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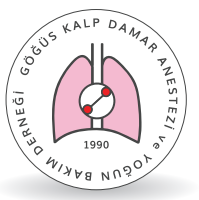

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Araştırma/*Research Article*

Morbidity and Mortality Markers in Elderly Patients with Cardiovascular Surgery

Kardiyovasküler Cerrahi Geçiren Yaşlı Hastalarda Morbidite ve Mortalite Belirteçleri

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Sumru Sekerci

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ABSTRACT

Objective: *In recent years, as a result of increased average longevity, the number of hospitalized elderly patients has been increasing. Today, although many parameters are used to determine the prognosis of hospitalized patients, more specific information about elderly patients is required. This study aims to investigate the effect of preoperative and postoperative parameters on postoperative complications and mortality among patients aged 65 and over who underwent cardiovascular surgery.*
Methods: *Demographic data, preoperative and postoperative hemoglobin, neutrophil/lymphocyte ratio, mean platelet volume, erythrocyte distribution width, platelet, glucose, urea, creatinine, albumin values and postoperative data were recorded.*
Results: *When the preoperative risk factors for postoperative complications and mortality were evaluated, low preoperative hemoglobin and albumin values and high blood urea and glucose levels were statistically significant (p <0.005). Low postoperative hemoglobin, albumin values, platelet counts, and and high glucose, urea and creatinine values were found to be significant markers of postoperative complications (p <0.005). When preoperative risk factors were evaluated in terms of postoperative 30-day mortality, preoperatively decreased hemoglobin and albumin, increased urea , decreased postoperative hemoglobin, albumin levels, platelet counts, and increased glucose, urea and creatinine values were statistically significant (p <0.005).*
Conclusion: *We believe that closely monitoring the nutritional status of elderly patients, providing them with dietary supplementation for deficient parameters, and keeping blood glucose, urea, and creatinine at optimum levels could help us to decrease hospital stay, mortality-morbidity, and total economic cost.*

Keywords: *Cardiovascular surgery, postoperative complications, mortality, anemia, hypoalbuminemia, hyperglycemia, geriatrics*

ÖZ

Amaç: *Son yıllarda ortalama yaşam süresinin artması sonucunda hastaneye yatırılan yaşlı hasta sayısı artmaktadır. Günümüzde hastanede yatan hastaların prognozunu belirlemek için birçok parametre kullanılsa da yaşlı hastalar hakkında daha spesifik bilgilere gereksinim duyulmaktadır. Bu çalışma, 65 yaş ve üzeri kardiyovasküler cerrahi geçiren hastalarda ameliyat öncesi ve sonrası parametrelerin ameliyat sonrası komplikasyonlar ve mortalite üzerine etkisini araştırmayı amaçlamaktadır.*
Yöntem: *Demografik veriler, ameliyat öncesi ve sonrası hemoglobin, nötrofil/lenfosit oranı, ortalama trombosit hacmi, eritrosit dağılım genişliği, trombosit, glukoz, üre, kreatinin, albümin değerleri ve ameliyat sonrası veriler kaydedildi.*
Bulgular: *Postoperatif komplikasyonlar ve mortalite için preoperatif risk faktörleri değerlendirildiğinde, preoperatif düşük hemoglobin ve albümin değerleri ile yüksek kan üre ve glukoz seviyeleri istatistiksel olarak anlamlıydı (p<0,005). Düşük postoperatif hemoglobin, trombosit ve albümin değerleri ile yüksek glukoz, üre ve kreatinin değerleri postoperatif komplikasyonların önemli belirteçleri olarak bulundu (p<0.005). Postoperatif 30 günlük mortalite açısından preoperatif risk faktörleri değerlendirildiğinde, preoperatif düşük hemoglobin ve albümin, yüksek üre değeri, düşük postoperatif hemoglobin, trombosit ve albümin seviyeleri ve yüksek glukoz, üre ve kreatinin değerleri istatistiksel olarak anlamlı bulundu (p<0.005).*
Sonuç: *Yaşlı hastaların beslenme durumlarının yakından izlenmesi, eksik parametreler için diyet takviyesi yapılması ve kan şekeri, üre ve kreatinin optimum seviyelerde tutulmasının hastanede kalış süresini, mortalite-morbiditeyi ve toplam ekonomik maliyeti düşürmemize yardımcı olabileceğine inanıyoruz.*

Anahtar kelimeler: *kardiyovasküler cerrahi, postoperatif komplikasyon, mortalite, anemi, hipoalbuminemi, hiperglisemi, geriatri*

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INTRODUCTION

In recent years, an increase in the average longevity and the overall aging of the population have brought about a dramatic rise in the number of hospitalized elderly patients. Cardiovascular surgery has also had its share. It is stated in the literature that from 1990 to 2007, the average age of cardiac surgery patients in Germany increased from 55.8 to 68.8, and the proportion of the patients aged 80 and over was 9.8% [1]. In the USA, it has been reported that approximately 25% of the population develop cardiovascular diseases at the age of 75 and over, and the number of potential elderly candidates for surgery has increased in more than half of candidates for all cardiac procedures applied to this age group [2]. Therefore, the perioperative evaluation and care for elderly patients are becoming more important day by day. This group of patients is affected by certain aging-related conditions such as the presence of comorbid diseases, weakening cognitive functions, poor nutrition, increased physical dependence rate, and multiple drug use, the severity of the diseases requiring intervention, atypical responses to inflammation, and failing kidney functions [3].

Today, the perioperative management of elderly patients is mostly based on data from the adult population. Prognostic factors that may affect the evaluation of elderly patients are still being investigated [3,4]. In particular, it is noteworthy that cardiovascular diseases increase dramatically with age, and the majority of the deaths associated with cardiovascular diseases are seen in the elderly population. In fact, cardiovascular diseases are the most common cause of death among patients over 65 years of age and cause severe morbidity [5].

In this context, this study aims to determine preoperative and postoperative risk factors which cause postoperative complications and mortality in elderly patients undergoing cardiovascular surgery.

MATERIAL and METHODS

Patients aged 65 and over who underwent cardiovascular surgery in our clinic between April 2015 and March 2017 were included in the study after receiving the approval of the ethics committee of our hospital (No: 43,19.07.2018). In our retrospective cross-sectional study, the preoperative and postoperative data of the patients were obtained from the electronic database of our hospital. Patients under 65 years of age, emergency cases, and cases that had undergone re-do surgeries were excluded from the study.

All patients received a balanced anesthesia using our routine clinical protocols. Standard CPB was established and antegrade cold blood cardioplegia was used for myocardial protection. Hemoglobin concentrations were kept above 7.5 g dl^{-1} during CPB and above 8.5 g dl^{-1} after CPB. All patients were transferred to the ICU after surgery.

Patients' demographic data, comorbidities, preoperative variables (hemoglobin, neutrophil/lymphocyte ratio (NLR), mean platelet volume (MPV), erythrocyte distribution width (RDW), platelet, glucose, urea, creatinine, albumin), postoperative variables (hemoglobin, NLR, MPV, RDW, platelet, glucose, urea, creatinine, albumin), type of surgery, intensive care unit and hospital stay, postoperative morbidity and mortality information were recorded.

Statistical analyses were performed using IBM SPSS for Windows (IBM Corp., version 22.0, Armonk, NY, USA). Descriptive statistics outline the basic features of the data. According to the distribution of data, Mann-Whitney U or two-sample t-test was used to compare independent groups. Additionally, regression analysis was performed to analyze risk factors in complications and mortality. A *p*-value <0.05 from two-sided tests was considered statistically significant.

RESULTS

Baseline demographics, preoperative variables, and surgery types for 346 patients are presented in Table 1. Postoperative variables and complications are presented in Table 2. The postoperative complication rate was 28.3%. The most common complications were reported to be bleeding (8.9%), arrhythmias (5.2%), and neurological complications (3.5%). Hospital mortality was 9.5%, and 30-day mortality was 2%.

Table 1: Patients' demographic data, preoperative laboratory values and types of surgery

n (%) or mean ± SD	N:346
Age, year	70.7±4.4
Male, gender	246(70.1)
BMI	29.9±2.1
Hemoglobin, g/dl	13.1±1.9
MPV, fL	9.1±1.1
RDW	14.5±1.8
Platelet,10^3/fL	233.1±71.3
Glucose, mg/dl	132.6±62.4
Urea, mg/dl	45.2±20.1
Creatinine, mg/dl	1.2±2.6
Albumin, g/dl	3.8±0.6
Anemia, n	133(38.4)
Comorbidity	
None	158(45.7)
Hypertension	91(26.4)
Chronic obstructive pulmonary disease	20(5.8)
Goitre	3(0.9)
Renal failure	5(1.5)
Diabetes mellitus	10(2.9)
Cerebrovascular accident	1(0.3)
Hyperlipidemia	63(18.2)
Surgery type	
CABG	218(63)
AVR/MVR	13/12(3.8/3.5)
CABG+valve replacement, carotid endarterectomy	26(7.5)
Ascending / descending aorta grafting	14(4)
Femoropopliteal bypass	20(5.8)
Thoracoabdominal aortic aneurysms	16(4.6)
TAVI, EVAR, TEVAR	20(5.8)
AVR+Ascending aortic grafting / MVR	4(1.2)
LVAD	1(0.3)
ASD	2(0.6)
Total	346 (100)

Values are expressed as n (%) or mean ± SD, BMI: body mass index, MPV: mean platelet volume, RDW: red cell distribution width, CABG: coronary artery bypass grafting, AVR: aortic valve replacement, MVR: mitral valve replacement, TAVI: Transcatheter aortic valve implantation, EVAR: Endovascular aneurysm repair, TEVAR: Thoracic endovascular aortic repair, LVAD: left ventricular assist device, ASD: atrial septal defects

