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- Mustafa Deniz DİNKCİ[1]
- Yücel YÜCE[2]
- Banu ÇEVİK[3]
- Kutlu Hakan ERKAL[4]

Correspondance

Yücel YÜCE
Kartal Dr. Lutfi Kirdar Education and Research Hospital, Anaesthesiology and Reanimation Department, Kartal, ISTANBUL

Phone: 00 90 216 458 30 00
Fax: 00 90 216 352 00 83
e-mail: dryyuce@gmail.com

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[1] Umraniye Education and Research Hospital, Anaesthesiology and Reanimation Department, Umraniye, ISTANBUL
[2] Kartal Dr. Lutfi Kirdar Education and Research Hospital, Anaesthesiology and Reanimation Department, Kartal, ISTANBUL
[3] Kartal Dr. Lutfi Kirdar Education and Research Hospital, Anaesthesiology and Reanimation Department, Kartal, ISTANBUL
[4] Kartal Dr. Lutfi Kirdar Education and Research Hospital, Anaesthesiology and Reanimation Department, Kartal, ISTANBUL

Research

RETROSPECTIVE ANALYSIS OF FACTORS AFFECTING INTENSIVE CARE UNIT MORTALITY IN PATIENTS OVER 75 YEARS OF AGE

Abstract

Aim: This study aimed to investigate the value of the APACHE II scoring system in predicting mortality and identify the factors affecting mortality in advanced-age patients in the intensive care unit.

Material and Methods: The medical records of patients >75 years of age who were hospitalized at the intensive care unit of Dr. Lutfi Kirdar Education and Research Hospital between January 1, 2012 and December 31, 2012 were examined. The patients were divided into two groups according to the diagnosis upon their hospitalization: medical and surgical. Total lymphocyte and leukocyte counts, as well as blood/serum levels of glucose, electrolytes and creatinine, were recorded on the day of hospitalization. Correlation of mortality with Glasgow Coma Scale, APACHE II score, and laboratory findings was studied upon admission.

Results: While mortality was associated with higher APACHE II score, factors such as advanced age on admission, higher serum creatinine levels, lower mean arterial pressure (<60 mmHg), need for inotropic agents within the first 24 hours, longer duration of mechanical ventilation, and presence of acidosis during intensive care unit stay could increase risk of mortality. Regression analysis showed that APACHE II score was more related and could therefore serve as a better predictor of mortality than SAP 3 score.

Conclusion: The predictors of intensive care unit mortality were found to be the same, regardless of the age group. Higher APACHE II score was a valuable scoring system for advanced-aged patients as well as for all age groups.

Key Words: geriatrics, APACHE , intensive care unit

Araştırma

75 YAŞ ÜSTÜ HASTALARDA YOĞUN BAKIM MORTALİTESİNE ETKİ EDEN FAKTÖRLERİN RETROSPEKTİF ANALİZİ

Öz

Amaç: Bu çalışma yoğun bakımdaki ileri yaş hastalarda mortaliteye etki eden faktörleri belirlemek ve mortaliteyi tahmin etmede APACHE II skorunun değerini araştırmayı amaçlamaktadır.

Materyal ve Metodlar: 1 Ocak 2012-31 Aralık 2012 tarihleri arasında Dr. Lutfi Kırdar Eğitim ve Araştırma Hastanesi Yoğun Bakım Servisinde takip edilmiş olan 75 yaş üzeri hastaların tıbbi kayıtları gözden geçirildi. Yoğun Bakıma kabul edildikleri andaki tanılarına göre 2 gruba ayrıldılar: Medikal ve cerrahi. Hastanın yoğun bakıma kabul edildiği tarihteki total lenfosit ve lökosit sayıları, kan glukoz, elektrolit ve kreatinin değerleri kayıt edildi. Hastanın kabul edildiği andaki Glasgow Koma Skalası, APACHE II skoru ve laboratuar değerlerinin mortalite ile korelasyonu çalışıldı.

