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An examination of factors affecting the length of stay in long-term intensive care

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Abstract

With increased life expectancy, developments in intensive care (IC) and applications, there has been an increase in the length of stay of patients in IC Unit (ICU) in recent years. The aim of this study was to examine factors affecting the Length of Stay (LOS) in long-term ICU (LTICU)A total of 503 patients were included and the effects of variables were evaluated such as age, gender, comorbidities, tracheostomy, nutrition, mechanical ventilator (MV) support, and bacteria produced in cultures, which were predicted to have a clinical effect on the LOS in LTICU. The mean LOS in LTICU was 47.6±52.9 days. The LOS was determined to be increased 0.408-fold in patients with tracheostomy, 0.678-fold with Proteus spp production in cultures and 0.400-fold with E. coli production ($p<0.001$) and nutrition with enteral tube increased the LOS 0.291-fold, however, patients with cancer had a shorter length in LTICU. ($p=0.001$). The median cost per patient was 30489.80(508.00; 386775.00) Turkish Liras.This study showed that the isolation of Proteus spp and E.coli in the cultures of patients and nutritional support prolonged the LOS in LTICU. By taking the necessary infection precautions in LTIC patients, the LOS and costs may be reduced.

Keywords: Long-term intensive care unit, length of stay in long-term intensive care unit, nutrition, e. coli

Introduction

The increasing elderly population is causing a significant increase in the clinical and economic burden of patients with severe chronic diseases[1]. Life expectancy is increasing in Turkey and currently stands at 75.3 years for males and 80.7 years for females [2]. In addition, developments in intensive care are prolonging the lifespan of patients[3]. If it is considered that elderly patients with a severe chronic disease have a poor prognosis, there can be understood to be a need for new approaches to the care of these patients [4].

Long-Term Care Hospitals (LTCH) are healthcare facilities which specialize in the treatment of patients with severe health problems who require continuous care [5]. LTCH have been defined by Medicare as hospitals where the average length of stay is more than 25 days[6]. Long-term acute care hospitals have been defined as acute healthcare facilities which accept patients requiring acute care (eg, wound care) and again with a LOS of >25 days[7]. Friedman et al. [8] reported that the provision of long-term care by acute care hospitals was more costly and >10% of beds were being occupied by patients being treated there until transfer to a more appropriate facility.

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Despite policies developed by the Ministry of Health to increase the number of intensive care (IC) beds in Turkey in the last decade, the desired number has not yet been reached. The Intensive Care Unit (ICU) of Ulus State Hospital was the first implementation in Turkey of Long-Term Intensive Care Unit (LTICU) and provides care of unlimited duration to patients transferred from ICUs of other hospitals following acute care for whom discharge to home or clinics is not planned.

The aim of this study was to examine the factors affecting the LOS of patients followed up in LTICU. This study is of value as the first study in Turkey to evaluate the factors affecting the LOS in LTICU.

Material and Methods

eApproval for the study was granted by the Ethics Committee of Ankara Numune Training and Research Hospital (decision no 655, dated 11.11.2015) and all procedures were applied in accordance with the principles of the Declaration of Helsinki. A retrospective examination was made of the records of 612 patients followed up in the LTICU of Ulus State Hospital between January 2013 and March 2016. A record was made of the age and gender of each patient, the Glasgow Coma Scale (GCS), the Acute Physiology and Chronic Health Evaluation II (APACHE II) score, conditions/comorbidities,

LOS in LTICU and the prognosis (exitus or survived). The GCS is scored between 3 and 15, 3 being the worst, and 15 the best. APACHE II: The total number of points gives a score ranging from 071, with an increasing score representing a greater severity of illness. In addition, the application of Percutaneous Endoscopic Gastrostomy (PEG), tracheostomy, mechanical ventilator (MV) support, nutritional route [total parenteral nutrition (TPN) or enteral nutrition (EN)], culture samples taken while the patient was in LTICU (blood, tracheal aspirate, urine, rectal swab, wound) and the total treatment costs (Turkish Lira) were also recorded. The costs were updated to current value based on Producer Price Index (PPI) in March 2016. The data of the patients and the treatment costs were determined from the patient information management system (HBYS -Alpdata Company, Ankara, Turkey).

