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RESEARCH

EFFECTIVENESS OF SCORING IN OUTCOME PREDICTION OF ELDERLY PATIENTS IN INTENSIVE CARE UNITS

ABSTRACT

Introduction: Scoring systems defining the severity of illnesses also predict the risk of mortality in intensive care units (ICUs). The aim of this study is to detect if APACHE II and SAPS II scores are highly sensitive in the prediction of survival in elderly in the ICU.

Materials and Method: Patients >70 years, admitted to the ICU during 2006–2011 were included. Demographic information, diagnosis at admission, comorbidities, duration of ICU stay, survival/mortality and, APACHE II, SAPS II scores at admission and standardized mortality rate (SMR) were recorded. The specificity and sensitivity predictive values of APACHE II and SAPS II scores were calculated on death or survival.

Results: A total of 176 patients aged 70–94 (mean±sd=79.8±5.3) years stayed in the ICU for 1–67 (mean±SD: 8.4±10.3) days, and the mortality rate (MR) was 36.9%. There was a significant relationship of APACHE II and SAPS II scores with the MR. The significance of area under the curve was greater for the APACHE II score than SAPS II score, and the significance scores increased for patients aged 80–85 and >90 years. The cut-off values were 22.5 and 43.5 for the APACHE II and SAPS II scores. SMRs were 77%, 82% and 80% for APACHE II predicted, APACHE II adjusted and SAPS II predicted MRs.

Conclusion: Success rate similar to that in the general population could be achieved in the ICU with the elderly, and APACHE II and SAPS II scores showed similar accuracy in the prediction of mortality and both were reliable for patients aged >70 years.

Kew Words: Health Status Indicators; Apache; Outcome Assessment (Health Care)/methods

ARAŞTIRMA

YOĞUN BAKIMDA GERİATRİK HASTALARDA SKORLAMA SİSTEMLERİNİN MORTALİTEYİ ÖNGÖRMEDEKİ ETKİNLİĞİ

ÖZ

Giriş: Hastalık şiddetini tanımlayan skorlama sistemleri, yoğun bakım ünitelerindeki (YBÜ) mortalite riskini de öngörmektedir. Bu çalışmanın amacı; YBÜ'de takip edilen yaşlı hastalarda sağkalımın öngörülmesinde APACHE II ve SAPS II skorlarının duyarlı olup olmadığının belirlenmesidir.

Gereç ve Yöntem: Çalışmaya 2006-2011 yılları arasında YBÜ'ne yatırılan 70 yaş üstü hastalar dahil edildi. Demografik veriler, yatış tanısı, ek hastalıklar, YBÜ'de yatış süresi, sağ kalım/mortalite, APACHE II ve SAPS II skorları ile standardize mortalite oranı (SMR) kaydedildi. APACHE II ve SAPS II skorlarının ölüm ve sağkalım için spesifisite, duyarlılık ve tahmin değerleri hesaplandı.

Bulgular: YBÜ'nde ortalama 8.4±10.3 (1-67) gün takip edilen 70-94 (ort±ss=79.8±5.3 yıl) yaş arası 176 hastanın (88 erkek, 88 kadın) mortalite oranı %36.9 idi. APACHE II ve SAPS II skorları ile mortalite oranı arasında anlamlı bir ilişki vardı. APACHE II için eğri altında kalan alanın anlamlılığı SAPS II skorundan daha yüksek idi. 80-85 ile >90 yaş hastalar için skorlar anlamlı olarak artmıştı. APACHE II ve SAPS II skorları için cut-off değerleri sırasıyla 22,5 ve 43,5 idi. APACHE II, APACHE II-adjusted ve SAPS II ile öngörülen mortalite oranları için SMR sırasıyla %77, %82 ve %80 idi.

Sonuç: APACHE II ve SAPS II skorlama sistemleri mortalite ve sağkalımı öngörmede YBU nde takip edilen genel hasta popülasyonuna benzer şekilde 70 yaş üstü hastalarda da başarılı öngörme oranlarına sahiptir.

Anahtar Sözcükler: Sağlık Durumu İndikatörleri; Apache; Öngörülen Mortalite.