Sonuçlar: Mortalite yüksek APACHE II skoru ile ilişkili iken yoğun bakıma kabul anındaki ileri yaş, yüksek serum kreatinin düzeyleri, düşük ortalama arter basınçları (<60 mmhg), ilk 24 saat içersindeki inotropik ajan ihtiyacı, uzamış mekanik ventilasyon süresi ve yoğun bakım takibi sırasında asidoz varlığı da mortalite riskini artırabilir. Regresyon analizine göre APACHE II skorunun SAP 3 skoruna göre mortalite ile daha fazla ilişkili olduğu ve bu nedenle mortalitenin daha iyi bir belirteci olduğu ortaya çıkmıştır.

Son Söz: Yoğun bakım mortalite belirleyicileri yaş grubundan bağımsız olarak aynı bulunmuştur. Yüksek APACHE II skoru diğer yaş gruplarında olduğu gibi ileri yaştaki hastalarda da değerli bir skorlama sistemidir.

Anahtar Sözcükler: geriatri, APACHE, yoğun bakım

INTRODUCTION

According to the World Health Organization, the cut-off age for being classified as elderly is 65 years; specifically, 65–74 years old is called early geriatrics, 75–84 years old is called advanced elderly, and >84 years old is called very advanced geriatrics (1). After the age of 65 years, an individual begins to benefit from social and health insurances after retirement; therefore, this age is accepted as the social and economic beginning of geriatrics (2).

In the intensive care unit (ICU) geriatric individuals account for the majority of admitted patients and their treatment may be different from that of younger patients. In fact, the duration of ICU stay was found to be seven times longer in patients over 75 years of age compared with individuals less than 65 years of age (3). Mechanical ventilation (MV) demand was 10 times more in patients over 85 years old compared to patients less than 55 years old. Moreover, one study found that 30% of patients over 85 years of age die in the ICU (4).

Today, advanced age is not a contraindication to ICU admission. Although most geriatric patients who need hospital admission have progressive, irreversible, and highly fatal diseases, withholding ICU admission for such reasons is not rational because the gravity of the medical indications are the same for both geriatric and young patients (5). In surgical ICUs, majority of patients are admitted because of major surgical procedures, mostly cardiac, that need postoperative follow-up. In internal medicine ICUs, the major indications for ICU admission are acute respiratory insufficiency and sepsis; cardiac problems such as myocardial infarction, angina pectoris, arrhythmia, conduction defects, and congestive heart failure are also common. In general, 27% of patients over 65 years of age need ICU follow-up (6).

MATERIALS AND METHODS

We aimed to investigate the factors affecting the mortality of geriatric patients (>75 years of age) admitted to the ICU of Dr. Lutfi Kirdar Research and Training Hospital in a period of one year and to evaluate the value of the APACHE II scoring system as a predictor of mortality.

We recorded data on age, diagnosis, co-morbid conditions, duration of hospitalization, duration of MV, body temperature, Glasgow Coma Scale (GCS), APACHE II score, expected mortality rate based on the APACHE II score, and actual mortality rate. Patients followed-up for less than 24 hours were excluded.

The patients were divided into two subgroups based on the diagnosis upon their hospitalization: these groups included medical disorders and surgical disorders. Total lymphocyte count (TLC), leukocyte count, and levels of blood glucose, serum electrolytes, and serum creatinine were recorded. During ICU stay, data on MV need and duration; need for tracheostomy and duration; and use of positive inotropic agents were also recorded. The number of mortalities and its correlation with GCS, APACHE II, laboratory findings, and additional systemic disorder were evaluated.

Statistical Analysis

Statistical analyses were performed using the software Statistical Package for Social Sciences for Windows 13.0. Comparison of descriptive parameters was made by Student's t-test; whereas comparison of multiple variables was made by analysis of variance (ANOVA). A p value of <0.05 was defined as significant.

RESULTS

In this study, the medical records of 85 patients were retrospectively examined. Majority of patients were in the 81–85 years old group (n = 44), whereas the >90 years old group (n = 6) comprised the minority group; 42.4% of the patients were men and 57.6% were women (Table 1).

Table 1. Age and gender of the cases

Age group	Number of patients		%
	Male	Female	
Age ≤ 80	3	5	9.4%
80 < Age ≤ 85	18	26	51.8%
85 < Age ≤ 90	13	14	31.8%
Age > 90	2	4	7%

The longest duration of ICU stay was 32 days for the surgical group and 114 days for the internal diseases group. However, majority of the patients in the surgical diseases group (n = 6) and internal diseases group(n = 11) stayed in the ICU for only two days. The mean duration of ICU stay was 7.59 days in the surgical group and 15.95 days in the internal diseases group (Table 2). The longest duration of MV was 32 days (mean, 5.55 days) in the surgical group and 114 days (mean, 15.05 days) in the internal diseases group (Table 2).

