Hospital and 1-Year Outcomes of Septic Syndromes in Older People: A Cohort Study

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Purpose. Our objective was to describe the relationship between sepsis syndrome mortality and cognitive and physical disability in elderly persons.

Methods. A 1-year consecutive cohort study in clinical beds of a university hospital was performed. Variables were severity of sepsis syndrome, organ failure, functional status, age, sex, and positive cultures. Outcomes were in-hospital and 1-year mortalities.

Results. The study included 137 patients (>70 years), both sexes. Data from 116 (84.5%) patients were obtainable at 1-year follow-up. Forty-eight (35%) patients presented with sepsis (11/137, 8%) or severe sepsis (37/137, 27%). In-hospital mortality was 15.3% (0% for sepsis and 21.8% if severe) and increased with organ failure (p < .0001). One-year mortality was 54.78% (63/116), mostly related to severe sepsis; predictors were severe organ failure (p < .0001), prior functional status (p = .0005), and Mini-Mental State Examination (p = .03). Prior functional status and organ failure were independent predictors.

Conclusions. In-hospital and 1-year mortality increased with septic syndrome severity, prior functional status, and organ failure.

Key Words: Sepsis—Septic syndrome—Organ failure—Functional capacity.

Sepsis, the 10th cause of death in elderly persons (1), represents a malignant generalized inflammation comprising the systemic inflammatory response syndrome (SIRS) (2), which progresses through stages of increasing severity (sepsis, severe sepsis, and septic shock) (3–6).

Aging predicts the most severe forms of sepsis (7), but is inconsistently associated with mortality (4–6,8,9). Functional capacity, more fundamental in elderly persons, seems more decisive than age. Nevertheless, to our knowledge no study has focused on evolution of sepsis syndromes (according to current criteria) in aged patients, and functional measures have not been regularly included (9).

SIRS in the elderly population could be affected by cognitive impairment, functional capacity (9), and different inflammatory response (10,11). Hence we aimed to study in-hospital and 1-year mortality of sepsis syndromes related to cognitive and physical disability in elderly persons.

METHODS

From September 2002 through August 2003, consecutive clinical patients (>69 years old, both sexes, admitted to one of eight internal medicine units at Buenos Aires University Hospital, from emergency and in-hospital ambulatory facilities), were prospectively included. The hospital’s Bioethics Committee approved protocol without informed consent because the study was harmless and anonymous. Patients from another hospital, those hospitalized for surgery, or those with shock on admission (admitted to intensive care) were excluded. Researchers, partly involved in the care of recruited patients, collected data. Standard care was based on the judgment of the attending physician.

We assessed demographic data, comorbidity with Charlson’s Comorbidity Index score (12) (based on prior diseases), mental status using the Mini-Mental State Examination (MMSE) (13) (severe alteration of speech or alert prompted exclusion), and previous functional status combining activities of daily living index (14) and instrumental activities of daily living index scores (15) (ranging from 0, totally dependent, to 11, fully independent). These scores are questionnaires for patients or proxies whenever a patient’s condition precludes interviewing. Delirium was evaluated using the Confusion Assessment Method (CAM) (16) and Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (DSM-IV) criteria (17). Blood cultures, number and degree of organ failures (Marshall’s score) (18), and SIRS criteria (3) were collected.
Table 1. Characteristics of the Patients

