

Comparison of APACHE II and Modified Charlson Index in Mortality Prediction in Patients at Medical Intensive Care Unit

Dahiliye Yoğun Bakım Hastalarında Mortalite Öngörüsünde APACHE II ve Modifiye Charlson İndeksinin Karşılaştırılması

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Abstract

Acute Physiology and Chronic Health Evaluation II (APACHE II) and Modified Charlson Index (MCI) are used to predict the fatality in intensive care units (ICU). We aimed to investigate the difference between these scores in the prediction of fatality in the medical intensive care unit. Our study is important because in our literature overview, this study is one of the rare studies that compares these scoring systems. 108 ICU patients included. In all subjects APACHE II and MCI performed. Procalcitonin, C-reactive protein(CRP) levels of patients were recorded. Patients were then grouped according to mechanically ventilated or not; mortality happened or not. Statistically significance found in age($p<0.045$), mechanical ventilation, procalcitonin, CRP and MCI ($p<0.001$) about mortality. MCI sensitivity and specificity were higher than APACHE II in %95 confidence interval. Area under curve in ROC analysis was CRP (0.728), Procalcitonin (0.719), MCI (0.686), APACHE II (0.665) respectively. Our study demonstrates that the Modified Charlson Index combined with procalcitonin and CRP can be used for predicting mortality in medical ICU as well as APACHE II

Keywords: APACHE II, Modified Charlson indeksi, Dahili yoğun bakım ünitesi, Prokalsitonin, C-reaktif protein

Özet

Acute Physiology and Chronic Health Evaluation II (APACHE II) ve Modifiye Charlson indeksi (MCI) yoğun bakımlarda mortalite öngörüsünde kullanılmaktadır. Biz bu skorlama sistemlerinin dahili yoğun bakımda yatan hastalardaki mortalite öngörüsünde aralarında fark olup olmadığını araştırdık. Çalışmamız dahili yoğun bakımda mortalite öngörüsünde bu iki skorlama sistemini karşılaştıran ilk çalışma olması açısından önemlidir. Çalışmaya 108 yoğun bakım hastası dahil edildi. Hastaların hepsine yatışlarının ardından APACHE II ve MCI hesaplandı. Hastaların prokalsitonin ve C-reaktif protein(CRP) seviyeleri kaydedildi. Hastalar mekanik ventilasyon uygulanıp uygulanmaması ve mortalite oluşup oluşmaması açısından gruplandırıldı. Mortalite açısından yaş($p<0,045$), mekanik ventilasyon, prokalsitonin, CRP ve MCI istatistiksel olarak anlamlı bulundu($p<0,001$). MCI'nin % 95 güven aralığında sensitivitesi ve spesifitesi APACHE II ye göre daha yüksekti. ROC analizinde eğri altındaki alan (Area under curve) sırasıyla CRP için 0.728, Prokalsitonin için 0.719, MCI için 0.686, APACHE II için 0.665 di. Çalışmamız Modifiye Charlson indeksinin, procalcitonin ve CRP ile birlikte dahili yoğun bakımda mortaliteyi öngörmeye APACHE II gibi kullanılabileceğini göstermiştir.

Anahtar Kelimeler: APACHE II, Modified Charlson indeksi, Dahili yoğun bakım ünitesi, Prokalsitonin, C-reaktif protein

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1. Introduction

Predicting mortality and morbidity risks of hospitalised patients is important for planning a sufficient treatment and patient care. For this purpose several scoring systems constituted for diseases using the features of related illness as vital signs or laboratory and clinical findings.

Disease severity, age, nutrition, comorbidities, inflammation biomarkers, artificial ventilation support and infection status are the important factors determining intensive care unit (ICU) survival.

Various scoring systems are used to predicting mortality in ICU. Among them Acute Physiology and Chronic Health Evaluation II (APACHE II), mortality prediction model (MPM) and Simplified acute physiology score (SAPS) are the most used scoring systems (1, 2).

Modified Charlson index (MCI) is also used for mortality prediction. MCI assesses patients according to 17 co-morbidities (3). Beside predicting the mortality and morbidity in ICU patients, MCI also used for assessing the mortality estimation in patients with sarcoma, orthotopic liver transplantation and pulmonary diseases (4-6). There is limited data about the prediction and risk assessment of the MCI for ICU patients (7). Furthermore there are only a few studies that compare MCI and APACHE II and have controversial results. Additionally a number of studies suggested interpreting MCI together with APACHE II could improve prognostic prediction (8) (9). Therefore, we tried to show the difference between MCI and APACHE II scoring systems for predicting hospital mortality among medical intensive care unit patients.