APACHE II score had the highest mean value at 33.33 in the neurosurgery subgroup and the lowest value at 8 in the OBGYN subgroup in the surgical disorder group. In the internal diseases group, the highest APACHE II score was 32 in the gastrointestinal subgroup and the lowest was 27 in the nephrology subgroup.

The relationship between mortality and different parameters like arterial pH, blood glucose level on admission, serum creatinine level, white blood cell count, mean arterial pressure, body temperature, total lymphocyte count, tracheostomy status, duration of mechanical ventilation, need and type of positive inotropic agent, APACHE II score were shown on Table 3-6.

Increasing TLC had an insignificant tendency to decrease the duration of hospitalization (one-way ANOVA, p =0.747; Table 7).

In the regression analysis, a Pearson correlation coefficient (R)>0.90 indicated correlation with mortality rate. Both APACHE II score and TLC predicted mortality, but the former (R = 0.925) was more precise than the latter (R = 0.668) (Figures 1 and 2).

Table 2. Duration of hospitalization and mechanical ventilation according to diagnosis group

		Surgical	Internal	Total
Total hospitalization (days)	Mean	7.59	15.95	13.09
	Standard deviation	7.06	23.61	19.93
Mechanical ventilation (days)	Mean	5.55	15.05	11.81
	Standard deviation	6.93	23.87	20.24

Table 3. Relationship of mortality with parameters upon intensive care unit admission

Groups	Number of patients	Mortality (%)	Standard deviation	p value
pH < 7.1	6	100	0	0.046*
7.1≤ pH <7.2	17	82.4	39.3	
7.2≤ pH <7.3	18	66.7	48.5	
7.3≤ pH <7.4	11	36.4	50.5	
7.4≤ pH	33	66.7	47.9	
BGL < 70	4	75.0	50.0	0.792
70 ≤ BGL<110	15	66.7	48.8	
110 ≤ BGL<145	24	70.8	46.4	
145 ≤ BGL <165	9	77.8	44.1	
165 ≤ BGL <200	12	50.0	52.2	
200 ≤ BGL	21	71.4	46.3	
Creatinine < 0.81	16	50.0	51.6	0.016*
0.81 ≤ Creatinine < 1.44	26	53.8	50.8	
1.44 ≤ Creatinine < 2	13	69.2	48.0	
2 ≤ Creatinine < 4	23	87.0	34.4	
4 ≤ Creatinine	7	100.0	0	
WBC < 4000	6	66.7	51.6	0.212
4000 ≤ WBC < 14000	61	68.9	46.7	
14000 ≤ WBC < 20000	11	45.5	52.2	
20000 ≤ WBC < 30000	4	100.0	0	
30000 ≤ WBC	3	100.0	0	
MAP< 50	4	75.0	50.0	0.033*
50 ≤MAP< 60	12	100.0	0	
60 ≤MAP< 80	21	76.2	43.6	
80 ≤MAP< 100	24	62.5	49.5	
100 ≤MAP	24	50.0	51.1	
BT < 36	3	100.0	0	0.352
36 ≤ BT < 38.3	69	65.2	48.0	
38.3 ≤ BT	13	76.9	43.9	
TLC < 900	43	69.8	46.5	0.333
900 ≤TLC<1500	30	60.0	49.8	
1500 ≤ TLC	12	83.3	38.9	

*p < 0.05 (significant, by one-way ANOVA test)

Table 4. Relationship of mortality with parameters during intensive care unit admission

Groups	No. of patients	Mortality (%)	Standard Deviation	p value
Tracheostomy(+)	15	66.7	48.8	0.887
Tracheostomy(-)	70	68.6	46.8	
MV ≤ 3 days	39	48.7	50.6	<0.001*
MV > 3 days	46	84.8	36.3	
Inotropic agent(+)	41	43.9	50.2	<0.001*
Inotropic agent(-)	44	90.9	29.1	

*p < 0.05 (significant, by Student's t-test)

