Sepsis in the Neurologic Intensive Care Unit: Epidemiology and Outcome

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Abstract

Background: Sepsis is a major contributor to mortality in patients admitted to a general intensive care unit (ICU). Early recognition and treatment of sepsis is key in improving outcomes. The epidemiology and outcome of sepsis in neurologic ICU (NeuroICU) has not been evaluated.

Methods: We retrospectively identified all patients admitted to our 16-bed NeuroICU between June 2009 and December 2013 using the acute physiologic and chronic health evaluation (APACHE) outcomes database. We excluded patients admitted with an infection, such as meningitis, encephalitis, brain or spinal abscess, or with any other infection. We compared NeuroICU patients who did to NeuroICU patients who did not develop sepsis after ICU admission. The diagnosis of sepsis was based on the SCCM/ACCP consensus conference definition.

Results: There were a total of 2,025 patients, out of which 29 patients (1.4%) developed sepsis. Patients who developed sepsis had a trend towards older age (67 ± 13 vs. 61 ± 11 years, P = 0.07), a trend towards more male gender (69.0% vs. 51.5%, P = 0.07), significantly higher APACHE III scores (58 ± 17 vs. 43 ± 21, P = 0.0001), and significantly higher acute physiologic scores (APS) (43 ± 16 vs. 32 ± 18, P = 0.001) than patients who did not develop sepsis. Patients who developed sepsis had higher ICU mortality (41.4% vs. 5.1%, odds ratio (OR) = 13.1; 95% confidence interval (CI), 6.1 - 28.2, P < 0.0001), and higher hospital mortality (44.8% vs. 8.2%, OR = 9.0; 95% CI, 4.3 - 19.0, P < 0.0001).

Conclusions: Sepsis developed in 1.4% of patients admitted to a NeuroICU. Predictors of sepsis development were comorbidities and worsening acute physiologic variables. Patients who developed sepsis had significantly higher mortality. Vigilance to development of sepsis in NeuroICU is paramount, especially in this era when early recognition and intervention of sepsis significantly improves outcomes.

Keywords: Sepsis; Epidemiology; Neurologic intensive care unit; Outcome

Introduction

In the United States, approximately 750,000 cases of sepsis occur each year, of which at least 225,000 are fatal. If it also causes organ dysfunction, the diagnosis is severe sepsis. If severe sepsis is accompanied with tissue hypoperfusion, the diagnosis is septic shock. Organ failure occurs in about one-third of patients with sepsis, and severe sepsis is associated with an estimated mortality rate of 30-50%. There is wide variation in the incidence of sepsis and severe sepsis in the general intensive care unit (ICU) setting, with reported rates ranging from 20% to 80%, and reported mortality of 20% to 50%. Septic shock, defined as a state of acute circulatory failure characterized by persistent hypotension unexplained by other causes, despite adequate fluid resuscitation, affects between 10% and 30% of patients managed in the ICU, and its incidence is increasing. Mortality from septic shock in the ICU is estimated to range between 45% and 63% in observational studies [1-7]. However, epidemiology of sepsis comes mainly from general medical and surgical ICUs. Epidemiology and outcome of sepsis in neurologic ICUs (NeuroICUs) has not yet been reported.

The primary objective of this study was to report the epidemiology and outcomes of sepsis in the NeuroICU.

Methods

We retrospectively identified all patients admitted to our NeuroICU between June 2009 and December 2013 using the acute physiologic and chronic health evaluation (APACHE) outcomes database. Our 16-bed NeuroICU is staffed by intensivists (board certified by the American Board of Internal Medicine in Internal Medicine and Critical Care Medicine and certified by the United Council of Neurologic Subspecialties in Neurocritical care) 24 h/day. APACHE outcomes database is a free, web-based offering from Cerner Corporation that provides users the ability to calculate and report on outcomes data based upon the APACHE IV predictions available in the public domain.

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by our institutional review board.

- moved from the database, and informed consent was waived.
- and gradients and error checking. Patient identifiers were re-
- pick lists and automated calculation of physiological means
- entered using a software program that included computerized
- antibiotics. Antibiotics are prescribed when patient is diagnosed
- sepsis is based on surviving sepsis campaign (SSC) definition
- did not develop sepsis after ICU admission. The diagnosis of
- sepsis development in NeuroICUs.

Figure 1. Outcomes of patients in NeuroICU who did and did not de-
velop sepsis.

domain. The system may then be used either as an on-line cal-
culator to quickly obtain scores and predictions for individual
patients or subsets of patients on an as needed basis, or as a
severity-adjusted outcomes measurement system for an indi-
vidual ICU (or group of ICUs) to assess quality of care and
identify opportunities for improvement. We excluded patients
admitted with an infection, such as meningitis, encephalitis,
brain or spinal abscess, or with any other infection. We com-
pared NeuroICU patients who did to NeuroICU patients who
did not develop sepsis after ICU admission. The diagnosis of
sepsis is based on surviving sepsis campaign (SSC) definition
[8]. It is not standard in our institution to start prophylactic ant-
ibiotics. Antibiotics are prescribed when patient is diagnosed
with or suspected to have an infection or sepsis. Data were
entered using a software program that included computerized
pick lists and automated calculation of physiological means
and gradients and error checking. Patient identifiers were re-
moved from the database, and informed consent was waived
by our institutional review board.