Statistical Analysis: Calculations and statistical analysis of the study data was made using the IBM SPSS Statistics 21.0 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) and MS-Excel 2007 programs. Conformity to normal distribution of the study variables was evaluated with the Shapiro-Wilk test. Descriptive statistics were stated as median (minimum-maximum) and mean±standard deviation (SD) values. Number (n) and percentage (%) were stated to show the distribution of patients in categorical variables. The effects of variables such as age, gender, comorbidities, GCS, APACHE II, tracheostomy, TPN, EN, MV, bacteria produced in cultures, which were predicted to have a clinical effect on the LOS in LTICU, were examined with regression analysis. At each stage, the entry probability of the variable to the regression model was taken as 0.05 and the probability of removal from the regression as 0.10. To examine the presence of multiple correlations, the non-parametric Spearman Rho correlation coefficient was used in the examination of relationships between independent variables and the Shapiro-Wilk test was used in the examination of the conformity to normal distribution hypothesis of the model remainder. Since analysis results were skewed to the right, logarithmic linear regression model was applied to the variable representing LOS in LTICU. During the assessment of results values were exponentiated (e Fixed coefficient +β ϒ(for each variable)) (Table IV). A value of $p<0.05$ was accepted as statistically significant.

Results

From a total of 612 patients followed up in the LTICU of Ulus State Hospital between January 2013 and March 2016, 109 patients were excluded from the study; 70 patients with incomplete records, 27 patients with length of LTICU stay ≤2 days and 12 patients with repeated admittance. Thus, a total of 503 patients were included in the study for evaluation. The patients comprised 275 (54.7%) males and 228 (45.3%) females with a mean age of 72.3±16.2 years. The GCS score was 7.7±3.2, the APACHE-II score was 25.7±5.4, LOS in LTICU was 47.6±52.9 days and while 91 (18.1%) patients were discharged, 412 (81.9%) were exitus in ICU. The median cost per patient was 30489.80 (508.00; 386775.00) Turkish Liras and updated cost based on PPI was 35628.38 (545.84; 386619.50) (Table I). The most common comorbidities were hypertension (HT) in 275 (54.7%) patients, cerebrovascular event (CVE) in 204 (40.6%), diabetes mellitus in 94 (18.7%) patients and cancer in 66 (13.1%) patients. The conditions and comorbidities of the patients are shown in Table II.

PEG was applied to 230 (63.4%) patients, tracheostomy to 315 (62.6%) and MV (72.6%) support to 365 patients. All patients required nutritional support, with TPN applied to 369 (73.4%) and EN (PEG and nasogastric tube) to 347 (69.0%) patients.

Table 1. Patient characteristics

Variables	Median (min; max)	Mean±SD
Age(Years)	76.0 (17.0; 101.0)	72.3±16.2
LOS in LTICU (days)	29.0 (3.0; 309.0)	47.6±52.9
GCS	7.0 (3.0; 15.0)	7.7±3.2
APACHEII	26.0 (8.0; 39.0)	25.7±5.4
Total cost (Turkish Lira)	30489.82 (508.00; 386775.00)	
PPI current cost (Turkish Lira)*	35628.38 (545.84; 386619.54)	

LOS: Length of Stay, LTICU: Long-Term Intensive Care Unit, GCS: Glasgow Coma Scale,
APACHE II: Acute Physiology and Chronic Health Evaluation II, PPI: Producer Price Index
*The costs were updated to current value based on PPI in March 2016.

Table 2. Patient characteristics

Conditions/comorbidities	Present n (%)
Alzheimer's - Dementia	67 (13.3)
Parkinson's disease	21 (4.2)
Diabetes Mellitus	94 (18.7)
Hypertension	275 (54.7)
Heart Disease	28 (5.6)
Cerebrovascular Event	204 (40.6)
Respiratory disease	90 (17.9)
Hypoxic brain	76 (15.1)
Traumatic Brain and Spinal Cord Injury	35 (7.0)
Cancer	66 (13.1)
Concomitant problems	**Present n (%)**
Tracheostomy	315 (62.6)
Mechanical ventilation	365 (72.6)
Percutaneous Endoscopic Gastrostomy	230 (45.7)
Pressure Ulcer	397 (78.9)
Total Parenteral Nutrition	369 (73.4)
TPN additional nutrition	347 (69.0)
Enteral tube	352 (70.0)
Enteral aditional nutrition	106 (21.1)

In the culture samples, the most commonly isolated bacteria was Escherichia coli (E. coli) (n: 180, 35.8%) and the other bacteria were Acinetobacter spp (28.0%) Pseudomonas spp (24.9%) and MRSA (24.9%) (Table III).