Table 5. Relationship of mortality with type of positive inotropic agent

Groups	No. of patients	Mortality (%)	Standard Deviation	p value
Dopamine	14	78,6	42,6	<0.001*
Dopamine + Steradine	30	96,7	18,3	
Not used	41	43,9	50,2	

*p < 0.05 (significant, by one-way ANOVA test)

Table 6. Relationship of mortality with APACHE II score

Groups	No. of patients	APACHE II EMR (%)	Mortality (%)	Standard Deviation	p value
APACHE II < 20	15	13	13.3	35.2	<0.001*
20 ≤ APACHE II	70	61	80.0	40.3	

*p <0.05 (significant, by Student's t-test)

Table 7. Relationship between TLC and duration of hospitalization

Groups	No. of patients	Duration of Hospitalization (day)	Standard Deviation	p value
TLC <900	43	13.93	22.70	0.747
900 ≤ TLC <1500	30	13.53	19.60	
1500 ≤ TLC	12	9.00	5.68	

*p <0.05 (significant, by one-way ANOVA test)

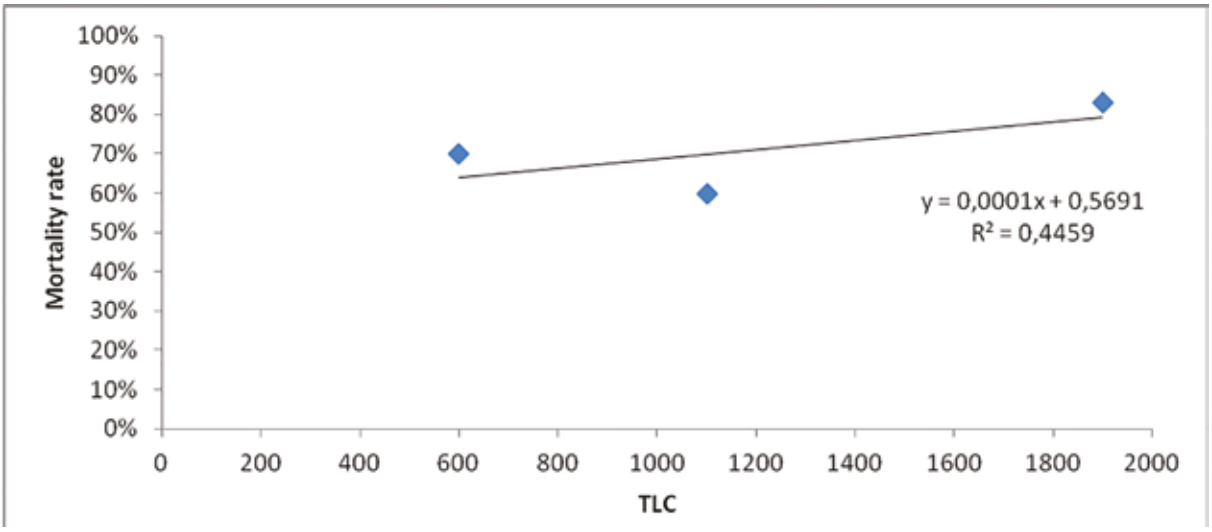

Figure 1: Regression analysis for TLC (Total Lymphocyte Count)