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/Female (n)</td>
<td>67/70</td>
</tr>
<tr>
<td>Age, mean years (95% CI)</td>
<td>80.81 (79.71–81.92)</td>
</tr>
<tr>
<td>Hospital stay, mean days (95% CI)</td>
<td>12.81 (10.63–14.99)</td>
</tr>
<tr>
<td>Comorbidity score, mean (95% CI)</td>
<td>2.36 (2.03–2.68)</td>
</tr>
<tr>
<td>Mini-Mental State Examination score, mean (95% CI)</td>
<td>20.14 (18.30–21.98)</td>
</tr>
<tr>
<td>Functional status, mean (95% CI)</td>
<td>6.00 (5.25–6.75)</td>
</tr>
<tr>
<td>Maximal Marshall score, mean (95% CI)</td>
<td>2.56 (2.04–3.08)</td>
</tr>
<tr>
<td>Nursing home residents, n (%)</td>
<td>22 (16.2)</td>
</tr>
<tr>
<td>Sepsis syndrome on admission, n (%)</td>
<td>48 (35)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>11/48</td>
</tr>
<tr>
<td>Severe sepsis</td>
<td>37/48</td>
</tr>
<tr>
<td>Nosocomial sepsis syndrome, n (%)*</td>
<td>15 (10.9)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>5/15</td>
</tr>
<tr>
<td>Severe sepsis</td>
<td>5/15</td>
</tr>
<tr>
<td>Septic shock</td>
<td>5/15</td>
</tr>
<tr>
<td>Positive blood culture, n (%)</td>
<td>14 (10%)</td>
</tr>
<tr>
<td>Coagulase-negative staphylococcus</td>
<td>2/14</td>
</tr>
<tr>
<td>Serratia</td>
<td>2/14</td>
</tr>
<tr>
<td>β-hemolytic streptococcus</td>
<td>2/14</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>214</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>6/14</td>
</tr>
<tr>
<td>In-hospital mortality, n (%)</td>
<td>21 (15.3)</td>
</tr>
<tr>
<td>Long-term mortality, n (%)</td>
<td>53 (44.5)</td>
</tr>
</tbody>
</table>

Notes: *Sepsis de novo and progression from lower stages together. CI = confidence interval.

daily until discharge. Marshall’s score assesses respiratory, cardiovascular, cerebral, blood, renal, and hepatic failure, ranging from 0 (best) to 5 (worst) for each, building a global dysfunction scale. Patients were classified (American College of Chest Physicians/Society of Critical Care Medicine [ACCP/SCCM] criteria) as having sepsis (SIRS plus infectious focus), severe sepsis (any organ failure), or septic shock (hemodynamic failure).

Outcome variables were in-hospital and 1-year mortality (telephone contact to patients or proxies). Tested variables were maximal sepsis syndrome category and Marshall’s score (on admission and during hospitalization), functional status, MMSE score, age, sex, place of residence, and positive blood culture. For 1-year mortality, a Cox proportional hazard model was adjusted with variables significant in univariable tests and then adjusted to the best predictor model. The Kaplan–Meier test was applied. Values of $p$ are two-tailed.

SPSS 10.0(r) for Windows (SPSS, Chicago, IL) was used.

**RESULTS**

Of 137 consecutive patients followed during hospitalization, 116 (84.5%) completed 1-year follow-up and 18 (15.5%) were lost; these were comparable to cohort in age (mean = 81 years), sex (male/female = 8/10), functional status (mean = 5.7), and Marshall score (mean = 2.1). Patients were hospitalized with no-SIRS (48.9%, 67/137), noninfectious SIRS (9.5%, 13/137), infection without SIRS (6.6%, 9/137), or sepsis syndrome (48/137) (Table 1).

During hospitalization, five (3.6%) additional patients subsequently developed severe sepsis, and five (3.6%) developed septic shock. The most common foci of infection were lungs (33/137), urinary tract (15/137), and skin (5/137). Twenty patients (14.5%) presented with delirium.

In-hospital mortality (15.3%, 21/137), was 14.9% (10/67) in patients admitted with no SIRS, 23.1% (3/13) in those with noninfectious SIRS, 0% (0/11) in septic patients, 21.6% (8/37) in those with severe sepsis on admission, and 11% (1/9) in infected patients without SIRS. Mortality for severe sepsis on admission or during hospitalization was 21.8% (12/43). Septic syndrome was more prevalent among nursing home residents (72% vs 38% for community, $p = .003$), men (53% vs 35% among women, $p = .04$), those with a lower average MMSE score (17 vs 22 in nonseptic patients, $p = .017$), and those with lower functional capacity (4.5 vs 6.2, $p = .003$). Most common organ failures were renal (54/137, 38.7%), respiratory (41/137, 29.9%), neurological (31/137, 22.6%), and cardiovascular (31/137, 22.6%).