2. Methods

We evaluated patients hospitalised to Keçioren Research and Training Hospital intensive care unit between 01.01.2018 and 31.12.2018 after approval of local ethical committee. Patients older than 18, and diagnosed with diseases related to internal medicine were included in the study.

Coronary care patients, surgery and postoperative patients, neurological disease, and gynecology and obstetrics patients were excluded. The demographic data, procalcitonin, CRP, APACHE II, and MCI scores and supportive therapies were retrospectively collected from the hospital database.

Statistical analysis

Patients were grouped according to mortality and both groups were analysed for several demographic and clinical features . APACHE II scores were considered high risk if >8 , and MCI scores were considered high risk if >3 .

For statistical analysis, version 22.0 of SPSS was used. The normality of the distribution of continuous variables was tested by the Kolmogorov-Smirnov test. Variables shown as mean \pm SD if continuous and if discrete as median and IQR (Inter Quartile Ranges) 25-75.AUC (area under curve) values calculated with ROC (Receiver Operating Characteristic) analysis. Chi-square test was applied to investigate the relationship between 2 categorical variables. Comparison of continuous variables done by using Mann Whitney U test. P value < 0.05 was accepted as statistically significant.

Ethical Approval

Health Sciences University Keçiören Education and Research Hospital Ethics Committee Permission was obtained with the letter dated 12.08.2020 and numbered 2156. Our research design was compatible with the Declaration of Helsinki, and was accepted by the Institutional Review Board (December 18, 2018; 43278876-929)

3. Results

108 cases were involved (n: 64 (53%) female; 44 (47%) male). Median age was 77(IQR: 67 –82). Forty five (41.7%) patients died and 63 patients were discharged. Fifty seven (52,8 %) patients were mechanically ventilated. Demographic data, laboratory findings and scoring points of patients were demonstrated in table 1.

Table-1. General characteristics of patients

| | |
|--|------------------|
| Sex n (%) | |
| • Female | 64(53) |
| • Male | 44(47) |
| Age median (IQR%25-75) | 77 (67 –82) |
| Comorbidities n (%) | |
| • Chronic Hypertension | 44(40.7) |
| • Diabetes Mellitus | 44(40.7) |
| • Chronic Kidney Disease | 49(45.4) |
| Mortality n(%) | |
| • Presence | 45(41.7) |
| • Absence | 63(58.3) |
| Mechanical Ventilation (%) | |
| • Presence | 57(52.8) |
| • Absence | 51(47.2) |
| Procalcitonin median (IQR%25-75) | 0,67(0,11-5,4) |
| CRP median (IQR%25-75) | 5,54(1,65-10-57) |
| APACHE II median (IQR%25-75) | 29(22-36) |
| Modified Charlson index median (IQR%25-75) | 7(5-9) |
| APACHE II | |
| • 0-8 n(%) | 4(3) |
| • 8< n(%) | 104(96,3) |
| Modified Charlson index | |
| • 0-3 n(%) | 10(9,3) |
| • 3<n(%) | 98(90,7) |

As shown in table 2; when both groups were compared for several parameters, it was found that there are statistically significance in age ($p<0,045$); mechanical ventilation, procalcitonin,crp, and modified charlson score.($p<0,001$)

When comparing the diagnostic performance of each scoring system and several markers for mortality, it was found that MCI was as useful as APACHE II. Sensitivity, specificity, positive predictive value and negative predictive value of MCI and APACHE II were displayed in table 3.

Table-2. Characteristics and laboratory data of patients according to Mortality

| | <u>Mortality(+)</u> | <u>Mortality(-)</u> | <u>PValue</u> |
|----------------------------|---------------------|---------------------|---------------|
| Sex n (%) | 28(62,2) | 36(57,1) | 0,5 |
| • Female | | | |
| • Male | 17(37.8) | 27(42.9) | |
| Age (IQR%25-75) | 78(74,5-85,5) | 76(64-81) | 0.045 |
| Comorbidities n (%) | | | |
| • Chronic Hypertension | 25(55,6) | 32(50,8) | 0,6 |
| • Diabetes Mellitus | 19(42,2) | 25(39,7) | 0,7 |