Table 2: Postoperative data

n (%) or mean ± SD	N: 346
Anemia	35 (10.1)
Hemoglobin, g/dl	15.3±9.3
MPV, fL	15.6±9.4
RDW	14.8±1.6
Platelet count,10^3/fL	155.4±61.0
Glucose, mg/dl	174.1±56.4
Urea, mg/dl	46.8±20.1
Creatinine, mg/dl	1.2±0.6
Albumin, g/dl	2.9±0.5
Postoperative complications	
None	248(71.7)
Pleural effusion	8(2.3)
Renal failure	3(0.9)
Bleeding	31(8.9)
Arrhythmia	18(5.2)
Infection (pneumonia, wound infection)	10(2.9)
Major advance cardiac events	4(1.2)
Neurological complications	12(3.5)
Mortality	
None	306 (88.4)
≤30 days	33 (9.5)
>30 days	7 (2.0)
Duration of ICU stay (day)	3.07±6.3
Hospital stay (day)	8.4±7.5

Values are expressed as n (%) or mean ± SD, MPV: mean platelet volume, RDW: red cell distribution width, ICU: intensive care unit

When preoperative risk factors were evaluated in terms of postoperative complications, low preoperative hemoglobin and albumin and high blood urea and glucose levels were statistically significant predictors ($p<0.005$). When postoperative risk factors were examined, decreased postoperative hemoglobin, albumin values, platelet counts and high glucose, urea, and creatinine values could predict postoperative complications at a statistical significance level of $p<0.005$ (Table 3). In the evaluation of postoperative 30-day mortality, low preoperative hemoglobin and albumin, high urea, low postoperative hemoglobin, albumin levels, and platelet counts and, increased glucose, urea, and creatinine values were found as significant predictors and risk factors ($p<0.005$) (Table 4). A multivariate risk analysis was performed to determine preoperative and postoperative risk factors. Low albumin level was both a preoperative and

Table 3: Preoperative and postoperative risk factors for postoperative complications; univariate analysis

	Complication (-)	Complication (+)	p value
Age, year	70.5±4.3	71.1±4.6	0.242
BMI	30.1±2.8	29.9±2.1	0
Preoperative variables			
Hemoglobin, g/dl	13.2±1.8	12.6±2.0	0.004*
MPV, fL	9.1±1.1	9.2±1.1	0.304
RDW	14.5±1.8	14.5±1.5	0.904
Neutrophil/Lymphocyte ratio	3.5±3.6	3.5±3.0	0.874
Platelet, 10^3/fL	236.6±67.9	224.3±79.2	0.150
Glucose, mg/dl	128.2± 57.6	143.7±72.3	0.039*
Urea, mg/dl	43.6±18.1	49.4±24.3	0,017*
Creatinine, mg/dl	1.0±0.5	1.6±4.8	0.078
Albumin, g/dl	3.8±0.5	3.5±0.7	0.000*
Postoperative variables			
Hemoglobin, g/dl	9.5±1.5	9.0±1.2	0.004*
MPV, fL	9.3±1.2	9.4±1.2	0.770
RDW	14.8±1.6	14.9±1.5	0.310
Neutrophil/Lymphocyte ratio	17.5±14.9	16.9±10.6	0.727
Platelet,10^3/fL	162.5±57.9	137.5±65.3	0.001*
Glucose, mg/dl	165.3± 44.4	197.0±75.1	0.000*
Urea, mg/dl	43.3±14.4	55.4±28.3	0,000*
Creatinine, mg/dl	1.2±0.6	1.4±0.7	0,000*
Albumin, g/dl	3.1±0.5	2.7±0.5	0,000*

Values are expressed as mean ± SD, BMI: body mass index, MPV: mean platelet volume, RDW: red cell distribution width

Table 4: Preoperative and postoperative risk factors for postoperative 30-day mortality; univariate analysis (mean±SD)

	Mortalite (-)	Mortalite (+)	P value
Preoperative variables			
Hemoglobin, g/dl	13.1±1.8	12.4±2.4	0.045*
MPV, fL	9.1±1.1	9.0±1.2	0.651
RDW	14.5±1.7	14.9±2.3	0.216
Neutrophil/Lymphocyte	3.6±3.5	2.8±1.6	0.208
Platelet,10^3/UL	232.8±68.2	236.0±97.6	0.804
Glucose, mg/dl	133.3±64.0	127.6±44.9	0.527
Urea, mg/dl	44.0±18.1	56.6±34.4	0.001*
Creatinine, mg/dl	1.2±2.7	1.2±0.4	0.921
Albumin, g/dl	3.8±0.6	3.5±0.6	0.003*
Postoperative variables			
Hemoglobin, g/dl	9.4±1.4	8.5±0.9	0.000*
MPV, fL	9.4±1.2	9.3±1.3	0.944
RDW	14.8±1.6	14.9±1.0	0.660
Neutrophil/Lymphocyte	16.8±13.4	23.1±16.5	0.015
Platelet,10^3/UL	159.6±59.5	115.4±61.9	0.001*
Glucose, mg/dl	169.2±46.3	223.4±106.1	0.000*
Urea, mg/dl	44.9±17.0	64.8±33.8	0.000*
Creatinine, mg/dl	1.2±0.6	1.6±0.6	0.001*
Albumin, g/dl	3.0±0.5	2.6±0.3	0.000*

Values are expressed as mean ± SD, MPV: mean platelet volume, RDW: red cell distribution width

postoperative risk factor. High glucose and urea levels were considered as postoperative risk factors. Albumin was also a preoperative and postoperative risk factor as for postoperative 30-day-mortality. Higher postoperative glucose and urea levels were evaluated as postoperative risk factors (Table 5).

DISCUSSION

In this study, we investigated the effects of perioperative laboratory parameters on postoperative complications and mortality in patients aged 65 and over who underwent cardiovascular surgery. We found that among preoperative factors, low hemoglobin and albumin, and high glucose and urea levels were associated with postoperative complications. We also determined that preoperative low hemoglobin and albumin and high urea levels were significantly associated with 30-day mortality.

When the postoperative laboratory data were evaluated, postoperative low hemoglobin, platelet, and albumin and high glucose, urea, and creatinine scores were observed to be associated with postoperative complications. Furthermore, postoperative low hemoglobin, thrombocyte, and albumin and high glucose, urea, and creatinine scores were found to be significantly associated with 30-day mortality.

Although there are many prognostic markers being used to evaluate surgical patients in the literature, these markers are still being investigated for elderly patients. Today, there are studies evaluating the effects of easily observable laboratory parameters on postoperative morbidity and mortality, as well as markers such as age, BMI, accompanying comorbidities, and Euroscore which are widely used in the middle age group [4,6-9]. It has been emphasized that the presence of preoperative anemia (<13g / dl regardless of gender) is a very strong indicator of mortality in surgical patients [10-12]. It has been reported that 16-54% of patients undergoing cardiac surgery suffer anemia [13], and most cases have resulted from iron deficiency [10,14]. In elderly patients,

Table 5: Multivariate regression analysis of pre-, and post-operative risk factors

Preoperative variables for postoperative complications	OR	95% CI	p value
Hemoglobin, g/dl	0.983	0.8-1.1	0.822
Glucose, mg/dl	1.002	0.9-1.0	0.212
Urea, mg/dl	1.008	0.9-1.0	0.240
Albumin, g/dl	0.474	0.3-0.8	0.003*
Postoperative variables for postoperative complications			
Hemoglobin, g/dl	1.029	0.8-1.3	0.824
Platelet,10^3/uL	0.996	0.9-1.0	0.187
Glucose, mg / dl	1.008	1.00-1.01	0.009*
Urea, mg/dl	1.032	1.01-1.05	0.001*
Creatinine, mg/dl	1.068	0.6-1.7	0.815
Albumin, g/dl	0.287	0.1-0.5	0.000*
Preoperative variables for postoperative 30- day mortality			
Hemoglobin, g/dl	1.038	0.8-1.3	0.738
Urea, mg/dl	1.015	1.00-1.03	0.054
Albumin, g/dl	0.497	0.3-0.9	0.036*
Postperative variables for postoperative 30- day mortality			
Hemoglobin, g/dl	0,606	0.4-1.0	0.087
Platelete,10^3/uL	0,088	0.9-1.0	0.088
Glucose, mg/dl	0.015	1.00-1.02	0.015*
Urea, mg/dl	0.002	1.02-1.07	0.002*
Creatinine, mg/dl	0.210	0.2-1.4	0.210
Albumin, g/dl	0.034	0.1-0.9	0.034*
Neutrophil/Lymphocyte ratio	0.061	0.9-1.0	0.061

preoperative anemia may develop mostly due to malnutrition, malabsorption, bone marrow dysfunction , or chronic blood loss. In many studies, it is stated that anemia impairs the quality of life in the elderly and causes cognitive dysfunction, depression, and congestive heart failure. It is also stated that it causes an increase in mortality, length of hospital stays, and cost [15,16]. In a study by Spahn et al. [10], it was observed that simply administering intravenous iron treatment to elderly patients with iron deficiency anemia the day before surgery had a positive impact on postoperative results. Elective surgeries are recommended to be postponed for 2-3 weeks in elderly patients with iron deficiency meanwhile filling iron stores with intravenous iron preparations since adequate absorption cannot be achieved with oral supplements during this period [7,10]. In our study, the presence of preoperative and postoperative anemia was found to be associated with postoperative complications and 30-day mortality. Due to age-related physiological changes and the effect of anemia, these patients may be more susceptible to hypoxia. Preoperative low albumin was reported to be a risk factor for the development of postoperative atrial fibrillation in elderly patients with off-pump cardiac surgery [17]. Another study suggested that low hemoglobin and albumin scores were not associated with postoperative atrial fibrillation, ventricular fibrillation, or asystole [11]. In our study, the most frequent postoperative complications were bleeding (8.9%), cardiac arrhythmias (5.2%), and neurological complications (3.5%). The data we obtained in this study show that elderly patients with anemia must receive treatment in the preoperative period. As oral iron replacement might be ineffective due to possible nutritional disorders or malabsorption, intravenous iron preparations may be considered.

