr>
<tr>
<td>S/P myocardial infarction</td>
<td>51</td>
<td>56</td>
<td>0·20</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>35</td>
<td>43</td>
<td>0·10</td>
</tr>
</tbody>
</table>

CPR=cardiopulmonary resuscitation; hypercholesterolaemia=cholesterol levels >220 mg . dl $^{-1}$, both treated and untreated; P-VT/VF=pulseless ventricular tachycardia or ventricular fibrillation; S/P=status post.

Study limitations

We did not have quantitative data regarding our patients’ cholesterol levels shortly before the cardiac arrest had occurred to enable us to judge the possible effect on outcome of lipid-lowering treatment received by some of them. However, since this applies to both survivors and non-survivors, we can assume that this does not confound our conclusions. The low percentage of patients identified as being hypercholesterolaemic in our cohort may be explained by the possibility that some members were not aware that they might have had hypercholesterolaemia at the time of enrolment. Nevertheless, it is not unreasonable to assume that such patients were represented in both groups.

In summary, we found that a medical history of hypercholesterolaemia is an important risk factor which may adversely affect the outcome of cardiopulmonary resuscitation, regardless of whether or not the patient was under treatment.

References


