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Prolonged Stay in Intensive Care Unit: Retrospective Analysis of Predisposing Factors and Outcome

Yoğun Bakımda Uzun Yatış: Etkileyen Faktörler ve Sağkalımın Retrospektif Analizi

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ABSTRACT *Objective:* Prolonged stay in the intensive care unit (ICU) is a serious problem resulting in increased cost, resource utilization, and morbidity and mortality. This study was aimed to discuss the factors affecting the prolonged stay in ICU.
Materials and Methods: The data of 219 patients between the years 2015-2019 were evaluated retrospectively. The factors affecting the prolonged stay in ICU were evaluated, including age, gender, reason of admission, length of stay, duration of mechanical ventilation, identified infection, and requirement for renal replacement therapy, tracheotomy, blood transfusion, inotropic and vasopressor agents.
Results: The rate of prolonged stay in ICU was 14.56% for all admissions. The mean age of the patients was 64.74±18.18 years and the age was a predictive factor for the prolonged stay (p=0.006). The percentage of the male patient was %63.47 and 67.58% of all patients were admitted due to non-surgical reasons. Gender (p=0.73) and the reason for admission (p=0.629) were not predictive factors for prolonged stay. High APACHE II score (p=0.000), duration of mechanical ventilation (p=0.025), renal replacement therapy (p=0.000), tracheotomy (p=0.25) and inotropic and vasopressor agents requirements (p=0.000) were the other predictors of prolonged stay in ICU. The mortality rate was 67.13% in all admissions and 85.04% in patients staying more than 30 days in ICU. Mortality was significantly higher in long-term patients (p=0.004).
Conclusion: Many reasons cause prolonged ICU stay and this leads to inefficient use of ICU resources. We believe that the improvements in the high dependency units and palliative care units, and widespread home care facilities will play an important role in increasing the availability of ICU beds.
Keywords: Intensive care unit, length of stay, risk factors

ÖZ *Amaç:* Yoğun bakım ünitelerinde uzun yatış, maliyetin artması, kaynakların kullanılması, hasta mortalite ve morbiditesi ile sonuçlanan ciddi bir problemdir. Bu çalışmada yoğun bakım ünitesinde yatış süresinin uzamasına etki eden faktörlerin tartışılması amaçlandı.
Gereç ve Yöntem: 2015-2017 yılları arasında 14 günden uzun yatan 219 hasta retrospektif olarak incelendi. Yaş, cinsiyet, yatış nedeni, yatış süresi, mekanik ventilasyon süresi, renal replasman tedavisi ihtiyacı, trakeotomi, kan transfüzyonu ihtiyacı, inotropik ve vazopresör ilaçların kullanımı ve tanımlanmış enfeksiyon varlığının yatış süresi üzerine etkileri incelendi.
Bulgular: Uzun yatan hasta oranı tüm yatışların %14,56'sı idi. Yaş ortalaması 64,74±18,18 yıldı ve kalış süresinin uzamasında belirleyici bir faktör olarak bulundu (p=0,006). Erkek hastaların oranı %63,47 idi ve tüm hastaların %67,58'si cerrahi dışı nedenlerden dolayı kabul edilmişti. Cinsiyet (p=0,73) ve yatış nedeni (p=0,629) yatış süresini etkileyen faktörler olarak saptanmadı. Yüksek APACHE II skoru (p=0,000), mekanik ventilasyon süresi (p=0,025), renal replasman tedavisi (p=0,000), trakeotomi (p=0,25), inotropik ve vazopresör ihtiyacı (p=0,015) yoğun bakım ünitesinde uzun yatış süresini etkileyen diğer faktörler olarak belirlendi. Mortalite tüm uzun yatışlarda %67,13, yatış süresi 30 günden fazla olan hastalarda %85,04 idi. Yatış süresi uzamış hastalarda mortalite anlamlı olarak yüksek bulundu (p=0,004).
Sonuç: Birçok nedenden dolayı yoğun bakım hastalarının yatış süreleri uzamakta ve bu durum yoğun bakım kaynaklarının verimli kullanılamamasının önemli nedenlerinden biri olarak karşımıza çıkmaktadır. Palyatif ve ara bakım ünitelerinin geliştirilmesi ve evde bakım hizmetlerinin yaygınlaştırılmasının yoğun bakım yatak uygunluk oranlarının arttırılmasında büyük rol oynayacağı kanısındayız.
Anahtar Kelimeler: Yoğun bakım ünitesi, yatış süresi, risk faktörleri

Introduction

Intensive care unit (ICU) is an important part of the healthcare system in which dedicated to patients having severe, life-threatening diseases and requiring continuous life-support with specialized healthcare team besides advanced monitoring equipment (1). Because of rapid population growth and new developments in medical care, demand for ICU beds increases at a greater rate than supply and this suggests a major problem of triage decisions. Unavailable beds cause delay to ICU admissions and result in a high mortality rate (2).

