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RESEARCH

# WEANING IN GERIATRIC PATIENTS: A RETROSPECTIVE CLINICAL STUDY

## Abstract

***Introduction:*** With the growth of the geriatric population in the society, the number of geriatric patients followed up at intensive care units has also increased. Weaning in geriatric patients is a long and necessary process. In our study, we evaluated the weaning process in a geriatric patient group.

***Materials and Method:*** The relationship between the weaning process and mortality rates in 814 patients aged>65 years who were hospitalised in our intensive care unit between 1 January 2015 and 31 December 2016 was retrospectively analysed. Our geriatric patients were divided into three age groups: young (65–74), middle (75–84) and advance (≥85).

***Results:*** The mean Acute Physiology and Chronic Health Enquiry II score was 21.8±9.2 and Simplified Acute Physiology Score 2 was 43.2±20.9. Mechanical ventilation was provided to 615 patients. The mean duration of the weaning process onset was 6±13.4, 5.85±7.87 and 6.5±7.1 days in the three groups, respectively. Weaning was successful in 286 (46%) of the 615 geriatric patients, and 20 patients were discharged with a home ventilator.

***Conclusion:*** The weaning process in geriatric patients may be extended with age-related pulmonary dysfunction. The number of weaning trials in this process also increased. Our results indicate that the mean number of weaning trials in successfully weaned patients is higher. We consider that given the increase in geriatric patient follow-up rates in intensive care units, it will be possible to ensure successful weaning and lower mortality rates, along with successful management of such patient groups, by increasing the number of weaning trials.

***Key Words:*** Geriatrics; Respiratory insufficiency; Weaning; Critical care

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ARAŞTIRMA

# GERİATRİ YAŞ GRUBU HASTALARDA VENTİLATÖRDEN AYIRMA: RETROSPEKTİF KLİNİK ÇALIŞMA

## Öz

***Giriş:*** Toplumda yaşlı hasta sayısının artmasıyla birlikte yoğun bakımda takip edilen yaşlı hasta sayısı da artmaktadır. Yaşlı hastaların mekanik ventilatörden ayırma süreci uzun ve zorludur. Bu çalışmada yaşlı hasta grubunda ventilatörden ayırma süreci değerlendirilmiştir.

***Gereç ve Yöntem:*** Yoğun Bakım Ünitesinde Ocak 2015-Aralık 2016 tarihleri arasında yatan 65 yaş üstü 814 hastanın ventilatörden ayırma süreçleri ve mortalite değerleri arasındaki ilişkileri retrospektif olarak incelendi. Yaşlı hastalar ile ilgili veriler genç yaşlı (65-74 yaş), orta yaşlı (75-84 yaş) ve ileri yaşlı (85 yaş ve üstü) olarak üç yaş grubunda yorumlandı.

***Bulgular:*** Hastaların akut fizyoloji ve kronik sağlık değerlendirme II skor ortalaması; 21.8±9.2 idi. 615 hastaya mekanik ventilasyon uygulanmıştır. Ventilatörden ayrılma başlangıç zamanı ortalamaları gruplara göre sırasıyla; 6±13.4, 5.85±7.87 ve 6.5±7.1 gün olarak gözlenmiştir. 615 geriatrik hastadan 286'sı başarılı şekilde ventilatörden ayrılma uygulanmıştır (%46) ve 20 hasta eve homevent ile taburcu edilmiştir.

***Sonuç:*** Yaşlı hasta grubunda ventilatörden ayrılma süreci yaşa bağlı pulmoner disfonksiyonun artmasına paralel olarak uzayabilmektedir. Bu süreç içinde ventilatörden ayrılma deneme sayısı da artmaktadır. Çalışma sonucu başarılı ventilatörden ayrılma gerçekleşen hastalarda deneme sayısı ortalamasının fazla olduğunu işaret etmektedir. Yoğun bakım ünitelerinde yaşlı hasta takip yüzdeleri gözönüne alındığında, bu hastaların başarılı bir şekilde yönetilmesiyle, deneme sayıları arttırılarak başarılı ventilatörden ayrılma ve daha düşük mortalite değerleri elde etmek mümkün olacaktır.