In elderly patients, blood albumin levels may change due to malnutrition, or malabsorption. To this aim, the geriatric nutritional risk index (GNRI) evaluating nutritional risk factors according to height, weight, and serum albumin levels has been developed [8]. In the literature, a comprehensive geriatric assessment (CGA) and related frailty rates have been defined for each negative indicator, including accompanying malnutrition, anemia, and low albumin levels, and these scales have been reported to reduce morbidity [3,18]. A recent report has recommended avoiding surgery in patients with preoperative albumin levels <3 mg/dl, as the condition is associated with malnutrition and adverse postoperative outcomes [9]. In a study evaluating 4551 patients who had undergone total knee surgery, patients with albumin levels <3.5 mg/dl had a higher incidence of postoperative pneumonia, surgical site and urinary tract infections, sepsis, intraoperative and postoperative blood transfusions, prolonged mechanical ventilation periods, and acute renal failure [19]. In a different study comparing different albumin levels after cardiac surgery, as hypoalbuminemia deteriorated, patients with albumin <3 mg/dl were found to be more vulnerable to septic and bleeding-related complications, and even long-term survival rates were affected [9]. In our study, we have found that low albumin levels are both preoperative and postoperative independent risk factors. Postoperative bleeding, arrhythmias, infections, and neurological complications were observed more frequently in patients with albumin levels <3.5 ± 0.7 mg/dl in the preoperative period and <2.7 ± 0.5 mg/dl in the postoperative period. It is essential to plan how to improve the total quality of nutrition to mitigate or eliminate the postoperative impacts of this important predictor. It is possible to cooperate with the surgeon and dietician to ensure that the patients are optimally prepared for the surgery.

Hyperglycemia is an important cause of morbidity and mortality in elderly patients [20,21]. Even in non-diabetic patients, blood sugar levels may increase by various mechanisms (physiological stress response, deterioration of nutrition, etc.). These conditions also increase the risk of infection. In the literature, it has been stated that uncontrolled hyperglycemia is associated with poor postoperative clinical results and that although there is no consensus on an appropriate blood glucose level, a fasting blood glucose level above 126 mg/dl raises postoperative mortality [22]. Another study stated that blood glucose levels should be <200 mg/dl to prevent postoperative infections [23]. In our study, we found that preoperatively increased glucose levels (143.7 ± 72.3 mg/dL) were significantly associated with early postoperative complications. Postoperative glucose elevation (197.0 ± 75.1) was another independent

risk factor that can lead to postoperative complications and mortality.

Elderly patients are more likely to get dehydrated than middle-aged patients. Along with aging, kidney functions may be limited or impaired due to conditions such as loss of nephrons, decreased feeling of thirst, forgetfulness. In addition, the catabolic processes and nutritional status affect blood urea-creatinine levels [24,25]. In patients undergoing cardiovascular surgery, cardiac dysfunction, accompanying comorbidities (especially diabetes and hypertension), multiple drug use, cardiopulmonary bypass, renal ischemia-reperfusion, increased intraabdominal pressure, and inflammatory, immunological, and neurohumoral factors may increase the susceptibility to acute kidney injury (AKI) [25,26]. In a study comparing the incidence of AKI development in patients aged 18-69, and older who underwent cardiac surgery was found to be 3.1% and 10.5%, respectively [27]. It was reported that preoperative creatinine > 1.5 mg/dl increased postoperative mortality by 5-30% [28]. It is estimated that kidney mass and blood flow decrease by > 10% in each decade of life [25]. With the reduced sense of thirst and poor nutrition in elderly patients, blood urea and creatinine levels might be at the top limit or exceed it at the time of admission to the hospital. In our study, we found that postoperative elevation of creatinine was also a significant marker of postoperative complications and mortality. Postoperative elevation of blood was an independent variable in postoperative complications and mortality. We regard that the preoperative evaluation of elderly patients is of particular importance. We believe that negative postoperative conditions can be minimized with the appropriate measures to be taken on time.

Inflammatory mediators, which are present in the circulation in high quantities, have been reported to be one of the possible causes of cardiovascular disease [29]. Similarly, it is stated that the increase in hematological mediators such as MPV, RDW, and NLR could be a negative prognostic factor in acute coronary syndrome [30,31]. Although the primary pathophysiological mechanism that triggers the increase of RDW levels in the blood is unknown, it has been mostly associated with inflammation and nutritional disorder. Zalyesov et al. [32] found that the role of RDW in predicting mortality is closely related to advanced age. A different study suggested that the predictive power of double or triple combinations of MPV, RDW, and NLR parameters derived from the hemogram was higher than the predictive value of a single parameter [30]. Contrary to the literature, no significant effect of MPV, RDW, and NLR parameters on postoperative morbidity and mortality was found in our study. We consider that this might result from atypical inflammatory responses in elderly patients.

Elderly patients who will undergo cardiovascular surgery are at a high risk of coagulopathy and bleeding because of provoking factors as suppressed hematopoietic system, general anesthesia, medications used, prolonged CPB , and hypothermia. In addition, iron deficiency anemia, infections, mechanical heart valves, and disorders triggered by surgical trauma can lead to thrombocytosis/thrombocytopenia [33]. To have a more accurate postoperative prognosis, evaluating the number of platelets may offer significant data. In our study, we found that postoperatively decreased platelet counts (115.4±61.9 10^3/fL) were associated with postoperative complications and 30-day mortality.

The retrospective nature of data collection and differences in surgical procedures applied may be some limitations in our study which aimed to evaluate the mortality markers for elderly patients undergoing cardiovascular surgery. Another limitation of this study was that we did not calculate the geriatric nutrition risk index, which has been presented as an important marker in recent studies.

In conclusion, both preoperative and postoperative low hemoglobin and albumin, high glucose and urea levels were found to be risk factors for postoperative complications and mortality in elderly patients who underwent cardiovascular surgery. Postoperative low platelet counts and high creatinine levels were found to be associated with postoperative complications. Also, preoperative low hemoglobin, albumin levels and platelet counts, high glucose, urea, and creatinine levels were found to be significantly associated with 30-day mortality. We are of the opinion that closely monitoring the nutritional status of elderly patients, providing them

with dietary supplementation for deficient parameters, and keeping blood glucose, urea, and creatinine at optimum levels could help us to decrease hospital stay, mortality, morbidity, and total economic cost.

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Araştırma/*Research Article*

The Effect of Low- Flow Anesthesia on Hemodynamic Parameters and Gas Consumption in Single Lung Ventilation

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Tek Akciğer Ventilasyonunda Düşük Akımın Hemodinamik Parametrelere ve Gaz Tüketimine Etkisi

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ABSTRACT

Objective: *We aimed to compare the effects of low and medium high- flow anesthesia on hemodynamic parameters, blood gas values and gas consumption in patients undergoing single lung ventilation.*
Methods: *We studied 40 patients over 18 years of age in ASA I-III group who underwent elective thoracic surgery by single lung ventilation. The patients were intubated with double-lumen tube (DLT) following induction of anesthesia. We randomly divided the patients into two groups. In Group 1, 1L/min (80% oxygen+20% air) 4-6% desflurane; in Group 2, 2L/min (80% oxygen+20% air) was applied. Peripheral oxygen saturation, end-tidal carbon dioxide levels, heart rate, invasive blood pressure values, tidal volume, respiration rate, FiO2, fresh gas flow rate values during single lung ventilation in both groups were recorded. Arterial Blood Gas analysis was performed at 1 hour intervals. The amount of desflurane used at the end of single lung ventilation was monitored by anesthesia device.*
Results: *Desflurane consumption was significantly lower in Group 1 (55.3±18.4 vs. 84.9±37.6,p=0.003). EtCO2 was found to be statistically significantly lower in Group 2, especially between 30 and 75 minutes, and systolic, diastolic, and mean arterial pressure between 45 and 120 minutes. There was no significant difference between the groups in terms of NIRS. Only in both left and right NIRS there was a significant elevation in Group 1 at 120 minutes (p=0.08 and p=0.06, respectively).*
Conclusion: *Low flow with desflurane using appropriate equipment and close monitoring can be safely applied without side effects.*