Introduction

The proportion of elderly patients has increased rapidly in the last decade, including in a young generation society such as Turkey. The Statistical Yearbook 2010 of Turkey reports that 6.4% of citizens were >65 years (1). In the year 2013, this proportion increased to 7.7%. The increase in the elderly population was three times more than that in the overall population (13.7% vs 36.2%). Moreover, the dependency of elderly patients is increasing, as shown by the observation in 2013 that every 100 working persons need to take care of 11 old patients (2). Nguyen et al reported that the proportion of patients aged >80 years in Eastern European countries was 3.1% in 2010, which is expected to reach 6.5% in 2050 (3). This increase in the elderly population reflects the future population in the intensive care unit (ICU). Such an increase in the elderly population in the ICU has an impact on health care costs. In districts where the ICU beds are inadequate, the occupation of technologically highly equipped beds with elderly patients results in a conflict among physicians when young patients with long life expectancy cannot be admitted to the limited amount of beds. The justice in sharing beds between the young and elderly sometimes depends on the success rate of the ICU or the duration and quality of life expectancy. Old age should not be the only criterion in the decision of neglecting patients' admission to the ICU. Elderly patients have increased the prevalence of comorbidities and disabilities than younger age groups.

In the ICU, there is an increasing demand for reliable outcome predictors, assessment tools and prognostic models such as the Acute Physiology and Chronic Health Evaluation (APACHE), the Simplified Acute Physiology Score (SAPS) and several other scoring systems. These scoring systems were developed to grade the severity of illness by using various mixed characteristics and predict hospital survival for the ICU patients. They were prepared for the evaluation of heterogeneous populations for specific disease conditions and are still open to research for validation (4).

The hypothesis in this study is that old age is not the only criterion in predicting the outcome and comorbidities and disabilities affecting APACHE II and SAPS II scores are highly sensitive in the prediction of patient survival in elderly population in the ICU. This study was performed in a hospital complex that consisted of old-folks house and a multidisciplinary hospital.

Materals and Method

Approval for the study was granted by the Clinical Research Ethics Committee of Istanbul Umraniye Training and Research Hospital (Chairman- Prof. Dr. Sait Naderi, January 2016, 1145). The charts of patients who were admitted to the ICU of Surp Pırgiç Armenian Hospital, Istanbul (a charity hospital), were retrospectively reviewed. A seven-bed general ICU with complete facilities providing intensive nursing care, invasive monitoring and active interventions (inotropic support, mechanical ventilation, haemodialysis, etc) and major formal organ support (e.g. mechanical ventilation and renal dialysis) was established in the hospital in 2006. All the records of patients staying in the ICU for >24 h during 2006–2011 were evaluated retrospectively, and the details of only the patients >70 years are presented in this study. Only the first admission was accepted for cases who were admitted several times. Demographic information, diagnosis at admission, additional diseases, duration of ICU stay, survival/mortality and APACHE II and SAPS II scores at admission were recorded. The observed actual hospital mortality after ICU treatment was compared with the estimated risk of hospital death derived from the APACHE II scores and SAPS II predicted mortality rates, and this ratio was termed the standardised mortality ratio (SMR) (5). SMR was calculated to guide the performance of ICU. An SMR of 1.00 shows that the actual and estimated death rates are equal, which implies that the ICU has an average performance. SMR > 1.00 would predict a lower-than-average performance.

Statistical Analysis

The data are expressed as mean±sd. The cut-off values for APACHE II and SAPS II scores were calculated using the maximum value for Youden's index [Youden's index = sensitivity - (1 - specificity)]. The specificity, sensitivity and positive and negative predictive values of APACHE II and SAPS II scores were calculated on non survivors or survivors, and the receiver operating characteristic (ROC) curves were drawn. Area under the curve (AUC) was used to derive the 'sensitivity' and the '1-specificity' relationship (6). An AUC value of >0.8 is considered good, a variation between 0.60 and 0.80 is considered as moderate and an AUC value <0.60 is regarded as poor (7). Pearson correlation analysis was used for assessing the relationship between the scoring systems, mortality rate with age and duration of ICU stay. The definition proposed by Dancey and Reidy was used for defining the strength of correlation, with r = 0.1–0.3 indicating a weak correlation

Table 1— Demographics of the Patients.

	Survivor	Non-survivor	Total
No of patients	111	65	176
Gender			
Female	59	29	88
Male	52	36	88
Age years (mean± SD)	79.5±5.6	80.5±4.9	79.8±5.3
70-75	25	7	32
76-80	31	20	51
81-85	30	27	57
86-90	22	7	29
More than 90	3	4	7
Length of ICU stay days (mean± SD)	7.1±26.9	10±12.3	8.4±10.3

and r = 0.3–0.6 indicating moderate strength correlation. Data were analysed using SPSS® software version 17 (SPSS Inc., Chicago, IL, USA). A p value of <0.05 was considered as statistically significant.