***Anahtar Sözcükler:*** Yaşlılık; Solunum yetmezliği; Ventilatörden ayırma; Yoğun bakım

## INTRODUCTION

An increase in life expectancy has led to an increase in the proportion of the geriatric population. Reductions in mortality rates among geriatric patients have also contributed to the growth of the geriatric population. In the last 50 years, the increase in life expectancy has reached 20 years, and 2050 is estimated to be the first year when the worldwide geriatric population will match that of the children (1,2). According to data from the Turkish Statistical Institute, the proportion of the geriatric population was 7.5% in 2012, which has increased to 8.3% in 2016. Males constitute 43.9% and females constitute 56.1% of the geriatric population (3).

The growth in the geriatric population is proportional to the increase in geriatric patients followed up in clinics and intensive care units (ICUs). The process of intensive care for the geriatric population differs from that for the young population in several aspects. Among the several problems faced by geriatric patients in ICUs, an extended duration of mechanical ventilation is one of the most significant. In geriatric patients who require mechanical ventilation for any reason, age-related impaired elasticity of the lungs, decreased muscle mass and reduced lung volume render weaning a difficult process (4-6). Furthermore, the frequent presence of comorbidities and malnutrition in this population hamper the treatment of respiratory insufficiency (7-9). However, with more experiences in ICU care and weaning in geriatric patients, an increase in treatment success is expected.

In our study, we retrospectively investigated the weaning process in geriatric patients aged >65 years who constitute a majority of our intensive care unit population.

## MATERIALS AND METHOD

In the present study, we retrospectively investigated the data of 814 patients aged >65 years who were admitted to the ICU of the University of Health Sciences Fatih Sultan Mehmet Health Research and Application Center between 1 January 2015 and 31 December 2016. This study was approved by our hospital's scientific studies board (FSM SSB Ref. No: 2017/23). Our clinic is a tertiary ICU with a capacity for 20 beds; patients with clinical hospitalisation for >24 h were included in our study based on their initial admission times. Patients were provided intensive care admission and mechanical ventilation for primary and secondary respiratory insufficiencies and neurological, postoperative, post-CPR and post-traumatic causes. Demographical data of the patients, Acute Physiology and Chronic Health Evaluation (APACHE) II score, Simplified Acute Physiology Score (SAPS 2) averages, type of diagnosis, mean Glasgow coma scale (GCS) scores of the neurologic patient group and duration of mechanical ventilation were recorded. The time of weaning onset was considered as the time when patients with invasive mechanical ventilation were switched to a T-tube; the number of weaning trials and success rates were also recorded. The relationship between the weaning process from mechanical ventilation and mortality rates were investigated. Our geriatric patients were divided into three age groups: young (65–74 years), middle age (75–84) and advance (≥85); statistical analyses were conducted according to this classification.

### Statistical analysis

IBM SPSS Statistics 22 (IBM SPSS, Turkey) programme was used for statistical analysis. Normal distribution of the parameters was evaluated using the Shapiro–Wilk test. In addition to descriptive statistical methods (mean, standard deviation and frequency), one-way analysis of variance was used for intergroup comparisons of parameters manifesting a normal distribution, and the Tukey's honest significant difference test was used to compare quantitative data to identify significant differences between groups. The Kruskal–Wallis test was used for intergroup comparisons of the parameters not manifesting a normal distribution, and the Mann–Whitney U test was used to identify

significant difference between the groups. Student's t test was used to compare parameters manifesting a normal distribution between two groups, and the Mann–Whitney U test was used to compare parameters not manifesting a normal distribution between two groups. The chi-square, Fisher's exact and correction for continuity (Yates) tests were used to compare qualitative data. Spearman's rho correlation analysis was used to examine the correlation between parameters not manifesting a normal distribution.

The optimal cut-off point was selected based on the receiver operating characteristic curve analysis. Statistical significance was set at $p < 0.05$.

## RESULTS

Noninvasive mechanical ventilation was applied to 199 of 814 patients in the study. The mean patient age, duration of hospitalisation and APACHE II, SAPS 2 and GCS scores of 191 patients hospitalised for neurological causes as well as the duration of mechanical ventilation of 615 patients under invasive mechanical ventilation are listed in Table 1.