Univariable in-hospital mortality predictors were maximal Marshall score (mean: alive 17.0 vs dead 7.2; $p < .0001$) and number of organ dysfunctions (mean: alive 1.56 vs dead 3.38; $p < .0001$). Nursing home origin (alive 13% [16/121] vs dead 30% [6/20]; $p = .069$) and functional status (mean: alive 6.22 vs dead 4.50; $p = .11$) were near the statistical limit. Age, sex, comorbidity, MMSE score, and positive blood culture were not significant. Multivariate analysis was obviated because events were insufficient (21 in-hospital deaths).

One-year mortality was 54.78% (63/116). One-year survival was 65% (95% confidence interval [CI], 53%–76%) among nonseptic patients. Survival rates were lower as sepsis worsened: 83% (95% CI, 46%–96%) for sepsis, 41% (95% CI, 27%–56%) for severe sepsis, and 0 for patients who developed septic shock (log rank test $p = .02$) (Figure 1); other univariable predictors were maximal Marshall score ($p < .0001$), previous functional capacity ($p = .0005$), and MMSE ($p = .03$). A first Cox model was performed including sepsis syndrome, MMSE score, age, sex, comorbidity, and functional capacity; variables were progressively removed until the best model was obtained; emergence of septic shock (hazard ratio [HR] = 3.37, 95% CI, 1.1–10.1; $p = .03$) and functional capacity (HR = 0.92, 95% CI, 0.85–0.98; $p = .01$) remained significantly associated with 1-year
mortality. Marshall score was not included in the model as severe sepsis entails organ dysfunction. In a separate Cox model adjusted for organ failures comprised in Marshall score, 1-year mortality was independently associated with respiratory (HR = 2.4, 95% CI, 1.38–4.15; p = .0018), neurological (HR = 3.2, 95% CI, 1.87–5.43; p < .00001), and hepatic failure (HR = 1.9, 95% CI, 1.03–3.48; p = .038) during hospitalization.

**DISCUSSION**

This study describes sepsis-associated in-hospital and 1-year mortality related to cognitive and physical disability in elderly persons. As previously described (3,5), hospital mortality was higher for severe sepsis compared to sepsis. In-hospital and 1-year mortality were conditioned by organ failure and prior functional status, implying that elderly infected patients without organ failure or poor functional capacity may have a good prognosis despite age. As a maximal Marshall score was independently associated with in-hospital mortality, it could serve to establish prognosis in this population.

Age, sex, comorbidity, MMSE score, and positive blood cultures were not in-hospital mortality predictors. Association of cognitive disability with early prognosis exists (11), but disappears when adjusted for functional capacity, which is probably a better predictor. Likewise, age was not independently associated with 1-year mortality. Accordingly, evidence shows that mortality decelerates and even declines at older ages (19). Functional status, not age, should induce decision making in septic aged patients (11).

Noticeably, more than half of discharged patients died within 1 year, especially those hospitalized with severe sepsis, compared to a population 20 years younger (9). Association between sepsis syndrome and 1-year mortality weakens if adjusted for on-admission functional status, emphasizing the need of these measures in predictive models for outcomes in elderly persons with sepsis (11).

It is surmised that elderly patients show increased risk of death as they present severest forms of SIRS; it seems to also affect 1-year mortality, which is extremely high among hospital survivors. Stronger predictors were prior functional status and organ failure, not age. Our study confirms that infection with common systemic manifestations such as fever does not necessary entail a bad prognosis, and that previous functional status and acute organ failure should be considered instead.

**REFERENCES**


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