Keywords: *anesthesia, low flow, thoracic surgery, desflurane*

ÖZ

Amaç: *Tek akciğer ventilasyonu uygulanan hastalarda, düşük ve orta yüksek akımlı anestezinin hemodinamik parametreler, arter kan gazı değerleri ve gaz tüketimi üzerine etkilerinin karşılaştırılması amaçlanmıştır.*
Yöntem: *ASA I-III grubunda tek akciğer ventilasyonu ile elektif torasik cerrahi uygulanan 18 yaş üstü 40 hasta incelendi. Hastalar anestezi indüksiyonunu takiben çift lümenli tüp (DLT) ile entübe edildi. Hastaları rastgele iki gruba ayrıldı. Grup 1'de 1L / dak (% 80 oksijen +% 20 hava)% 4-6 desfluran; Grup 2'ye 2L / dk (% 80 oksijen +% 20 hava) uygulandı. Her iki grupta da tek akciğer ventilasyonu sırasında periferik oksijen satürasyonu, End-tidal CO2 seviyeleri, kalp hızı, invazif kan basıncı değerleri, tidal hacim, solunum hızı, FiO2, taze gaz akım hızı değerleri kaydedildi. Arteriyel Kan Gazı analizi 1 saat aralıklarla yapıldı. Tek akciğer ventilasyonu sonunda kullanılan desfluran miktarı anestezi cihazı ile takip edildi.*
Bulgular: *Desfluran tüketimi Grup 1'de anlamlı olarak daha düşüktü (55.3 ± 18.4'e karşı 84.9 ± 37.6, p = 0.003). EtCO2 Grup 2'de özellikle 30 ile 75 dakika arasında, sistolik, diyastolik ve ortalama arter basıncı 45 ile 120 dakika arasında istatistiksel olarak anlamlı derecede düşük bulundu. NIRS konusunda gruplar arasında anlamlı fark yoktu. Sadece hem sol hem de sağ NIRS'de 120. dakikada grup 1'de anlamlı bir yükselme vardı (sırasıyla p = 0,08 ve p = 0,06).*
Sonuç: *Tek akciğer ventilasyonunda uygun ekipman ve yakın izlem ile düşük akım uygulaması, yan etki olmaksızın güvenle uygulanabilir.*

Anahtar kelimeler: *anestezi, düşük akım, torasik cerrahi, desfluran*

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INTRODUCTION

Low-flow anesthesia is a method which is applied by using a re-inhaled anesthesia system during general anesthesia, where the re-inhaled fresh oxygen flow rate is at least 50%, the metabolic requirement is fully met and sufficient volatile agent can be given[1]. The main advantages of low-flow anesthesia include lowering the cost of inhaled agents by reducing the amount of inhaled agent consumed, providing better dynamics, maintaining airway moisture, reducing atmospheric pollution, maintaining ecological balance and lowering heat loss[2]. However, improperly applied low-flow anesthesia may result in hypoxia, hypercapnia, accumulation of potential toxic gases and insufficient accumulation of volatile anesthetic agent [3].

Patients undergoing thoracic surgery are at risk of hypoxemia and hypercarbia caused by their existing disease. In addition, planned surgery-specific features, adverse effects of mechanical ventilation, and ventilation perfusion rates associated with single lung ventilation predispose to perioperative complications[4]. In the perioperative period; there is very limited information in the literature about the need for oxygen concentration titration during surgical manipulations, intermittent separation of the respiratory circuit, the need for alveolar recruitment maneuver and the use of low-flow anesthesia during single lung ventilation.

Studies have shown that increase in heart rate and left ventricular end-diastolic pressure; and the decrease in mean arterial pressure, left ventricular systolic pressure, and stroke volume are observed during desflurane administration at 1 - 1,5 MAC[5]. Gormley WP et al. reported that the use of desflurane in vaporizer settings above 6% caused an increase in heart rate and blood pressure by increasing transient sympathetic activity[6]. Elmacıoğlu et al. examined the effects of desflurane in low-flow anesthesia and reported that hemodynamic stability was maintained in the perioperative period when desflurane anesthesia was administered with different fresh flow rates[7].

We aimed to compare hemodynamic parameters, artery blood gas (ABG) values and gas consumption in patients undergoing low and medium high- flow anesthesia and single lung ventilation.

METHODS

A randomized controlled study was performed with 40 ASA I-III group patients over 18 years of age who underwent elective thoracic surgery and single lung ventilation after the permission of the Ethics Committee (Number: 2019/514/145/4) was obtained.

Patients aged <18 years with ASA physical status greater than III, body mass index >30 kg/m^2 , severe COPD, history of previous thoracic surgery, those who neded postoperative mechanical ventilation treatment, and would undergo emergency surgery, cases that did not consent to participate in the study were excluded.

Anesthesia induction was followed by insertion of double-lumen tube. Difficult intubation during insertion of double-lumen tube (DLT), patients with desaturation observed despite fiberoptic bronchoscopy (SpO_2<95%), those requiring 100% FiO_2 requirement, $ETCO_2$, patients with>45 mmHg and individuals with a single lung ventilation time of less than 1 hour were excluded from the study.

The patients were intubated with DLT following induction, and their records were kept during single lung ventilation. In patients exceeded one hour procedural time limit; in case of requirement for recruitment maneuver due to anesthesia or surgical indications and double lung ventilation, time period and relevant parameters were recorded.

In the preoperative examination, the patients were informed about the study and their written consent was obtained. Anesthesia gas monitor calibration and leakage test was started with automatic tests of anesthesia device (Drager-Perseus A500) in the morning of operation. Alarm limits were set as FiO_2 30% lower limit, desflurane 10% vol upper limit, $etCO_2$ 45mmHg upper limit, Paw 5cmH_20 lower limit, 30 cmH_2O upper limit.

Carbon dioxide scavenger (soda lime: Sorbolime, Berkim) was evaluated in terms of dryness and color and replaced at appropriate intervals. Venous access was made to the patients who were taken to the operation table with a 20 G cannula inserted on the

back of the hand and 0.9% sodium chloride perfusion was started at 10 ml/kg/h. Electrocardiogram (ECG), SPO_2, noninvasive blood pressure (NIBP) monitoring (Drager Infinity XL) was performed. NIRS (Near Infrared Spectroscopy) was used for monitorization, starting before anesthesia (basal), after induction and intubation at 15 min intervals. Following induction, 20 gauge catheter was inserted into the radial artery and invasive arterial blood pressure measurements were started. Hourly arterial blood gas monitoring was performed during, and at the end of single lung ventilation.

For anesthesia induction 1µg/kg fentanyl (Fentanil Citrate, Abbott Lab. North Chicago, USA) was used after spontaneous respiration preoxygenation at 100% O_2 and fresh gas flow at a rate of 4L/min with a three minute mask, and 2-3 mg/kg propofol (Fresenius) Istanbul, Turkey) and 0.5 mg/kg rocuronium bromide were administered intravenously. When muscle relaxation was observed, orotracheal intubation was performed and the patient was connected to an anesthesia workstation (Dräger Perseus) and tidal volume (4-6 ml/kg,) the respiratory frequency (16-18/min), and the I:E ratio (1:1,5) were maintained at indicated settings. Selective intubation was performed with fiberoptic bronchoscopy and endotracheal tube was inserted. In the maintenance of anesthesia, patients were divided into two groups using the program on https://www.randomizer.org/. The first group was defined as low-flow (1.00 L/min) desflurane group (Group 1, n=20) and the second group as medium flow (2.00 L/min) desflurane group (Group 2, n=20). Single lung ventilation was initiated in both groups after confirming the location of the tube with fiberoptic bronchoscopy. Within the first 10 min, 4L / min (80% oxygen+20% air mixture) , and 8-10% desflurane (Suprane, Baxter, Puerto Rico, USA) were used. In Group 1, 1L/min (80% oxygen+20% air mixture) 4-6% desflurane (Suprane, Baxter, Puerto Rico, USA), and in Group 2, 2L/min (80% oxygen+20% air mixture) were used. Peripheral oxygen saturation, end-tidal carbon dioxide levels, heart rate, invasive blood pressure values, NIRS (near-infrared spectroscopy), tidal volume, respiration rate, FiO_2, fresh gas flow rate, PEEP (adjusted to 5 cmH_2O) values were monitored during single lung ventilation in both groups at 15 min intervals

Twenty minutes before end of the surgery, flow was increased to 4 L/min. The amount of desflurane used at the end of single lung ventilation was monitored by anesthesia device and recorded. Muscle relaxant antagonism was achieved with 2 mg/kg suggamadex in all patients.

Statistical analysis

The demographic characteristics and collected data of the patients were entered into the IBM SPSS (Statistical Package for Statistics) version 25. Variables were characterized using mean, maximum and minimum values, and percentage values were used for qualitative variables. Normal distributions were reported as mean±SD and Student t-test was used for comparisons between groups. Pearson chi-square test and Fisher exact test were used for the analysis of qualitative variables. Nonparametric continuous variables were recorded as median and intermittent distribution and compared using Mann-Whitney U tests. $p<0.05$ was considered statistically significant.

G * power program (G * Power 3.1.9.2 for Windows 10) was used to calculate the sample size. Within the confidence interval of 95%,, total number of 42 patients were required for the study, when the alpha level (5%), the margin error (5%) and the effect size (0.50) were kept at indicated levels. (Figure 1).

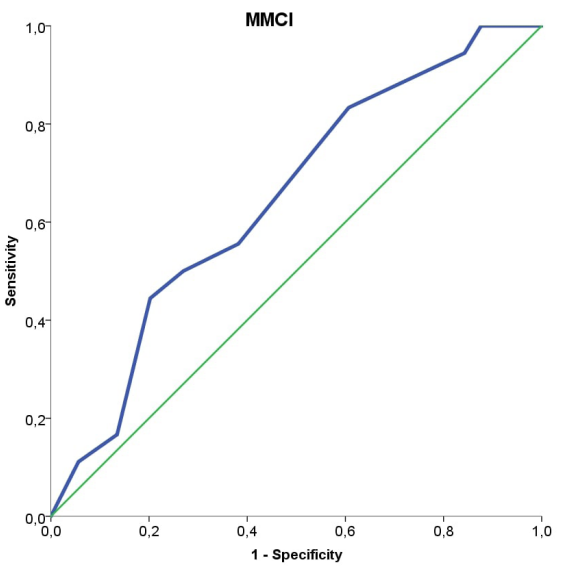

Figure 1: Power analysis of the study.