Successful weaning was achieved in 286 (46%) of 615 patients under invasive mechanical ventilation; 20 patients who were discharged with a home ventilator were also included in the successful weaning group. Weaning times of patients with successful weaning are listed in Table 2, and 75.9% of patients were weaned off in the first 48 h.

**Table 1.** Evaluation of study parameters.

| Parameter | Min–Max | Mean ± sd |
|---|---|---|
| Age | 65–101 | 79.14 ± 8.08 |
| Duration of ICU stay | 0–163 | 12.5 ± 20.31 |
| SAPS 2 (n=790) | 0–99 | 43.56 ± 20.91 |
| APACHE II score (n=814) | 2–80 | 21.85 ± 9.27 |
| GCS score (n=191) | 3–15 | 6.04 ± 2.75 |
| Number of days under mechanical ventilation (n=623) | 1–163 | 12.46 ± 20.34 |

**Table 2.** Weaning process according to successful weaning time.

| Weaning time (in days) | Number of patients; n (%) |
|---|---|
| Before the second day | 202 (75.9%) |
| Between 2 and 5 days | 30 (11.2%) |
| Between 6 and 15 days | 26 (9.7%) |
| After the 16$^{th}$ day | 8 (3.0%) |

The total mortality rate was 42.1%, and standard mortality rate (SMR) was 1.06%. Correlations of the duration of ICU stay, number of days under mechanical ventilation and number of weaning trials with the mortality rate are described in Table 3, according to the three age groups [young (65–74 years), middle (75–84 years) and advance (≥85 years)]. In surviving patients of all the three geriatric groups, the duration of ICU stay and mechanical ventilation was lower, whereas the number of weaning trials was higher.

**Table 3.** Characteristics of the weaning process in patients.

| Age (years) | Characteristics | Mortality | | p |
|---|---|---|---|---|
| | | Exitus Mean ± sd | Alive Mean ± sd | |
| 65–74 | Length of ICU stay (days) | 13 ± 19.4 | 9.2 ± 20.8 | 0.141 |
| | Length of mechanical ventilation (days) | 10.7 ± 17.5 | 7.5 ± 19.2 | 0.012* |
| | Number of weaning process | 0.3 ± 0.8 | 1.7 ± 3.3 | 0.001* |
| 75–84 | Length of ICU stay (days) | 17.1 ± 21.7 | 10.5 ± 19.4 | 0.001* |
| | Length of mechanical ventilation (days) | 16.5 ± 21.7 | 10.6 ± 21.2 | 0.006* |
| | Number of weaning process | 0.5 ± 1 | 1.3 ± 0.8 | 0.001* |
| ≥85 | Length of ICU stay (days) | 18.9 ± 23.1 | 7.1 ± 10.4 | 0.001* |
| | Length of mechanical ventilation (days) | 17.9 ± 22.3 | 6.7 ± 6.8 | 0.004* |
| | Number of weaning process | 0.6 ± 1 | 1.6 ± 2 | 0.001* |

## DISCUSSION

In geriatric patients, age-related impairments of lung elasticity, decrease in muscle mass and reduction in lung volume render the weaning process more difficult. In addition, comorbidities and complications can cause weaning failure (10).

In a multicentre study across 20 countries with 5183 patients who were under mechanical ventilation for >12 h, Esteban et al (11) observed no difference in the duration of mechanical ventilation, weaning time and duration of ICU stay between the middle aged (43–70 years) and geriatric (>70 years) groups. However, they emphasised the effect of comorbidities, such as acute renal failure and shock, on mortality.

Some geriatric patients under mechanical ventilation for acute respiratory failure may have prolonged weaning periods of >2 or 3 weeks. These patients progress to chronic respiratory failure, and a tracheotomy becomes inevitable. In cases of prolonged respiratory failure, the increased use of opioids to prevent dyspnoea can result in a vicious cycle. There is a high rate of transition to chronic respiratory failure in the geriatric patient group. Tracheotomy in patients with expected long-term respiratory failure allows for the use of home ventilators, and families can also adapt to this treatment approach. Support given to home care and home ventilation enables the widespread use of this approach and the most efficient use of ICU beds. (12,13) In our study, 105 of 615 geriatric

patients underwent tracheotomy, and 20 patients were discharged with a home ventilator.