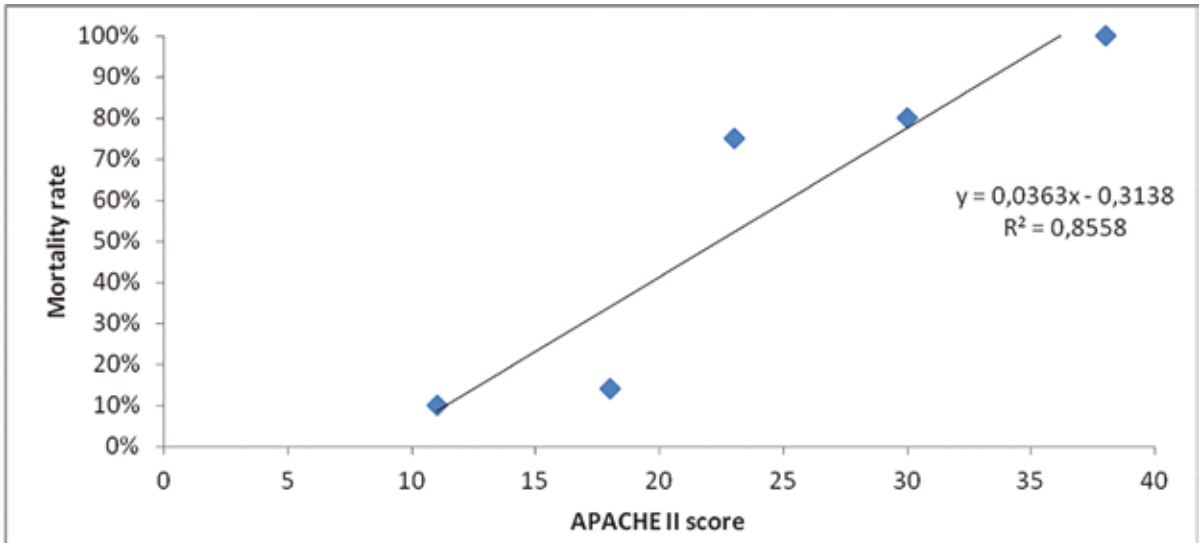

Figure 2: Regression analysis for APACHE II

DISCUSSION

Many researches have studied geriatric patients followed-up in the ICU according to different patient groups. Zampier et al (7) used the SAPS 3 score and Charlson Comorbidity Index (CCI) to examine the factors affecting morbidity and mortality in 1129 patients over 80 years of age. Mortality rate was significantly lower in patients who were admitted to the ICU for internal medicine problems and for elective surgery than those admitted for emergency surgical procedures. Moreover, mortality was high in patients admitted to the ICU for sepsis and renal

injury. The lowest mortality was observed in patients who underwent cardiovascular surgery. That study concluded that SAPS 3 and CCI were statistically and clinically correlated with mortality. Somme et al (8) studied the factors affecting mortality in patients >85 years of age and found that age was not the sole factor that determined ICU mortality. APACHE II score was related with short-term mortality, but not with mortality in the long-term or at one year after ICU discharge.

In this study, we found that APACHE II was more valuable than TLC in predicting mortality. Initially, we presumed that nutritional status, as reflected by the TLC, and the follow-up time in the ICU were related with mortality. However, our results showed otherwise.

Rooij et al (9) found that among patients in the 80–84 years age group,mortality was 85% when the admitting diagnosis was sepsis and 58% in patients with problems in the gastrointestinal system. Both APACHE II and SAP 3 scores were found to be similarly significant in predicting mortality.

The overall mortality rate was 68.24% in our study population, 48.28% for the surgical patients and 78.57% in the internal medicine patients. We presumed that this distribution was due to the presence of additional systemic disorders.

In a retrospective study of Fuchs et al (10) on the 28-day and one-year mortality rates of 7265 geriatric patients, the number of heart failure, severe cardiac arrhythmia, and valvular disorders as reasons for ICU admission was found to increase by age. The highest mortality rate was 56% in the >85 years age group and the lowest was 36% in the 65–74 age group. The SOFA score increased with increasing age and was found to increase mortality. This study claimed that in patients >75 years of age, mortality might be higher than expected; the necessity for special care for these patients was emphasized (10).

In this present study, the highest mortality rate was observed in neurosurgery patients and in patients with renal injury, among the other internal medicine patients; this trend was also reported by other studies (7,9,10). However, it is important to note that our patients with renal injury had lower APACHE II scores (mean 27) than the other internal medicine patients. Caution should be taken when interpreting these results because the small population size of the renal injury group might render the findings statistically and clinically insignificant. Similar to available literature (10), this study showed that low MAP and use of positive inotropic agent on ICU admission significantly correlated with mortality.

Although mortality was not affected by sex, it tended to be higher in women. Time of ICU follow-up was longer in women than in men, regardless of survival outcome. In general, hematocrit is relatively low in women; however, it was high in our female patients. This situation might have been due to the varying amounts of blood samples drawn, duration of ICU follow-up, and other confounding factors.

Burri et al (11) found that although arterial blood gas and pH values might be useful for the management of respiratory failure, these were not significant predictors of annual mortality. In contrast, our results showed that arterial blood gas analysis, especially the pH value, significantly correlated with mortality, which increased in patients with arterial pH <7.1.

