The Principle of Parsimony: Glasgow Coma Scale Score Predicts Mortality as Well as the APACHE II Score for Stroke Patients

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Although the development and use of severity-of-illness measures has gained widespread enthusiasm, uncertainty remains as to the optimal measure for stroke patients. The Health Care Financing Administration recently derived a severity-of-illness measure based on the APACHE II system to explain differences in Medicare mortality rates among hospitals treating stroke patients. We hypothesized that the Glasgow Coma Scale score provides prognostic information of accuracy comparable to that of the APACHE II score for stroke patients, yet is simpler and cheaper to abstract from the medical record. We therefore studied 246 patients hospitalized with stroke, including 49 oversampled mortalities. The Glasgow Coma Scale score was as accurate as the APACHE II score in predicting stroke mortality both before (r=−0.50 and r=0.50, respectively) and after (r=−0.40 and r=0.38, respectively) the oversampled mortalities were excluded. The APACHE II score required abstraction of 16 variables from the medical record compared with three for the Glasgow Coma Scale score and required more than three times the time to abstract from the medical record. Therefore, in the interest of parsimonious data collection, the Glasgow Coma Scale may be a preferable severity-of-illness measure for patients with stroke. (Stroke 1990;21:1280–1282)

Measurement of severity of illness has become a vital component of health care research over the past decade for its potential value in assessing quality of care. For real-time use, accurate prognostic assessment may assist clinical management and counseling of patients and their families. In addition, severity indicators are useful for selecting and comparing patients in clinical trials. Retrospective assessment of illness severity is invaluable for making inferences about quality of care and is required to facilitate comparisons of hospitals’ expected mortality rates with their actual mortality rates.

Although stroke is the third leading cause of death in the United States and is responsible for 5% of all acute-care bed-days, few severity-of-illness measures assess prognosis in such patients. Moreover, the Health Care Financing Administration (HCFA) has targeted stroke for development of a severity indicator to assist in case-mix adjustment of Medicare mortality data. In a recent study performed by HCFA and the Health Data Institute, a severity-of-illness measure based on the APACHE II system, a measure validated in intensive care unit patients, was derived for stroke patients. This measure may be used to facilitate analysis of Medicare mortality rates at hospitals throughout the country. However, the Glasgow Coma Scale, because of its relative simplicity of measurement and abstraction, may be preferable to the APACHE II system as a severity-of-illness measure if the former demonstrates comparable accuracy. We therefore directly compared the accuracy of the APACHE II system with that of the Glasgow Coma Scale for patients hospitalized with stroke.

Subjects and Methods

The study was performed at Cedars-Sinai Medical Center, an 1,100-bed community teaching hospital serving west Los Angeles. Medical records of patients discharged with the principal diagnosis of stroke between July 2, 1986, and June 26, 1987, were abstracted. Medical records were recovered for 197 patients (91% recovery rate). We oversampled 49
additional patient deaths, bringing the total patient
cohort to 246. Survival was assessed at the time of
hospital discharge. Patients ≥18 years of age hospi-
talized with a sudden neurologic deficit consistent
with cerebral infarction, ischemia, hemorrhage,
embolism, or thrombosis were included in the study.
We excluded patients with a neurologic deficit due to
cerebral aneurysm or arteriovenous malformation
without stroke, neoplasm, trauma, or subdural or
epidural hematoma and patients whose symptoms
resolved ≤24 hours after admission.

A trained chart abstractor audited the medical
records using precoded forms. The first complete set
of data available was used to compute the APACHE
II score and the Glasgow Coma Scale score; all data
were obtained ≤24 hours after admission. Normal
values were substituted for missing values. The Glas-
gow Coma Scale is a 15-point measure of neurologic
dysfunction, with lower scores denoting more severe
impairment. The APACHE II system incorporates
physiologic variables, age, and a chronic health eval-
uation into a measure of the risk of mortality; the
higher the score the worse the prognosis.

Interrater agreement was measured in a 10%
random sample of the original patient cohort
(excluding oversampled mortalities). Differences
between raters of ≤1 point for both the APACHE II
score and the Glasgow Coma Scale score were
accepted as agreement. In addition, a reviewer
recorded the time required for abstraction of data for
each score from the medical records of 20 patients.

Student's t test was used to compare continuous
data. Correlational analysis was performed using
sas. A probability value of <0.05 was considered to
indicate statistical significance.

Results

Of the 246 patients enrolled in the study, 96 (39%) were
male, and 221 (90%) were white. The mean age
was 77 years. At admission, 83% of the patients
resided in their home, 8% in a nursing home, and 9%
in a board-and-care facility. A total of 76% (188)
of the patients were admitted to the medical ward, 20%
(50) to the intensive care unit, and 3% (8) to the
intermediate care unit. Discharge diagnosis was cere-
bral infarction in 70% (172), lacunar infarction in 9%
(22), intracerebral hemorrhage in 7% (17), cerebellar
infection in 6% (15), brain stem infarction in 4%
(10), and cerebellar or subarachnoid hemorrhage in
4% (10). Twenty-two patients (9%) died during
hospitalization, excluding the oversampled mortal-
ties.