| | | | |
|-----------------------------------|------------------|-----------------|--------|
| • Chronic Kidney Disease | 25(55,6) | 24(38,1) | 0,07 |
| Mechanical Ventilation (%) | | | |
| • Presence | 43(95,6) | 14(22,2) | <0.001 |
| • Absence | 2(4,4) | 49(77,8) | |
| Procalcitonin (IQR%25-75) | 3,24(0,35-12,83) | 0,33(0,01-1,50) | <0.001 |
| CRP (IQR%25-75) | 8,68(5,03-14,9) | 4,16(1,3-8,53) | <0.001 |
| APACHE II | | | |
| • 0-8 n(%) | 2(4,4) | 2(3,2) | 0.55 |
| • 8< n(%) | 43(95,6) | 61(96,8) | |
| Modified Charlson index | | | |
| • 0-3 n(%) | 1(2,2) | 9(14,3) | 0.03 |
| • 3<n(%) | 44(97,8) | 54(85,7) | |

Table-3. Comparison of Apache 2 and Modified Charlson scores findings % (95%CI)

| | APACHE 2 | M.CHARLSON |
|--------------------|---------------------|---------------------|
| Sensitivity | 95,56 (84,85-99,46) | 97,78 (88,23-99,94) |
| Specificity | 3,17 (0,39-11) | 14,29 (6,75-25,39) |
| Accuracy | 41,67 (32,25-51,55) | 49,07 (39,33-58,87) |
| PLR | 0,99 (0,91-1,07) | 1,14 (1,02-1,27) |
| NLR | 1,4 (0,2-9,57) | 0,16 (0,02-1,18) |
| PPV | 41,35 (39,49-43,23) | 44,9 (42,19-47,6) |
| NPV | 50(12,76-87,24) | 90 (54,16-98,56) |

PLR: Positive likelihood ratio, NLR: Negative likelihood ratio, PPV: positive predictive value, NPV: Negative predictive value

4. Discussion

Scoring systems predict the risk of mortality by using symptoms, physical examination findings and the results of the laboratory tests . Therefore our aim was to establish a scoring system that is valid and reliable. The objective of our research was to compare the performance of MCI and APACHE II systems for predicting the mortality of ICU patients. Our study's importance and difference from previous studies is that it was one of the few studies carried out in a medical intensive care unit. According to our knowledge, most of these studies in the literature were done in surgical and anesthesia intensive care units.

In our study, age, and mechanical ventilation were associated with mortality as expected. Procalcitonin, CRP, and MCI were associated significantly with mortality, however APACHE II was not associated with mortality. MCI was more sensitive and

specific than APACHE II, the accuracy was superior in MCI compared to APACHE II (%95 confidence interval) .Table 3

There are conflicting results regarding the comparison of scoring systems in the literature. Evran et al. reported that age was significantly linked with higher mortality rates (10). One study determined APACHE II had a more correct evaluation system for fatality contrast to ODIN(organ dysfunction and infection system), SAPS2 and MCI in geriatric patients undergoing emergency abdominal surgery (11). Quach et al.found that the MCI had not enough accuracy as APACHE II for prognosticating hospital mortality in an intensive care unit (12). APACHE II was found a better option for betokening to sepsis related deaths (13).However Dosset et al. did not suggest APACHE II for the trauma associated

mortality prediction in the first 24 hours (14). In another study APACHE III was found more sensitive and specific than APACHE II in predicting mortality(15). PIRO (predisposition, insult, response, organ dysfunction) score, APACHE II and MEDS(mortality in emergency department sepsis) were similar in forecasting mortality in sepsis cases (16). Another study that analysed the association between mortality and procalcitonin, CRP, and SOFA(sequential organ failure assessment) score in ICU, showed that both procalcitonin and CRP were associated with mortality(17).In sepsis patients Chien-Chang Lee et al showed MEDS score was the most specific and procalcitonin was the most sensitive in predicting mortality(18). Similar to our results some studies showed MCI can be useful in mortality prediction. A study comparing MCI and APACHE II found that

these scoring systems are similar in short and prolonged-term mortality for ICU patients (19). Violante Di Donato et al. concluded that MCI could be used as a prognostic factor for surgery needed vulvar cancers(20). Sampada B.Desai et al found that MCI can predict postsurgical adverse events. Like our results there was a high negative predictive value for adverse events(21). Another study in patients undergoing prostatectomy MCI was an effective prognostic factor(22). A study in kidney transplant recipients suggested MCI in clinical practice to stratify the mortality hazard in patients who undergo renal transplantation(23).However another study showed no association between MCI and mortality (24)

In decision we demonstrated that MCI combined with procalcitonin and CRP can be used reliably for predicting mortality instead of APACHE II in medical ICU cases.

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