Results

There were a total of 2,025 patients, out of which 29 patients
(1.4%) developed sepsis. Patients who developed sepsis had a
trend towards older age (67 ± 13 vs. 61 ± 11 years, P = 0.07), a
trend towards more male gender (69.0% vs. 51.5%, P = 0.07),
significantly higher APACHE III scores (58 ± 17 vs. 43 ± 21,
P = 0.0001), and significantly higher acute physiologic scores
(APS) (43 ± 16 vs. 32 ± 18, P = 0.001) than patients who did
not develop sepsis (Table 1). Patients who developed sepsis
had higher ICU mortality (41.4% vs. 5.1%, odds ratio (OR) =
13.1; 95% confidence interval (CI), 6.1 - 28.2, P < 0.0001), and
higher hospital mortality (44.8% vs. 8.2%, OR = 9.0; 95% CI,
4.3 - 19.0, P < 0.0001) (Table 1, Fig. 1).

Discussion

In our center, sepsis developed in 1.4% of patients admitted to
a NeuroICU. Predictors of sepsis development were comorbid-
ities and worsening acute physiologic variables. Patients who
developed sepsis had significantly higher mortality. Sepsis is
the number one cause of death in the non-coronary ICU [9].
Timely, aggressive, and efficient recognition and management
of patients with sepsis/severe sepsis/septic shock is crucial,
particularly with the increasing incidence, costs, and mortality
associated with untimely management of these patients.

Dramatic benefit of early goal-directed therapy (EGDT)
in a single-center study of patients with severe sepsis/septic
shock published by Rivers et al in 2001 created a paradigm
shift on how we treat these patients [10]. Since then, guidelines
were published by SSC in 2004, 2008, and 2012 [8] in order
to guide management of sepsis/severe sepsis/septic shock. In
summary, resuscitation parameters have to be accomplished
within 6 h of diagnosis in order to achieve improvement in
survival [8]. In a very recent study “Protocolized care for early
septic shock (ProCESS trial)”, septic shock patients were ran-
donally assigned to one of three groups for 6 h of resuscitation:
protocol-based EGDT; protocol-based standard therapy that
did not require the placement of a central venous catheter, ad-
ministration of inotropes, or blood transfusions; or usual care
[11]. All three groups in this study had similar outcomes. One
important contribution of the ProCESS trial is the evidence
it provided regarding the ongoing role of early recognition of
sepsis in improving survival. The ProCESS trial showed the
paramount positive effect of early recognition of sepsis, early
administration of antibiotics, and early adequate volume resus-
citation, on outcomes. Despite the low prevalence of sepsis in
the NeuroICU (1.4%), the high mortality of patients with sep-
sis, the importance of early recognition and treatment, and the
tremendous improvement in outcomes associated with early
recognition and treatment underscore the need for early identi-
fication of septic patients in the NeuroICU.

Our study has several limitations. It is a retrospective and
a single-center study. However, it encompasses a large cohort
of patients, and the outcomes of septic patients in our study
are similar to other larger multicenter studies [1-8]. Our Neu-
roICU may not be representative of other NeuroICUs. Our
center is a large university-affiliated hospital with 1,000 beds,
primary stroke center and a level I trauma center, which might
explain the three top diagnoses in our patient population (Table
1). Hence, epidemiology might be different in other centers
that may not be stroke centers, trauma centers, or university-
affiliated hospitals.

Conclusion

Sepsis developed in 1.4% of patients admitted to a Neuro-
ICU. Predictors of sepsis development were comorbidities
and worsening acute physiologic variables. Patients who de-
developed sepsis had significantly higher mortality. Vigilance
to development of sepsis in NeuroICU is paramount, especially
in this era when early recognition and intervention of sepsis
significantly improves outcomes. Larger multicenter studies
are warranted to more accurately report the epidemiology of
sepsis development in NeuroICUs.
Table 1. Characteristics and Outcomes of Patients in the NeuroICU Who Did and Did Not Develop Sepsis

|                          | Sepsis | No sepsis | P value |
|--------------------------|--------|-----------|---------|
| n, %                     | 29 (1.4)| 1,996 (98.6)|         |
| Age, years (SD)          | 67 (13)| 61 (11)   | 0.07    |
| Gender, male, %          | 69     | 52        | 0.07    |
| APACHE III score (SD)    | 58 (17)| 43 (21)   | 0.0001  |
| APS score (SD)           | 43 (16)| 32 (18)   | 0.001   |
| Top three diagnoses, n (%)|       |           |         |
| TBI, 5 (17.2)            |        | TBI, 316 (15.8)|    |
| ICH, 5 (17.2)            |        | Ischemic stroke, 290 (14.5)| |
| Encephalopathy, 5 (17.2) |        | Seizures, 190 (9.5) | |
| ICU mortality, n (%)     | 12 (41.4)| 102 (5.1) | < 0.0001|
| Hospital mortality, n (%)| 13 (44.8)| 164 (8.2) |< 0.0001|

APACHE: acute physiologic and chronic health evaluation; APS: acute physiologic score; ICU: intensive care unit; SD: standard deviation; TBI: traumatic brain injury; ICH: intracranial hemorrhage.

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