The Glasgow Coma Scale score was 15 in 54%,
10–14 in 26%, and <10 in 20% of the patients. The
APACHE II score was 0–5 in 7% (17), 6–10 in 47%
(115), 11–16 in 26% (64), 17–20 in 11% (26), and
>20 in 10% (24).

The average Glasgow Coma Scale score for survi-
ors was 13.7 compared with 9.9 for nonsurvivors
(p<0.0001). The mean APACHE II score for survi-
ors was 9.8 compared with 16.2 for nonsurvivors
(p<0.0001). The Glasgow Coma Scale score corre-
lated with mortality (r=−0.50, p<0.0001) as well as
did the APACHE II score (r=0.50, p<0.0001). When
the oversampled mortalities were excluded, the Glas-
gow Coma Scale still performed as well as the APACHE
II system (r=−0.40 and r=0.38, respect-
ively).

The mean±SEM time required to abstract the
Glasgow Coma Scale score was 1.1±0.6 minutes; that
for the APACHE II score was 3.7±1.0 minutes
(p<0.000001). Therefore, abstraction and scoring of
the Glasgow Coma Scale took less than one third the
time of the APACHE II system. The interrater
agreement for the Glasgow Coma Scale score was
90% compared with 70% for the APACHE II score.

Discussion

Both the Glasgow Coma Scale and the APACHE
II system are desirable severity-of-illness measures
since they are objective, reliable, and suitable for
retrospective or prospective review. Since both sever-
ity measures are assessed upon hospital admission,
they are treatment-independent and therefore are
insensitive to differences in quality of care. In our
study, the Glasgow Coma Scale score predicted mor-
tality as well as the APACHE II score for stroke
patients. The APACHE II score consists of the
Glasgow Coma Scale score plus 11 other physiologic
variables, age, and a chronic health evaluation.6
Abstraction and scoring of the APACHE II system
took approximately three times as long as abstraction
and scoring of the Glasgow Coma Scale. Thus, use of
the Glasgow Coma Scale may be advantageous since
data collection is less labor-intensive and cheaper
than for the APACHE II system.

The optimal severity-of-illness measure for stroke
patients has not yet been determined. Previously
used measures include the APACHE II system,5,8 a
model based on the APACHE II system,2,3,9,10 and
the presence or absence of a mass effect on a
computed tomogram.9 The APACHE II system is a
widely accepted mortality predictor for intensive care
unit patients, but its accuracy for patients hospital-
ized outside the unit is unknown.5 In addition, more
elaborate prognostic predictors for stroke are being
developed, but these measures may be limited by the
lack of universal availability of information derived
from retrospective chart abstraction.11 The Medicare
Mortality Prediction System (MMPS), a fairly
detailed severity-of-illness measure based on the
APACHE II system, may provide a more accurate
assessment for stroke patients. The disadvantage of
the MMPS is that it requires far greater resources to
abstract the information required than either the
APACHE II system or the Glasgow Coma Scale.2

We used in-hospital mortality rather than the
30-day mortality rate to define survival, which is
consistent with the outcome used in previous valida-
tion studies of the APACHE II system and the
Glasgow Coma Scale. In a pragmatic sense, the effort
and cost for hospitals to compute 30-day mortality

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rates may be prohibitive. However, the MMPS has adopted the 30-day mortality rate to define survival to control for differences in discharge procedures (e.g., hospice transfers) in contributing to mortality rates. The predictive abilities of the APACHE II system and the Glasgow Coma Scale for 30-day mortality rates have yet to be defined.

The Glasgow Coma Scale and the APACHE II system probably predict neurologic dysfunction poorly in patients with focal brain disease. The APACHE II score and the Glasgow Coma Scale score are derived solely from physiologic variables, which correlate well with survival but perhaps less well with functional status. Since the only outcome measured in our study was survival, the severity-of-illness measures that we employed appear to have been appropriate.

The accuracy of the Glasgow Coma Scale has been well established for patients with head trauma and more recently for patients suffering out-of-hospital cardiac arrest. The Glasgow Coma Scale has fared well in predicting outcome for patients with intracerebral hemorrhage, although its accuracy in predicting outcome for patients with nonhemorrhagic stroke is uncertain. We suggest that the Glasgow Coma Scale is a useful severity-of-illness measure for stroke patients, including those without intracerebral hemorrhage (93% of our study patients) and may be used instead of the APACHE II system for that purpose. In fact, the APACHE II score added no additional predictive information to that provided by the Glasgow Coma Scale score, although the former required much more time to abstract. Further research is required to determine whether the Glasgow Coma Scale may be employed to measure the effectiveness of medical care.

References


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