RESULTS

The charts of 547 patients were reviewed, and 176 patients (88 males, 88 females) fulfilled the criteria. The actual mortality rate was 36.9%, i.e. 65 patients died. The patients' age varied from 70 to 94 years, with a mean age of 79.8 ± 5.3 years. The duration of ICU stay was 1–67 days (8.4 ± 10.3 days). The relationship between the mortality rate and age and duration of ICU stay was not significant (p > 0.05). The patients were categorised as survivors and non-survivors (Table 1). The length of ICU stay was also not related to age, and the length of hospital stay was similar between the survivors and non-survivors (p > 0.05).

There was a significant relationship of the APACHE II and SAPS II scores with the mortality rate. The significance of AUC was greater for the APACHE II score (AUC: 0.74, p = 0.006) than for the SAPS II score (AUC: 0.726, p = 0.053). The AUC for APACHE II adjusted prediction ratios was the lowest and the AUC for SAPS II predictive mortality ratio was the highest. The significance increased for patients aged 80–85 years and >90 years. The APACHE II score had a cut-off value of 22.5, whereas the SAPS II score had a cut-off value of 43.5 (Table 2, Figure 1).

A significant correlation was observed between the APACHE II and SAPS II scores (Pearson correlation, r = 0.65; r^2 = 0.42; 95% confidence interval: 0.5573–0.7292, p = 0.0001).

The stratification of patients according to the primary diagnosis at admission to the ICU resulted in variable mortality rates. Patients with metastasis of carcinoma or acute or chronic renal failure diagnosis had 100% mortality. Patients with multiple trauma, neurological disorders, aggravation of chronic multiple organ problems (n = 42) and sepsis (n = 15) had mortality rates of 66%, 52%, 42% and 40%, respectively.

Table 2—Analysis of APACHE and SAPS II Scores According to Patient Survival by Using ROC Curves

	All Patients Mean±sd (min-max)	Survivors Mean±sd	Non-survivors Mean±sd	Area Under ROC Curve (95% CI)
APACHE II score	23.8±8.3 (8-53)	21.3±7.5	27.9±8.2	0.739(0.663 to 0.817)
APACHE II predicted mortality	47.6±23.8 (8.7-99)	40.5±20.9	60±23	0.731 (0.652 to 0.810)
APACHE II adjusted mortality	44.8±25.1 (3.2-98)	39.4±23.1	53.9±25.9	0.660 (0.575 to 0.746)
SAPS II score	48.5±17.1 (12-99)	43.7±15.4	56.5±16.8	0.726 (0.649 to 0.804)
SAPS II predicted mortality	46.3±26.3 (3.9±97)	37.8±23.9	60.9±22.8	0.756 (0.682 to 0.830)

Area Under ROC curve analysis ****p value is less than 0.0001 for all scoring systems and mortality predictions.

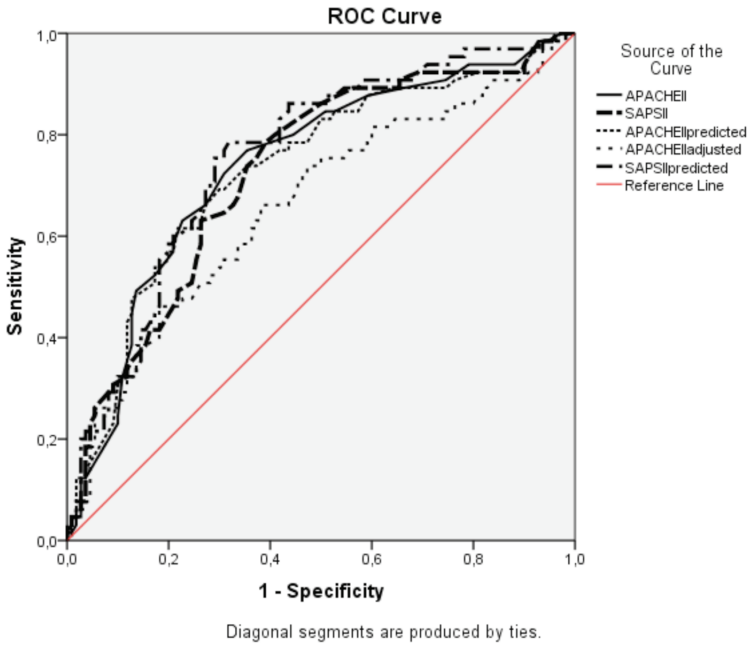

Figure 1— Receiver Operating Characteristic (ROC) Curve.