A 27-bed geriatric centre study (12) assessed the data of 89 geriatric patients who were followed for 22 months (mean age, 65 years) and reported that the major primary diagnosis was respiratory failure, followed by neurological diagnoses, sepsis-related conditions and metabolic causes. The centre boasted of health professionals and respiratory physiotherapists with specialised training in geriatric care. The weaning criteria were $FiO_2$ of <0.5, negative inspiratory pressure of −20 cm $H_2O$, respiratory rate of<35 and spontaneous tidal volume of >250 ml. A total of 22 patients were successfully weaned, and no correlation was observed between weaning failure and increased age. With increased experience with geriatric respiratory failure patients and considering physiological changes in this age group, it is important to uniquely evaluate weaning parameters for each patient.

In a 2-year prospective study, Lieberman et al (14) examined survival and weaning rates in geriatric patients aged>65 years with similar diagnoses as those of our patient groups. Their results revealed that 242 of 641 patients could be discharged after successful weaning; however, only 138 of the 242 discharged patients survived for >1 year; 63 patients died within 3 months and 85 within 6 months from discharge. From this perspective, it is appropriate to also consider the survival after discharge when defining successful weaning.

Among several factors responsible for unsuccessful weaning in geriatric patients, Epstein et al (15) have emphasised the importance of volume status. In their study on postoperative patients aged >60 years (n = 40), patients with successful weaning had a mean net cumulative fluid balance of 6.856 l and a daily fluid balance of −0.389 l, whereas in the group that could not be weaned, these values were 16.212 l and 1.904 l, respectively. Despite the small sample size, their results stress the importance of volume status in the weaning in geriatric patients.

A study comparing 2-h T-piece trials in young and geriatric patient groups reported more difficult weaning in the geriatric group; however, the use of a T-piece was shown to help in determining the respiratory capacity and in strengthening respiratory muscles of geriatric patients. (16) We also applied the 2-h T-piece trial in our clinic, particularly for geriatric patients.

Several studies have compared the weaning criteria for geriatric patients. Corbellini et al (17) have reported that the f/VT parameter, a standard weaning criterion, is highly sensitive in geriatric patients. Azeredo et al (18) used the integrative weaning index (IWI) parameter, which is calculated from static compliance values using logistic regression, in addition to the standard criteria for weaning in geriatric patients. They reported that IWI could be routinely used for predicting successful weaning in geriatric patients.

No studies in our country have evaluated the cost-effectiveness of prolonged mechanical ventilation in geriatric patients. However, Hamel et al (19) analysed 963 (of 1005) mechanically ventilated patients and determined a cost of $32,000 for patients aged <65 years and $46,000 for those aged >65 years. They have reported high costs for short survival periods in patients aged ≥75 years.

The results of our retrospective study revealed a high success rate of weaning in geriatric patients in our clinic. Our SMR rates are within ideal limits. We believe that our clinical experience has grown with the substantial increase in the number of geriatric patients we have treated in the recent years, and this is reflected in the successful weaning in our patients. We have observed that success in weaning can be achieved by performing T-piece trials as soon as possible, which should be repeated as necessary, before the already insufficient respiratory muscles can adapt to mechanical ventilation. We also emphasise the importance of closely monitoring patients' cardiac and volume statuses.

A limitation of our study was that in our mortality assessment, even 1-year mortality was not evaluated. Considering that our study is retrospective and all patients could not be contacted by telephone, we excluded the 1-year mortality parameter because it would not have yielded a reliable result.

In conclusion, despite the challenges in the successful weaning in geriatric patients, the ever increasing geriatric population in the ICU is an inevitable reality in the clinical setting. Therefore, we believe that weaning success can be increased with shared clinical experiences and prospective studies that enable the standardisation of clinical applications. Importantly, clinicians have to be aware of the different age-related physiology and pathology of the geriatric population and should accordingly revise their clinical practices. If "weaning is an art," then weaning in geriatric patients can be defined as "a polyphonic music piece or a colourful painting."

**Conflict of interest**

The authors declare that they have no competing interests.

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