Time spent in ICU is not accurately predictable and the most encountered question is how long it will take the patient to recover and discharge. There is no consensus definition of the prolonged length of stay (LoS) and the percentage of patients with LoS varies from one center to another. It has been variously defined as over 10, 21 or 30 days (3-5). More recently Zampieri et al. (6) described at the least a 14-day stay in ICU as being prolonged. The ratio of the prolonged stay was previously reported on 4-11% of all admission (7-9). Some suggested that up to 45% of all ICU stays may be consumed by these patients (9).

Different factors have been discussed as contributors to a prolonged stay in ICU. Need for mechanical ventilation (9), intracranial mass (6), Acute Physiology and Chronic Health Evaluation (APACHE II) score (10) and blood transfusion (11) were identified as factors associated with the prolonged stay.

There is limited data from Turkey related to patient's characteristic having prolonged LoS. Aygencel et al. (12) reported a ratio of 9.3% patients with ICU stay ≥21 days in a tertiary medical ICU. Köse et al. (13) suggested a ratio of 11.3% in critically ill patients staying ≥28 days in another tertiary center. The main goal of this study was to document the factors associated with LoS in a mixed medical-surgical tertiary ICU and outcome of these patients.

Materials and Methods

After ethical committee approval, a 3-year-retrospective study (2015-2017) conducted at a 680-bed-referral hospital affiliated to a 32-bed ICU that admits 1600 patients per year. In our hospital, there are 3 mixed medical-surgical closed tertiary units accepting all surgical (except cardiovascular surgery) and non-surgical critically ill patients under the department of anesthesiology and intensive care with anesthesiologists available 24/7. There is also 6-beds-burn intensive care unit staffing by the anesthesiologist excluded from this study. Data was collected from the 10-bed tertiary ICU mostly accepting patients from operating theater and wards.

All data were recorded in a three-step process from admission registry, patients' charts and hospital electronic database including age, gender, the reason of admission, length of stay, duration of mechanical ventilation, requiring renal replacement therapy, tracheotomy, blood transfusion, inotropic and vasopressor agents, identified infection and outcome. APACHE II scores and Predicted Death Rate (PDR) was also recorded from the patients' first-day follow-up charts previously calculated online by http://ybs.saglik.gov.tr with the Health Quality Standards (HQS) of The Ministry of Health of Turkey.

The study was conducted according to the ethical principles outlined in the Helsinki Declaration and the guideline of the Good Clinical Practice. Written informed consent was obtained from the patients or their relatives.

Statistical Analysis

Statistical analyses were performed using SPSS 20 (SPSS Inc, Chicago, IL, USA). Continuous variables such as age, length of stay, duration of mechanical ventilation, APACHE II scores were expressed as mean (standard deviation). Multiple logistic regression analysis was used to investigate the predictors of LoS. Results are presented as odds ratios with 95%confidential and $p<0.05$ values were accepted as statistically significant.

Results

The study group was composed of 219 (14.56% of overall admissions) patients stayed longer than 14 days between 2015-2017 years with a mean LOS of 40.47±43.93 days (14-335). Mean age of the patients was 64.74±18.18 (16-98) years with male gender prominence (63.47%). The cause of admission in 148 patients was non-surgical. The mean APACHE II score was 22.60±5.21 and the mean PDR was 44.87±17.13%. In 97 patients the length of MV was longer than 21 days. In 52 patients (23.74%) renal replacement therapy and in 86 patients (39.27%) tracheotomy was performed. Transfusion rate was 15.52% (n=34). Infection was diagnosed with 32.88% (n=72) of the patients. Inotropic and vasopressor agent requirement was 61.64% (135 patients). The mortality rate was 67.12% (Table 1).