The results of the regression model created to examine the effects on the LOS in ICU of independent variables such as age, gender, comorbidities, GCS, APACHE II, tracheostomy, TPN, EN, MV and bacteria produced in cultures, are shown in Table IV. Although the explanatory coefficient of the model was at a moderate level ($R2=0.521$), the model was statistically significant ($F= 67.129$; $p<0.001$).

As a result of the multi-variable linear regression analysis with parameters predicted to affect the LOS in LTICU, it was determined that patients with cancer had a shorter length in LTICU (β; -0.281, p =0.008). The LOS in LTICU was determined to be increased 0.408- fold in patients with tracheostomy, 0.678-fold with Proteus spp production in cultures and 0.400-fold with E. coli production (p<0.001) and nutrition with enteral tube increased the LOS 0.291-fold (p=0.001). However, age, gender, diagnoses other than cancer, MV support, and the production of Pseudomonas spp, Acinetobacter spp and MRSA in cultures were not observed to affect the LOS in LTICU (Table IV).

Table 3. Type, proliferation status and amount of each bacteria

Bacteria type	Produced	Not produced	Amount of bacteria produced Median (min; max)
E. coli	180 (35.8)	323 (64.2)	2 (1; 16)
Pseudomonas spp	125 (24.9)	378 (75.1)	2 (1; 10)
Acinetobacter spp	141 (28.0)	362 (72.0)	2 (1; 10)
MRSA	125 (24.9)	378 (75.1)	1 (1; 6)
Proteus spp	60 (11.9)	443 (88.1)	2 (1; 8)
Other	88 (17.5)	415 (82.5)	1 (1; 6)

E. coli: Escherichia coli, MRSA: Methicillin resistant staphylococcus aureus

Table 3. Variables related to the length of stay in long-term intensive care unit: multi-variable linear regression analysis*

Variable	$\hat{\beta}$	$SE(\hat{\beta})$	95% CI fo $\hat{\beta}$ Lower limit; Upper limit	t	p	LOS in LTICU (days)**	Coefficient for LOS***
Fixed coefficient	1.659	0.098	1.467; 1.851	16.969	<0.001	5.254	-
Cancer	-0.281	0.105	-0.488; -0.074	-2.669	0.008	3.967	0.755
Tracheostomy	0.408	0.077	0.257; 0.559	5.312	<0.001	7.901	1.503
Proteus spp	0.678	0.115	0.451; 0.904	5.881	<0.001	10.350	1.970
E. coli	0.400	0.086	0.231; 0.568	4.653	<0.001	7.838	1.492
TPN	0.642	0.081	0.482; 0.801	7.918	<0.001	9.984	1.900
ET	0.291	0.084	0.126; 0.457	3.454	0.001	7.028	1.338

LOS: Length of Stay, LTICU: Long-Term Intensive Care Unit, E.coli: Escherichia coli, TPN: Total Parenteral Nutrition, ET: Enteral tube,
*n=503, p=8, R2=0.521, 2=0.514, Durbin Watson d=1.907, F=67.129, p<0.001, Values calculated for ln (DOS)
**LOS = e Fixed coefficient +βˆ
***Coefficient for LOS=Variable /Fixed coefficient

Discussion

With increased life expectancy and developments in IC and applications, there has been an increase in the LOS of patients in ICU in recent years. In the acute phase, the patients who are hospitalized for a lengthy period may have requirements such as MV, intravenous antibiotic treatment or wound care [6, 7]. Transfer to an LTCH of stable, chronic, critical patients who no longer require acute IC allows acute IC beds to be used by more urgent cases and does not entail high costs [9].

In the current study, the LOS in LTICU was determined as 47.6±52.9 days. The service profile of our unit is different from that of other ICUs. As we accept patients followed up in ICU of other hospitals, those with a need for acute care and patients with a chronic and poor prognosis who cannot be discharged, the LOS is longer. When patients remain in ICU for more than 10 days, mortality is known to increase [3]. Similar to the findings of the current study, it has been reported that in a comparison of patients with chronic, critical disease with patients with critical disease, the LOS in ICU and mortality rates were reported as 40.8 ± 24.2 days vs 8.7 ± 18.0 days and 32% vs 11.8%, respectively [10]. In the current study, mortality was determined at the high rate of 81.9%.