Table 3— Incidences of Pathologies and Mortality Rates.

Diagnosis	n	Mortality %
Metastatic carcinoma	5	100
Acute or chronic renal failure	4	100
Polytrauma	5	66
Neurological disorders	21	52
Agravation of chronic multi organ problems	42	42
Sepsis	15	40
Isolated respiratory problems	41	29
Cardiac problems	21	23
Post CPR	7	14
Postoperative patients	18	11

The mortality rates in patients with isolated respiratory problems and cardiac problems were 29% and 23%, respectively. One of the three post-CPR patients and two of the 18 (11%) postoperative patients had died (Table 3).

SMR was <1, indicating the success rate of the ICU, and this outcome was observed in all patients treated in the ICU, irrespective of age (SMR = 0.75–0.85, with APACHE II and SAPS II predictions) (Table 4).

Table 4— Standardized Mortality Ratio

Predicted Mortality Scoring System	SMR= Actual Rate/ Predicted Rate
APACHE II predictive rate	0.77
APACHE II adjusted predictive rate	0.82
SAPS II predictive rate	0.80

Discussion

APACHE II consists of 12 different physiological measurements, age and previous health status. The system provides an increasing amount of points for extreme measurements, between 0 and 4 for heart rate, systolic blood pressure, temperature, mechanical ventilation or CPAP (PaO_2, FiO_2) and sodium, potassium, bicarbonate and white blood cell levels. The lowest Glasgow Coma scale has 11 points, and patients aged >75 years received 6 points. The maximum score is 71 points. The impact of the presence of a chronic disease is also included in the evaluation (8).

SAPS II consists of similar variables but has more complicated gradings. Age is defined in more detail. Using the scores evaluated in the first 24 h of admission, the mortality is predicted by using the calculations (8).

The global life expectancy is 69 years and 74.6 years in Turkey (9). In this study, elderly patients were classified as those aged >70 years. In Qiao's study, the elderly group started from the age of 65 years (n = 106). They found similar results to the present study population in terms of APACHE II scores, with an AUC of 0.76 and a cut-off score of 21.5 (10). The AUC for APACHE II adjusted mortality prediction was less accurate than the APACHE II scores. APACHE II scores alone are more highly predictive of mortality. However, SAPS II mortality prediction has a higher predictive power, which is more than that of SAPS II scores.

Because, according to the authors' knowledge, this is the first study evaluating elderly patients in the ICU in Turkey, the outcomes of this study were compared to similar reports from other countries. In a study performed by Ip et al. (11) in Hong Kong on 150 patients aged ≥70 years, the mortality rate was 48% (11). They also observed a good correlation between prognosis (survivors and non-survivors) and APACHE II and SAPS II scores, with correlation coefficients of 0.92 and 0.97, respectively (11). A recent study from Norway including 395 patients aged >80 years (mean age: 83.8 years, 61.0% males) reported overall survival rates of 75.9% (mortality rate of 24.1%) in the ICU and 59.5% in the hospital (12). In this successful ICU performance, mortality was reported to be related to age, SAPS II and multiple trauma with head injury, as well as SOFA and mechanical ventilation. These factors are comparable with the results of the present study. Similarly, Kass et al reported that the severity of acute illness was the most significant predictor of mortality (13). Metastatic carcinoma, acute or chronic renal failure and multiple trauma increased the mortality rate. Exacerbation of chronic illnesses, sepsis and multi-organ involvement were not significantly associated with mortality. Unlike the report by Ip et al, pre-admission cardiopulmonary resuscitation had not resulted in significant mortality in our study group (11).

In contrast to the ICU results in this study, Strand et al reported a relationship between the length of ICU stay and patients >80 years among the non-survivors (14).

Predictions including 'as age increases, mortality increases' are not true in today's settings (15). A success rate similar to that in the general population could be achieved in the ICU with the elderly population, and APACHE II and SAPS II scores demonstrated similar accuracy in the prediction of mortality and both were reliable for patients aged >70 years. A large sample size and long-term studies are required for better evaluation of the ICU status in Turkey.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contributions

PSB participated in study designing, sequence alignment, data collection and analyses and drafting of the manuscript. PC participated in the data collection and analyses and sequence alignment and drafting of the manuscript data. GK participated in the data collection and analyses and sequence alignment and drafting of the manuscript data. AF participated in the data collection and analyses and sequence alignment and drafting of the manuscript data. AD participated in the statistical analyses. BG participated in the data collection and analyses. BB participated in the data collection and analyses. All authors have read and approved the manuscript.

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