RESULTS

Each group included 21 patients. However, after randomization, one patient from both groups gave their consent but wanted to leave the study before it ended. Therefore, the results were evaluated on 20 patients for both groups (Figure 2).

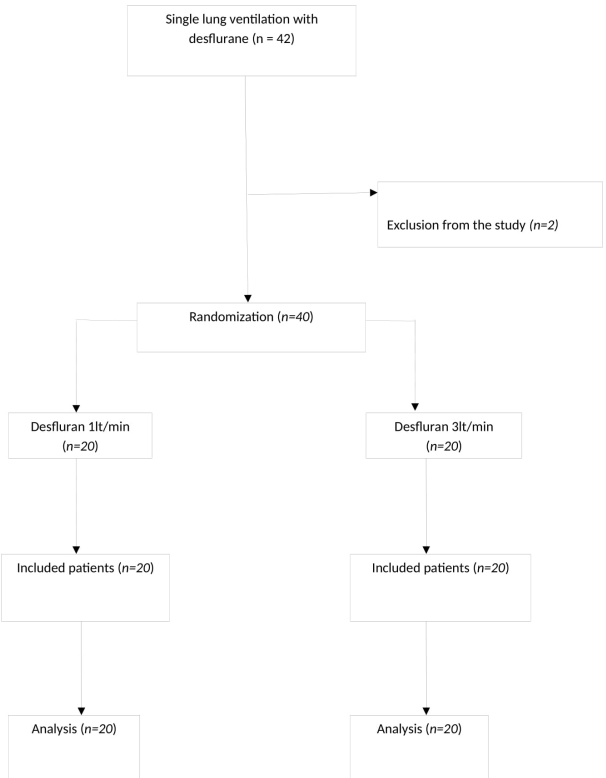

Figure 2: Flow diagram

Of the 40 patients with a mean age of 51.0±16.8 years (range 20-73 years), 33 were male (82.5%) and 7 were female (17.5%). Their mean height was 170.3±8.8 cm and their average weight was 73.3±12.7 kg. When ASA scores were examined, it was seen that the majority were ASA 3 (n=19). Comorbidities were present in 22.5% (n=9) of the cases. While video-assisted thoracic surgery (VATS) (n=22,55.0%) was the most common operation, anatomic lung resection was performed in 11 (27.5%)patients. Thirty-four (85%) patients had left- and 15 patients had right-sided operation. The most commonly used intubation tube length was 39 mm. (n=22.55%). The mean operation time (116.8±53.9 min), anesthesia time (128.8±59.9 min) and the single lung ventilation time (100.8±49.8 min) were as indicated. Mean amount of desflurane used (70.1±32.8 ml) and desflurane intake (23.0±8.6 ml) were also determined (Table 1). There was no statistically significant difference between groups in terms of gender, age, height, weight, ASA score, presence of comorbidity, type of operation, intubation tube size, duration of anesthesia, single lung ventilation, and operation time. Desflurane intake was similar between the groups (p=0.616). Desflurane consumption was significantly lower in Group 1 (55.3±18.4 vs. 84.9±37.6, p=0.003).

There was no statistical difference between groups in terms of SaO_2, heart rate, systolic and diastolic blood pressure, mean arterial pressure, FiO_2, tidal volume, respiration rate, pH, pCO_2, pO_2, HCO_3, end-tidal CO_2 and lactate values. (Table 2). When the perioperative findings were examined, SaO_2, heart rate, FiO_2, tidal volume and respiration rate did not change between the two groups during anesthesia, while $EtCO_2$, systolic artery pressure, diastolic artery pressure and mean arterial pressure significantly differed between the groups (Table 3). Systolic arterial pressures between the groups at 45, 60, 105 and 120 minutes, and diastolic arterial pressures at 90th and 105th min differed between groups. Perioperative blood gas results showed no difference between the groups in terms of pCO_2, pH and HCO_3, whereas pO_2 was higher in Group 2 only in the third hour. Lactate levels were stable in Groups 1 and 2, but increased significantly in Group 1 at the 3rd hour (Table 3).

$EtCO_2$ was found to be statistically significantly lower in Group 2, especially between 30 and 75 minutes, and systolic, diastolic, and mean arterial pressure between 45 and 120 minutes (Figure 3). When left and right NIRSs were examined separately, there was no significant difference between the groups (Figures 4,5,and 6). Only in both left and right NIRSs there was a significant elevation in Group 1 at 120 minutes (p=0.08 and p=0.06). In addition, both right and left NIRSs at 150.minute Group 1 were always at low levels.

DISCUSSION

In our study, we found that desflurane consumption was significantly reduced by using low-flow

Table 1. Demographic characteristics of patients

	Total	Group 1 (n=20)	Group 2 (n=20)	p value
Age (year)	51.0±16.8	52.6±17.8	49.3±15.9	0.542
Gender (M / F)	33 / 7	17 / 3	16 / 4	0.677
Length (cm)	170.3±8.8	172.2±8.9	168.4±8.5	0.183
Weight(kg)	73.3±12.7	76.7±13.1	70.0±11.8	0.09
ASA (1 / 2 / 3)	9 / 12 / 19	5 / 4 / 11	4 / 8 / 8	0.696
Comorbidity rate	9 / 22.5%	4 / 20.0%	5 / 25.0%	0.705
Operation type				
Anatomic lung resection	11 / 27.5%	6 / 30.0%	5 / 25.0%	
VATS	22 / 55.0%	9 / 45.0%	13 / 65.0%	0.638
Other*	7 / 17.5%	5 / 25.0%	2 / 10.0%	
Intubation tube type				
35	8 / 20.0%	2 / 10.0%	6 / 30.0%	
37	10 / 25.0%	5 / 25.0%	5 / 25.0%	0.115
39	22 / 55.0%	13 / 65.0%	9 / 45.0%	
Duration of anesthesia (min)	128.8±59.9	123.0±64.5	134.7±55.9	0.542
Duration of single lung ventilation (min)	100.8±49.8	98.2±53.1	103.5±47.4	0.744
Duration of operation (min)	116.8±53.9	111.6±55.1	122.0±53.5	0.551
Desflurane consumption	70.1±32.8	55.3±18.4	84.9±37.6	**0.003**
Desflurane intake	23.0±8.6	23.7±8.5	22.3±8.9	0.616

** Chest wall resection in 2 patients, pleural decortication in 1 patient, pleectomy in 1 patient, rib stabilization in 1 patient and metastasectomy in 1 patient.*

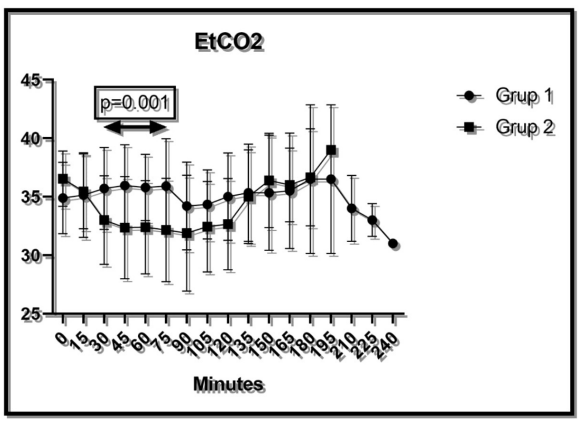

Figure 3. Perioperative change in $EtCO_2$

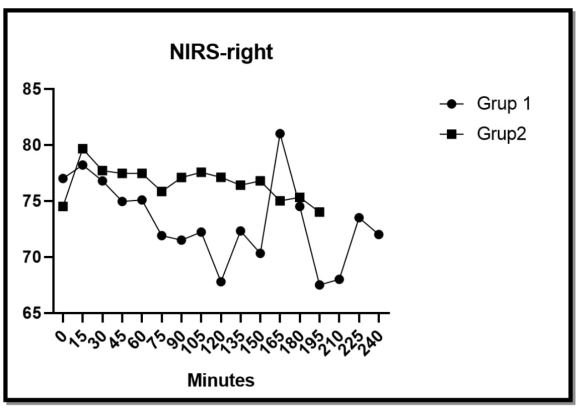

Figure 5. Comparison of right NIRS values between groups

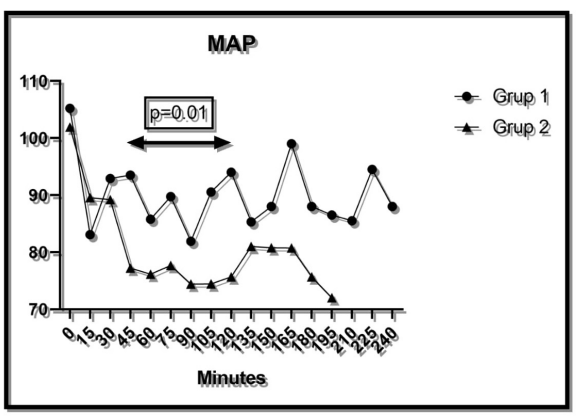

Figure 4. Perioperative change in mean arterial pressure

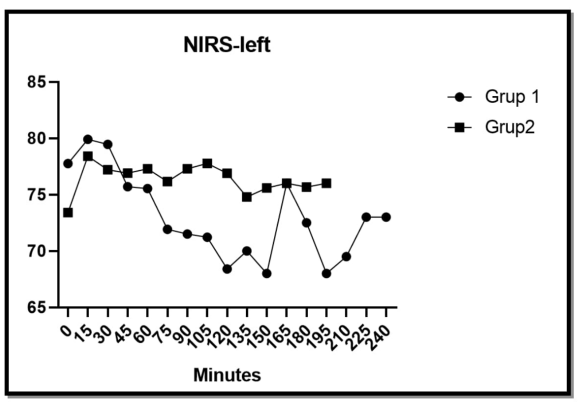

Figure 6. Comparison of left NIRS values between groups

Table 2. Comparison of the groups in terms of zero-minute physiological condition