The high mortality rate can be considered to be because the patients had multiple comorbidities, prolonged MV support, all were bed-ridden and had nutritional problems. Tracheostomy is one of the most commonly applied interventions to critical patients in ICU [11]. In the current study, tracheostomy was determined to increase the LOS in LTICU by 1.503-fold (p<0.001). However, in some studies, tracheostomy has been reported to shorten the ICU stay and to reduce mortality [11, 12]. The majority of the patients in the current study were those with a poor prognosis, in the terminal stage and for whom discharge could not be planned. It can be considered that the tracheostomy applied to these patients who could not be discharged could have prolonged the LOS in ICU by reducing mortality.

In a previous study in a long-term care facility, E. coli was observed to be the most isolated bacteria in patients who developed bacteremia [13, 14]. Consistent with the findings in literature, in the culture samples of the patients in the current study, E.coli was isolated at the highest rate in 180 (35.8%) patients. In the linear regression analysis of the LOS in LTICU, it was determined that the stay was 1.492-fold (p<0.001) longer for patients with isolated E.coli. Ko et al.[15] reported a statistically significantly longer stay of patients with bacteremia compared to those without bacteremia. In another study, which investigated the effect of E.coli from bloodstream infection on mortality rates and length of hospitalization, E.coli infection was reported to prolong the hospitalization period [16].

March et al. [17] reported that there were resistant organisms in patients transferred from long-term care facilities to acute-care geriatric units. In another study, bloodstream infections together with the length of hospitalization was reported to increase mortality rates, with mortality determined at 16.7% in S. Aureus, 16.5% in Pseudomonas and 12.3% in E.coli [18]. Similarly, in

the current study, Proteus spp and E.coli production in cultures was determined to prolong the LOS 1.970-fold and 1.492-fold respectively ($p<0.001$), while other bacteria were not observed to have any effect on the LOS in LTICU. This is thought to be due to the higher mortality of the infections caused by the other isolated bacteria and therefore patients were exitus in a shorter period in LTICU.

The LOS of cancer patients has been reported to be shorter because of the rapid functional decrease [19]. In the current study, patients diagnosed with cancer had a shorter LOS in LTICU compared with patients with other diagnoses. We also found that 53 (80.3%) of the patients with 66 cancers died and 13 (19.7%) were discharged. LOS may have been found to be low because of the high mortality of this patient group.

Malnutrition is known to be an independent risk factor for poor prognosis in ICU patients [20] and insufficient calorie intake in ICU patients has been reported together with high mortality rates [21]. Correia et al.[22] concluded that inadequate nutrition prolonged hospital stay, increased complications and mortality and was an independent risk factor for the length of hospitalization and costs. In the current study, TPN applied to patients was observed to prolong the LOS in LTICU 1.9-fold ($p<0.001$) and enteral tube nutrition 1.338-fold ($p=0.001$).

If this result seems to conflict with other findings in literature, this is because long-term care facilities have not been established in Turkey and the majority of patients followed up in ICU comprised patients who no longer required acute IC but could not be cared for at home and remained in ICU until death. In addition, as Do Not Resuscitate (DNR) orders or the implementation of withdrawing and withholding are not legal in Turkey, treatment and nutrition of all ICU patients is continued until death. As nutritional support was administered to patients until the last moments of life, the LOS in LTICU was prolonged. Therefore, in contrast to studies, which have shown that nutritional support shortened the LOS, in the current study, it can be considered that as TPN and EN reduced mortality, the LOS in LTICU was prolonged.

Conclusion

The results of this study showed that the isolation of Proteus spp and E.coli in the cultures of patients and nutritional support prolonged the LOS in LTICU. By taking the necessary infection precautions in LTIC patients, the LOS and costs may be reduced. As ICU is more costly and has lower capacity than LTICU, it should be used for patients requiring acute care, who could have a good prognosis or even fully recover. Patients with chronic problems or with an extended treatment period following acute care should be followed up in LTICU. A significant proportion of intensive care beds in Turkey are used for patients with complex problems who are hospitalized for a long time. Therefore, for more effective operation of ICUs in Turkey, there is an urgent need for LTICUs to be established for patients with these requirements and for the legal criteria to be determined for DNR and withdrawing and withholding implementation.

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