Safavi et al (12) showed that patients with high BGL on ICU admission had increased mortality. Similarly, we found that mortality rate was highest in patients with BGLs >200 mg/dl on admission. However, we think that it would be more clinically relevant to combine BGL on admission, mean BGL during ICU follow-up, and detailed glycemic control. A retrospective three-year study by Ucgun et al (13) on 262 ICU patients with the same age as our study population and with non-malignant respiratory disease identified that mortality was associated with changes in the following laboratory values with respect to baseline values: serum BUN, creatinine, LDH, protein levels, arterial blood pH, BE, and bicarbonate levels. On multivariate analysis, 10 of 15 variables were identified to independently predict mortality; these included low systolic blood pressure, APACHE II score >21, LDH >876 IU, arrhythmia, respiratory failure needing MV, short duration of ICU follow-up, use of positive inotropic agent, presence of complications, high BUN, low protein, and acidosis

on arterial blood gas examination. Of these 10, the first three that were enumerated had the highest odds ratios.

In this study, bicarbonate, pH, and BE levels were significant factors in the univariate analysis, but not in the logistic regression analysis. Similarly, Hill et al(14) showed that arterial blood gas measurements did not affect mortality in ICU patients with chronic obstructive lung disease. In another study on chronic obstructive lung disease patients in the ICU, Breen et al (15) found that arterial carbon dioxide levels, not acidosis or alkalosis, on admission independently predicted mortality. On the other hand, we found a significant relationship between pH levels and mortality, but unlike Ucgun et al (13), we found no correlation between alkalosis and survival. Highest mortality was observed in patients with pH level <7.1 in our study. These differences may be accounted for by differences in patient populations and diagnosis groups.

Sudarsanam et al (16) similarly found that increase in mortality in ICU patients (mean age, 41 years) on MV was predicted by need for positive inotropic agents, but not by need for tracheostomy. The duration of MV was short in their patients who died; in contrast, we showed that MV duration >3 days was associated with higher mortality. In addition, they showed that high APACHE II score was related with mortality. Although they used a cut-off APACHE II score of 22 and the age groups were different from those in our study, we both demonstrated that need for positive inotropic agent and high APACHE II score can be used as determinants of mortality independent of age.

Although the patient groups in the four studies discussed above do not exactly overlap with those in our study, the high mean age of the population in these studies are comparable to that in our study. The significant increase in mortality with lower MAP on ICU admission in our study was similar to the results of Ucgun et al (13). Additionally we found that when MAP was <60 mmHg, highermortality was clinically and statistically significant. In that study, renal function was evaluated by BUN, which was shown to independently affect mortality at high levels. Our study showed similar results, except that we used creatinine level instead as a parameter of renal function. Similar to most studies, this present research showed that need for positive inotropic agents and mortality had a significant relationship; we further analyzed this effect by taking into account the type and number of positive inotropic agents used. We could not evaluate the need for MV as a predictor of mortality because all our patients were mechanically ventilated, unlike the study patients of Ucgun et al (17).

Anon et al (17) studied 1661 mechanically ventilated patients and found that age did not affect MV duration and frequency of tracheostomy and reintubation. However, patients >75 years of age had higher mortality than patients <75 years old. After adjusting for tracheostomy and reintubation, diagnosis groups, and sex distribution, mean APACHE II score was shown to be lower in patients >75 years of age. This significant difference in mortality rate between the two age groups made us think that age was a dependent determinant of the mortality. In our study, patients on MV >3 days had higher mortality than those with less duration on MV. In contrary to the study of Anon et al (17), we showed that increase in APACHE II score was correlated with increased age and mortality.

In ICU patients, nutritional deficiency affects all organ systems, especially the immune system. In these patients, TLC and T cell ratio are lower than normal; in addition, the number of non-functional cells and lymphocytes increase in response to mitogenes. TLC was reported to correlate with cellular immunity and a decrease its value indicated visceral protein deficiency (18). Although the TLC is frequently used to determine adequacy of nutrition in ICU patients, we found no study that examined its relationship with ICU mortality. In this study, TLC was not related with mortality, but duration of hospitalization was significantly shorter in patients with TLC>1500.

CONCLUSION

High APACHE II score is a valuable scoring system in advanced age group as in all other age groups.

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