	Group 1 (n=20)	Group 2 (n=20)	p value
SaO_2 %	98.3±3.0	98.4±1.7	0.851
Heart Rate /Min	82.4±17.0	86.4±14.7	0.438
$ETCO_2$ (mmhg)	34.9±3.0	36.5±2.3	**0.06**
Systolic blood pressure (mmhg)	139.7±21.0	136.8±19.9	0.651
Diastolic blood pressure (mmhg)	78.6±13.0	81.4±12.3	0.491
Mean Arterial Pressure (mmhg)	105.2±15.7	101.9±14.5	0.496
FiO_2 %	100.0±0.0	100.0±0.0	Na
Tidal volume Min/Lt	597.5±47.1	620.0±47.3	0.140
Respiratory rate /Min	12.0±0.0	12.0±0.0	Na
PEEP (cmH_2O)	5.0±0.0	5.0±0.0	Na
pH (mmhg)	7.39±0.02	7.41±0.02	0.112
pCO_2 (mmhg)	42.3±6.2	40.3±4.3	0.253
PaO_2 (mmhg)	179.8±54.0	202.6±60.1	0.215
HCO_3 (mmol/Lt)	24.8±1.2	25.0±1.3	0.678
Lactate (mEq/Lt)	1.09±0.34	1.28±0.33	**0.08**

na; not applicable

Table 3. Peroperative blood gas results *

	Group 1 (n=20)	Group 2 (n=20)	p value
pH			
1.hour	7.39±0.04	7.40±0.04	0.674
2. hour	7.38±0.04	7.40±0.03	0.231
3. hour	7.32±0.09	7.37±0.04	0.428
pCO_2			
1. hour	40.4±4.9	37.9±5.8	0.151
2. hour	40.2±6.4	37.8±4.2	0.360
3. hour	42.0±9.8	41.7±6.8	0.972
PaO_2			
1. hour	133.6±44.7	139.8±44.6	0.663
2. hour	127.3±24.7	139.0±37.6	0.430
3. hour	141.0±49.4	154.2±17.7	**0.01**
HCO_3			
1. hour	24.1±1.4	23.6±1.6	0.389
2. hour	23.9±1.8	23.7±2.1	0.728
3. hour	20.5±2.1	23.4±1.3	0.09
Laktat			
1. hour	1.17±0.44	1.40±0.44	0.668
2. hour	1.18±0.59	1.22±0.35	0.739
3. hour	2.20±0.98	1.42±0.09	**<0.001**

** Fourth hour blood gas was not evaluated because there were only two patients*

anesthesia in patients undergoing single lung ventilation, while it did not cause hemodynamic changes during the operation and could be used safely with appropriate anesthesia device and monitorization.

The low- flow anesthesia method, which is widely used nowadays, decreases the cost of anesthetic gas consumption and reduces environmental pollution and leads to positive results[8]. Especially the rapidly increasing healthcare costs and the high costs of modern inhalation anesthetics have brought cost control into consideration.

In particular, the use of new inhalation anesthetics with low flow and low solubility and anesthetic potency is more significant[9]. The use of desflurane reduces the time of filling and discharging of the low-flow system with the agent and confirms the rapid induction and recovery of anesthesia[10]. Desflurane, which has low blood and fat solubility properties and no fresh gas flow limitation in CO_2 absorbers, is best suited for low- flow anesthesia[11]. Therefore; in our study, we used desflurane as inhalation anesthesia at two different flow settings.

The most important factor determining the amount of inhalation agents used in general anesthesia applications is flow rate[12]. In our study; desflurane consumption rate was significantly lower in Group 1 (55.3±18.4 versus 84.9±37.6, p=0.003). Low- flow desflurane use has been reported to reduce the cost per patient and isoflurane increases the cost[13]. In addition, when deslurane was evaluated according to the flow rate (0.5 $Lmin^{-1-1}$ $Lmin^{-1-3}$ L min^{-1}), it was found that there was a proportional decrease in consumption[14]. Similarly, our study showed that the amount of inhalation agent decreased with low flow and thus the cost decreased in patients undergoing single lung ventilation. In the literature, there are limited publications on the use of low flow in patients undergoing single lung ventilation, but the rapid recovery (especially in long-term operations) has been shown to significantly reduce inflammatory mediator expression in patients undergoing thoracic surgery, thereby reducing the risk of inflammatory response[15] Since the desflurane vaporizer can be adjusted over a wide dose range, the fresh gas flow is at a low rate, while the desflurane concentration of the inhaled gases can be changed in a short time. This is important in order to prevent insufficient depth of anesthesia due to shortage of inhalation agents that may be seen in low-flow anesthesia and to allow rapid intervention in the case of deep anesthesia. Also, use of low-flow desflurane, maintaining heat and moisture in the airways; reduces the deterioration of mucociliary activity, preserves the viscosity of secretions and reduces the tendency to atelectasis, especially in patients undergoing thoracic surgery[16].

In our study, initially in both groups; there was no statistically significant intergroup difference as for SaO_2, heart rate, systolic and diastolic blood pressure, mean arterial pressure, FiO_2, tidal volume, respiration rate, pH, pCO_2, pO_2, HCO_3; but $EtCO_2$, systolic arterial pressure, diastolic arterial pressure, mean arterial pressure was significantly different between groups. $EtCO_2$ was found to be significantly lower in Group 2, especially in the 45th and 120th minute measurements of systolic, diastolic and mean arterial pressure between 30 and 75 minutes. We think that this difference does not require intervention and the main reason for this difference is that desflurane causes a more stable response than other procurement agents. However, it has been reported that the use of desflurane at vaporizer settings above 6% increases transient and short-term sympathetic activity, heart rate and blood pressure[17].

Bilgi et al. had shown that oxygen transport parameters were maintained optimally during all anesthesia stages in patients receiving low- flow anesthesia using different inhalation agents[18]. In our patients, no difference was found between the groups in terms of peroperative pH, pCO_2, HCO_3, whereas pO_2 was higher in Group 2 only at the third hour. Hypoxemia developing in thoracic anesthesia during single lung ventilation is still the most important problem. For this purpose, ventilation with high concentration of oxygen and large breath volume is conventionally recommended for the prevention of atelectasis and hypoxia[19].

Fan SZ et al, have indicated that in low- flow techniques, as the fresh gas flow is reduced, the difference between the amount of O_2 content and the inspired O_2 concentration increases. Lower

inspiratory O_2 increases the risk of hypoxia. The inspiratory O_2 concentration should be at least 30% in order to prevent hypoxemia with certainty and to ensure consistently adequate O_2 delivery[20]. In our study, there were no decreases in inspired and expired O_2 concentrations in both groups during the operation. We did not find any findings related to hypoxia in arterial blood gas analysis.

There was a statistically significant difference in endtidal CO_2 and lactate. The use of desflurane interacts with soda lime to produce CO but moisture caused by low flow reduces the amount of CO_2 generated.

Increased blood lactate levels have been reported in all volatile anesthetics over 8 hours[22]. In our study; Lactate levels were found to be stable in Groups 1 and 2, but significantly increased in Group 1 at the 3rd hour.

We think that the reason for the increase in lactate after 3 hours in the low-flow group is that the volatile agent increases glycogenolysis and consequently increases the lactate level.

Low -flow applications, and depth of anesthesia should be monitored with NIRS as well as sympathetic and somatic responses to painful stimuli[23]. When the NIRS values of our patients were examined separately as left and right NIRS, no significant difference was found between the groups. Only in both left and right NIRS there was a significant elevation in Group 1 at 120 minutes (p=0.08 and p=0.06, respectively). In addition, it was observed that both right and left NIRSs were always low in Group 1 until 150 min.[24] showed similar results with their study. However, although it was clinically tolerated in patients whose procedures lasted more than two hours, lower oxygenation was observed in the low- flow group. We found that low flow application and NIRS monitoring prevented unnecessary and excessive drug administration to patients.

The most important limitation of our study was the evaluation of the use of a single inhalation agent in low-flow applications. It is known that carbon monoxide is formed in the use of desflurane as a result of interaction with soda lime. It has been stated that the amount of CO produced in low- flow anesthesia methods is clinically insignificant. In our study, the amount of CO accumulated in the system and the amount of carboxyhemoglobin in patients were not measured. However, in order to avoid a possible interaction of soda lime and desflurane and to prevent possible carboxyhemoglobin accumulation and COHb increase, CO_2 absorbance was changed at the end of each day in our study. The comfort of the patients in the recovery room was not evaluated. Since small number of patients were included in the study, further studies with a higher number of patients would be more beneficial

In conclusion, we think that low-flow anesthesia with desflurane delivered with appropriate equipment and close monitoring can be safely applied without causing hemodynamic side effects in single lung ventilation used for thoracic surgery.