Table 1. Demographic data and clinical characteristics of the patients				
	All patients (n=219)	**LOS>30 days (n=127)**	**LOS<30 days (n=92)**	**p value**
Age (years) (mean ± ss)	64.74±18.18	66.58±16.37	62.21±20.26	0.013*
Gender (n/%) - Female - Male	 80 (36.53) 139 (63.47)	 47 (37.00) 80 (63.00)	 33 (35.87) 59 (64.13)	0.73
Cause of ICU admission (n/%) - Non-surgical - Surgical	 148 (67.58) 71 (32.42)	 86 (67.72) 41 (32.28)	 62 (67.39) 30 (32.61)	0.629
APACHE II score	22.60±5.21	23.02±4.98	22.02±5.48	0.318
PDR (%)	44.87±17.13	45.98±16.65	43.33±17.73	0.432
Length of MV (n/%) - <21 days - >21 days	 97 (44.29) 122 (55.71)	 29 (22.83) 98 (77.17)	 68 (73.91) 24 (26.08)	0.000*
RRT (n/%)) - + - -	 52 (23.75) 167 (76.25)	 28 (22.05) 99 (77.95)	 24 (26.09) 68 (73.91)	0.587
Tracheotomy (n/%) - + - -	 86 (39.27) 133 (60.73)	 68 (53.54) 59 (46.46)	 18 (19.56) 74 (80.44)	0.000*
Transfusion (n/%) - + - -	 34 (15.52) 185 (84.48)	 18 (14.17) 109 (85.83)	 16 (17.39) 76 (82.61)	0.831
Infection (n/%) - + - -	 72 (32.87) 147 (67.13)	 65 (51.18) 62 (48.82)	 7 (7.61) 85 (92.39)	0.000*
Mortality - + - -	 147 (67.13) 72 (32.87)	 108 (85.04) 19 (14.96)	 39 (42.39) 53 (57.61)	0.004*
Inotropic and vasopressor agent (n/%) - + - -	 135 (61.64) 84 (38.36)	 103 (81.10) 24 (18.90)	 32 (34.78) 60 (65.22)	0.015*
LOS: Length of stay, ICU: Intensive care unit, PDR: Predictive death rate, MV: Mechanical ventilation, RRT: Renal replacement therapy *p<0.05 significant				

When the patients were divided into 2 groups according to the LOS as >30 days (Group I) or <30 days (Group II), 127 patients were in Group I and 92 patients were in Group II. There was a statistically significant difference in respect of age, length of MV, the requirement of tracheotomy, infection and mortality between groups. Gender, the cause of ICU admission, APACHE II score, PDR, renal replacement therapy and transfusion requirements showed the insignificant difference (Table 1).

When regression analysis was performed to evaluate the predictors of mortality, the age, APACHE II score, PDR, length of MV, renal replacement therapy, tracheotomy and use of inotropic and vasopressor agents were found highly predictive factors (Table 2).

Table 2. Predictors of mortality			
	Pearson correlation	(CI 95%)	p value
Age	0.169	(-0.002-0.006)	0.006*
Gender	-0.022	(-0.103-0.140)	0.371
Cause of ICU admission	-0.042	(-0.113-0.150)	0.27
APACHE II score	0.361	(-0.069-0.112)	0.000*
PDR	0.356	(-0.026-0.029)	0.000*
Length of MV	0.133	(0.060-0.359)	0.025*
Renal replacement therapy	0.231	(0.045-0.333)	0.000*
Tracheotomy	0.132	(-0.292-0.015)	0.025*
Transfusion	0.025	(-0.205-0.127)	0.355
Infection	0.034	(-0.120-0.179)	0.307
Inotropic and vasopressor agent	0.304	(0.086-0.333)	0.000*

ICU: Intensive care unit, MV: Mechanical ventilation, APCHE II: Acute Physiology and Chronic Health Evaluation, PDR: Predicted death rate, *p<0.05 significant

Discussion

We considered as prolonged stay longer than 14 days in a tertiary ICU accepting mixed surgical and non-surgical patients with a mean LoS of 40.47±43.93 days. The reasons were multi-factorial and showed variability according to ICU characteristics. Martini et al. (14) reported a mean 116 days of stay in surgical critical care patients. On the other hand, in a respiratory ICU, this ratio changed to a mean 24.17±8.38 days (15). Even nurse to patient ratio may affect the stay the patient in ICU (16).

According to gender characteristics, most of the patients were men in our study (63.47%). Gender-related differences were discussed in previous studies but it's unclear whether the gender was a predictive factor of clinical outcome. In Austria, men were admitted to ICU more than women even the severity of illness was the grater in women (17). A study from Sweden represented that 60% of patients were men in ICU but their severity of illness was similar to women (18). Some authors suggested gender-based treatments due to biologic differences between genders (19). In risk-adjusted mortality, male sex was associated with a lower mortality rate after cardiac arrest compared to menopausal aged women (20). In our study, gender was not a predictive factor for prolonged stay.