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Araştırma/*Research Article*

The Effect of Preoperative Ultrasonography Imaging Method on Success in Patients with Thoracal Epidural Procedure

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Torakal Epidural Uygulanacak Hastalarda Ultrasonografi ile Görüntüleme Yönteminin Başarıya Etkisi

Etik Kurul Onayı: Adnan Menderes Üniversitesi Tıp Fakültesi Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu onayı alındı. (18.01.2018; 13)
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Finansal Destek: Yok
Hasta Onamı: Alındı

Ethics Committee Approval: Adnan Menderes University Faculty of Medicine Non-Invasive Clinical Research Ethics Committee approval was obtained. (18.01.2018; 13)
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ABSTRACT

Objective: *To determine the actual measurement of skin-epidural distance in patients in whom epidural anesthesia would be applied at lower thoracic vertebral, and to examine the correlation of epidural space measurements made preoperatively with ultrasonography, and tomography with anthropometric values.*
Methods: *Our prospective, randomized controlled study was realized with 96 ASA I-III adult patients who would undergo epidural anesthesia applied through epidural spaces between 9.-12. thoracic vertebras. Neck and waist circumferences, and BMIs of the patients were recorded. The thoracic level to be used was determined by the anesthesiologist, and marked after verified by USG. From the same thoracic level the distances between skin-spinous process, and skin-ligamentum flavum were measured with USG . After the procedure epidural needle was marked, and obtained values were recorded. Distances between skin- spinous process, and skin-lig. flavum were measured from CTs recorded in the archival files of the same patient.*
Results: *In all three groups of patients (T 9-10 [n=35], T 10-11 [n=30 and T 11-12 [n=31]) skin-lig. flavum distance measured with USG was statistically shorter than that measured with CT, and length of the epidural needle inserted through all levels (p<0,001). Only in the T9-10 group. skin-lig.flavum distance measured in CT was statistically significantly shorter than the length of the needle inserted.*
Conclusion: *With this study, it is shown for the first time in the literature that ultrasonography, CT and anthropometric measurements such as BMI, neck and waist circumference may be useful to estimate the skin-epidural depth before the epidural procedures performed at the lower thoracic levels (T9-12).*

Keywords: *Thoracic epidural, antropometric measurements, epidural distance, ultrasound, Computed tomography*

ÖZ

Amaç: *Alt torakal vertebra seviyelerinde epidural anestezi uygulanacak hastalarda cilt-epidural mesafenin gerçek ölçümünü saptamak, girişim öncesi yapılan ultrasonografi ve tomografide ölçülen epidural mesafenin antropometrik değerler ile korelasyonunu incelemektir.*
Yöntem: *Prospektif, randomize kontrolü çalışmamız torakal 9-12 aralıktan epidural anestezi uygulanacak ASA I-III erişkin 96 hastada gerçekleştirildi. Hastaların boyun ve bel çevresi vücut kitle indeksi (VKI) kaydedildi. İşlem yapılacak seviye anestezist tarafından belirlendi ve USG ile doğrulanarak işaretlendi. Aynı seviyeden USG ile cilt-spinöz çıkıntı ve cilt- ligamentum flavum derinliği ölçüldü. İşlem sonrası epidural iğne işaretlenerek değerler kaydedildi. Aynı hastaya ait arşivimizde bulunan torakal BTdeki cilt-spinöz çıkıntı ve cilt-lig. flavum mesafeleri ölçüldü.*
Bulgular: *Üç grup hastada (T 9-10 (n=35), T 10-11 (n=30) ve T 11-12 (n=31)) USG cilt-lig.flavum ölçümü; BT ile ölçülen cilt-lig. flavum ölçümü ve epidural iğne boyundan istatistiksel olarak daha kısa bulunmuştur (p<0,001). BT ile ölçülen cilt-lig. flavum mesafesi iğne boyu ölçümünden sadece T9-10 grubunda istatistiksel olarak daha kısa bulundu. İğne boyu ile tüm seviyelerde USG, BT ile ölçülen epidural mesafe ve kilo, bel, boyun çevresi arasında korelasyon bulundu.*
Sonuç: *Bu çalışma ile literatürde ilk defa alt torakal seviyelerde (T9-12) epidural girişim öncesi cilt-epidural derinliği tahmin etmek için ultrasonografi, BT nin yanısıra hastanın kilo, bel ve boyun çevresi gibi antropometrik ölçümlerinin de faydalı olabileceği gösterilmektedir.*

Anahtar kelimeler: *torakal epidural anestezi, antropometrik ölçümler, epidural mesafe, ultrasonografi, Bilgisayarlı tomografi*

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INTRODUCTION

The use of ultrasonography (USG) for neuraxial blocks goes 40 years back . Cork had performed the first successful ultrasonographic measurement of the epidural space in the 1980s, and ligamentum flavum was recognized in the 1990s. While ultrasonography was initially considered for neuraxial anesthesia in patients with challenging anatomy, it has been suggested to be used in all patients by the National Institute for Health and Care Excellence (NICE)in 2008. [1]

Insertion of the thoracic epidural catheter is one of the most challenging regional anesthesia techniques due to "blinded" identification of the narrow intervertebral foramen by a needle. The rates of epidural intervention-related paresthesia and blood aspiration were reported as 0.16% and 0.67%. Significant nerve damage is quite rare, and the rate of epidural hematoma is less than 1/150.000. On the other hand, occurring complications may be catastrophic. [2]

USG has been frequently used to assess neuraxial structures as a noninvasive, reliable, and rapidly performed imaging method. It enables the anesthetist to preview the spine anatomy, determine the midline, find a specific intervertebral level, to predict the depth of the epidural space accurately, and identify the most suitable location and trajectory regarding needle insertion. [3,4,5] Numerous studies have reported that USG measurement of the skin-epidural depth was compatible to a great extent with the actual depth measured during the lumbar and thoracic epidural interventions. [2,5] All thoracic levels (upper, middle, and lower) have been generally assessed in studies that used USG to measure the thoracic epidural distance. However, since thoracic vertebral anatomy is different in the upper, middle, and lower levels, the results may also be different. [1,3,4,5] Our literature survey has not encountered any study comparing the epidural distance and USG measurement regarding lower thoracic vertebrae only.

Studies conducted up to this day have also investigated the relationships of epidural distance with genetic characteristics, race, ethnicity, geographic origin, age, gender, body weight and height, body mass index (BMI), waist circumference and foot size, abdominal fat thickness, and vertebral space. [6,7]

Our study has aimed to make actual measurements of the skin-epidural space distance (the length of the needle that intervention was performed with) and investigate its correlations with pre-procedural USG findings, the epidural distance measured with computed tomography (CT), and the anthropometric values (neck circumference, waist circumference, BMI, body weight, and height) in patients undergoing epidural anesthesia at lower thoracic vertebral (T9-12) levels.

MATERIAL and METHODS

After approval of the Ethics Committee of Adnan Menderes University Training and Research Hospital (Ethics Committee Decision 2018- 13) and obtaining the patients' written informed consent, this study was conducted on patients undergoing epidural anesthesia between January 2018 - September 2019. The patients were divided into three groups (T9-10, T10-11, T11-12 groups) using the lot-drawing randomization method. ASA I-III patients aged between 18-80 years, undergoing epidural anesthesia for elective surgery were included in the study. Patients in whom epidural anesthesia was contraindicated, patients whose CT images could not be retrieved from our system, patients in whom needle length measurement could not be obtained because of the inability to perform an epidural intervention, and those with uncompleted records, pregnant women, and emergency cases were excluded from the study. Standard monitoring (ECG, pulse oximetry, non-invasive blood pressure) was used in patients taken to the operating room. Neck and waist circumferences of the patients were measured, and BMI was calculated.

Then, ultrasonographic images were obtained with a console-type convex (1-8 MHz) ultrasonography device using a linear probe (3-22 MHz) (Esaote MyLab Five digital ultrasound, DesMoines, Iowa). The USG measurement process was completed while the patient was in a sitting position (with the elbows placed on the thighs), taking care that the total duration of process should not exceed ten minutes. Both the USG and palpation methods were used to

assess the intervertebral level, and the cutaneous needle insertion site was marked with a marker pen.

Identifying the Intervertebral Level

The anesthesiologist determined the level planned to be intervened before the USG examination, and the identified T9-10, T10-11, or T11-12 levels were marked, and confirmed by USG. Our console-type ultrasonography device was used during this process (Esaote MyLabFivedigital Ultrasound, DesMoines, Iowa). The identified level was confirmed by placing the probe at the 12th rib level, in the sagittal plane, 2 cm lateral to the midline, and directing it towards upper thoracic levels. During the procedure, these marks were considered as reference points. After that, the depth of the ligamentum flavum was measured,turning a linear (3-22 MHz) or convex (1-8 MHz) transducer medially and using a transverse median approach.

Measuring the Skin-Epidural Space Distance

The distance between the skin and epidural space at the specified level was determined by measurements made up to the posterior complex involving the dura mater and the hyperechoic line of the ligamentum flavum. The best acoustic window was searched by moving the probe 2-3 mm at the intervertebral space or angling it for 5-10° until the characteristic bright echo of the ligamentum flavum was visualized.

We could not obtain images with the linear probe, particularly in patients whose ligamentum flavum was located deeper than 4cm. Therefore, we used the convex probe in these patients, which shows deeper tissues at a higher resolution. Then, the distance between the skin, and spinous process was measured in the sagittal plane and recorded. The measurements were made after freezing the images, and the entire procedure lasted for a maximum of ten minutes. (Figures 1, 2, and 3).

Our hospital's radiologist made the skin-spinous process and skin-ligamentum flavum measurements from the same patient's thoracic CT images using the iSitePacs software. The ligamentum flavum localized on the mid-sagittal line, was used as an anatomical landmark. The recorded measurements were used as the data for statistical and correlation analyses.