Advanced age is considered to associate with high mortality rate. There is conflict data about the correlation between age and poor prognosis. Some small samples identified advanced age to be associated with high mortality (21,22) but in a larger group of patient, no correlation was found (23). In a Nigerian tertiary hospital, the ratio of patients older than 50 years with prolonged LoS was 28.9% (11). In our study, the mean age of patients was significantly higher in patients staying more than 30 days in ICU (p=0.006).

In literature, unexpected admissions of patients from wards or after surgical procedures correlated with LoS in ICU (6,9). In our results, Los was similar in surgical and non-surgical patients and not found a predictive factor of Los (p=0.27).

The mean APACHE II score of the patients was 22.60±5.21. The score was higher in patients staying more than 30 days (23.02±4.98) with an insignificant difference. High APACHE II score was related to increased risk of death, so PDR of these patients increased as high as 45.98±16.65%. Oliveira et al. (10) reported that APACHE II score >11 was significantly related to LoS in ICU.

Duration of mechanical ventilation showed a correlation with prolonged stay ICU in this study (p=0.25). Similar results were also reported by many authors (6,10,25). National Association for Medical Direction of Respiratory Care (NAMDRC) 2004 consensus stated that ICU care improvement and technological developments resulted with the prolonged mechanical ventilation (24). Prolonged mechanical ventilation associated with the infection which indicated worse prognosis (25).

Acute or chronic renal failure is a common condition which is frequently requiring dialysis strategies. In our center, we prefer continuous renal replacement therapy (CRRT) in ICU conducted by anesthesiologists. The ratio of CRRT in our study group was 23.74% and found a predictive factor of LoS.

Tracheotomy is the most frequent surgical procedure in ICUs with the indications of prolonged mechanical ventilation, weaning failure and obstruction in the upper airway. The LoS in patients with tracheotomy was reported longer than intubated patients (9,26). Our results also showed that the tracheotomy was a predictive factor of prolonged ICU stay.

Infection in ICU is a serious concern resulting in many clinical and medico-legal problems. Prolonged LoS is one of these problems resulting in unavailability of ICU beds. Dasgupta et al. (27) reported that infected patients stayed approximately more than 3-times longer than uninfected

patients (17.28±8.59 vs 5.8±4.72 days, p<0.001). In our study, there was a significant difference between patients with LoS ≤30 days or more but in regression analysis infection was not found as a predictor. This was a limitation of this study. The infection sources and pathogen identifications were not handled in this study. We simply evaluated the patients whether the infection was present or not. This issue may be a subject of another detailed study regarding the correlation between infection and the length of stay in ICU.

Inotropic agents and vasopressors are widely used pharmacological treatments in ICUs for many clinical settings to increase myocardial contractility and vascular tone. Despite widespread usage, understanding of the clinical effects of these agents was not clearly understood (28). In our study, the usage of these medications prolonged the LoS of patients. Another limitation of this study was the indications of inotropic and vasopressor agents. Evaluation of the requirements may explain the reasons for the prolonged stay in ICU more clearly. This subject may be evaluated in another clinical study.

Overall mortality was 67.12% in our patients. This seemed high but in mixed medical-surgical ICUs this ratio may show a great variability. One-year mortality rate was reported as 94.3% and 61.3% in older and younger patients respectively (13). It's better to examine the mortality within specific diagnostic groups but this issue was not a goal of this study.

This was a single-center investigation and reflected only our results. Multi-center analysis concerning the predictive factors of the prolonged stay in ICUs may be more helpful to understand the underlying reasons.

Conclusion

As a result, long-term patients constitute a considerable proportion of overall admissions to ICU with a high mortality rate. Overall mortality was 67.12% in our study; age, APACHE II score, duration of mechanical ventilation, renal replacement therapy requirement, presence of tracheotomy and the infusion of inotropic and vasopressor agents were found as predictive factors for prolonged stay in ICU. The reasons of LoS are multifactorial and show a wide variability between centers. It results with the unavailability of ICU beds despite of increasing the number of patients demanding for critical care. The development of intermediate and palliative care units and increasing in home care facilities will reduce the non-beneficial use of ICU resources.

Ethics

Ethics Committee Approval: This study was approved by Ethical Committee (29/05/2018-2018/514/130/11).

Informed Consent: Written informed consent was obtained from the patients or their relatives.

Peer-review: Externally and internally peer-reviewed.

Author Contribution

Surgical and Medical Practices: B.Ç., F.D.G., Concept: B.Ç., Design: B.Ç. Data collection and processing: B.Ç., Analysis and interpretation: B.Ç., F.D.G. Literature search: B.Ç., Writing: B.Ç.

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