Epidural Catheterization and Needle Length Measurement

The epidural technique was performed using the hanging drop technique with an 18G Tuohy needle through a median approach while the patient was in the sitting position, with the elbows kept over the knees. The Perican® epidural needle, Tuohy epidural needle (diameter 1.30X80 mm, 18G), and the Perifix® standard epidural catheter (radiopaque catheter with three lateral holes, 1000 mm, 20G) were used for the application. The skin-level point on the inserted epidural needle was marked with a sterile pen. The marked point was measured after the procedure and recorded as the actual depth.

The obtained values were written on the data collection sheet. The patient's chart number, age, gender, body weight, height, and BMI were written on the datasheet in addition to these values. The neck and wrist circumferences of the patient were measured with a measuring tape and recorded.

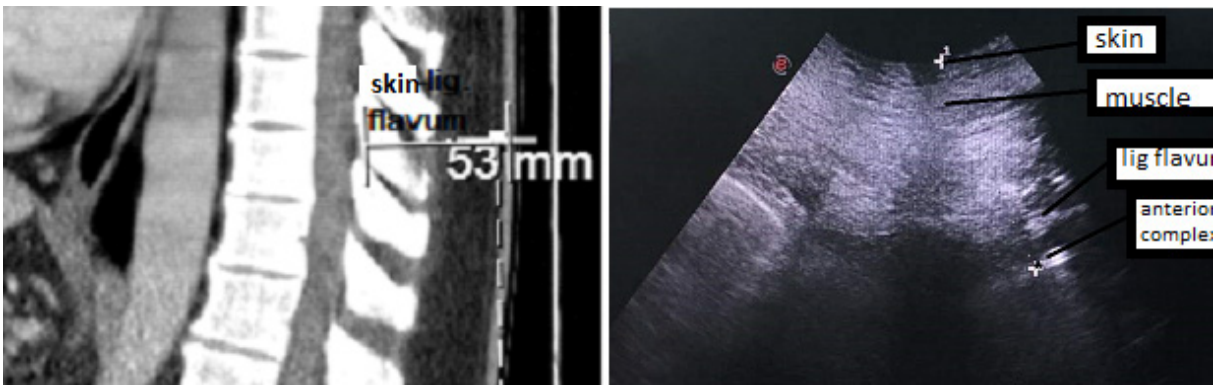

Figure 1. The CT measurement of skin-ligamentum flavum distance in the sagittal plane at the T9-10 level and the image of ligamentum flavum at the T9-10 level in the transverse median window acquired with the convex probe in the same patient

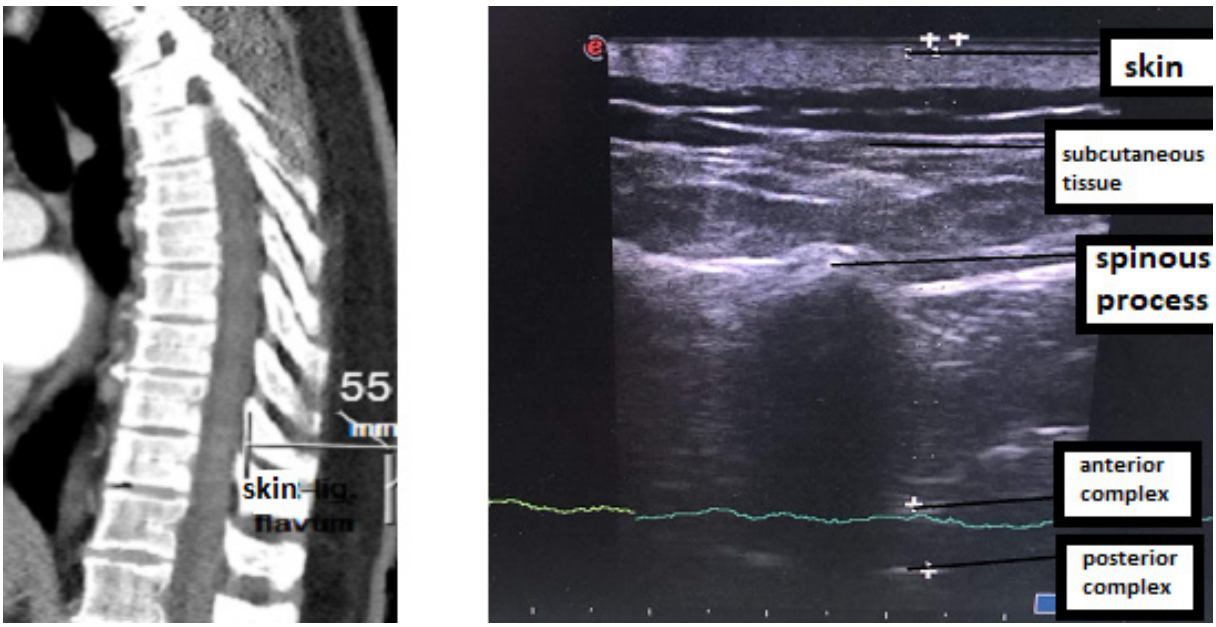

Figure 2. The CT measurement of skin-ligamentum flavum distance in the sagittal plane at the T10-11 level and the USG image of anatomical structures at the T10-11 level in the transverse median window acquired with the linear probe in the same patient

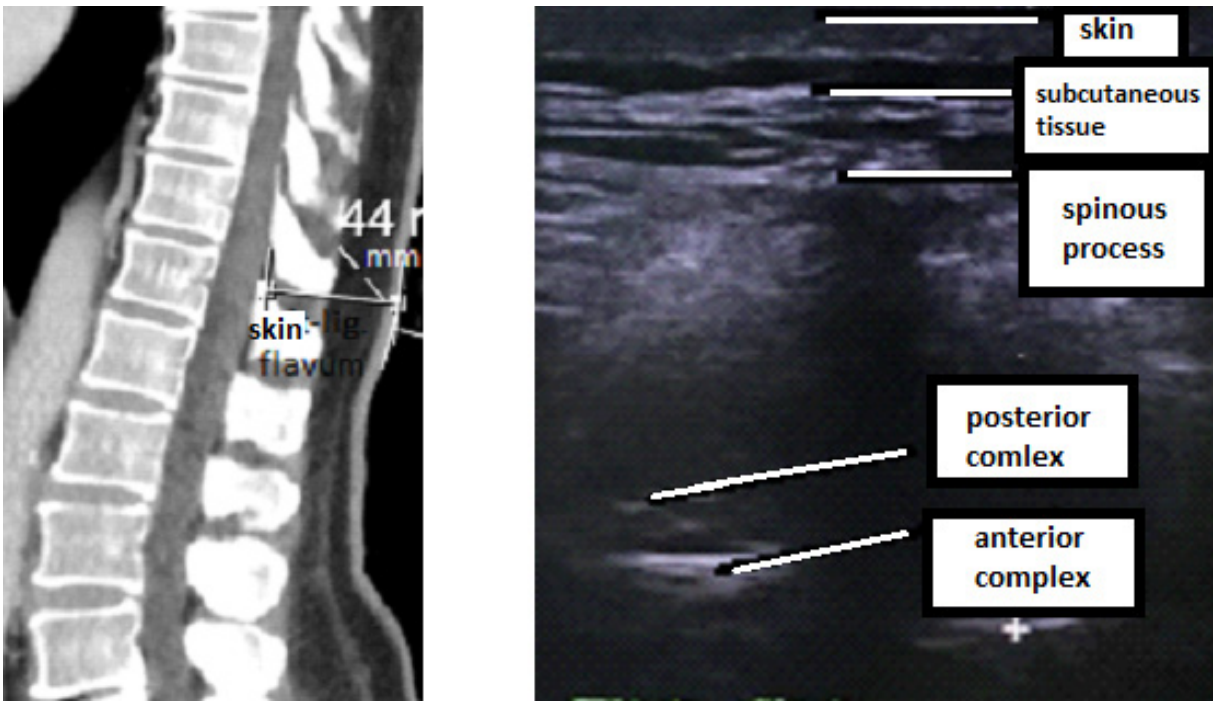

Figure 3. The CT measurement of skin-ligamentum flavum distance in the sagittal plane at the T11-12 level and the USG image of anatomical structures at the T11-12 level in the transverse median window acquired with the linear probe in the same patient

Other diseases, ASA score, type of operation, intervened thoracic level, and number of attempted punctures were also recorded.

Statistical Analysis

The Kolmogorov - Smirnov test analyzed the conformity of quantitative variables with a normal distribution. Independent groups were compared by one-way variance analysis (ANOVA) regarding normally distributed variables, whereas the Kruskal - Wallis test was used for variables with non-normal distribution. Dependent measurements with normal distribution were compared using the paired T-test, whereas Wilcoxon T-test or Friedman test was used for comparison of non-normally distributed dependent measurements. Relationships among quantitative variables were analyzed using the Pearson or Spearman correlation analysis. Descriptive statistics of qualitative variables were expressed as frequency (%). P<0.05 was considered statistically significant.

RESULTS

Among 136 patients participating in the study, 37 were excluded since the epidural space could not be visualized either by CT or USG, whereas three patients were removed from the study due to the failure to perform epidural anesthesia., The mean values for the age (61.79 ± 11.60 years), height (1.66 ± 0.09 m), body weight (73.80 ± 14.34 kg), and BMI (26.63 ± 4.63 kg/m^2), neck (40.24 ± 4.49 cm) , and waist (97.06 ± 15.16 cm) circumferences of the remaining 96 patients were determined. The average skin-spinous process distance and the average skin-ligamentum flavum distance measured with pre-procedural USG and CT performed in all patients, together with the mean post-procedural needle length, are presented in Table 1. When the three groups (T9-10, T10-11, T11-12) were compared, the USG value of skin-spinous process distance at the T9-10 level was found significantly longer than the T11-12 level. No significant difference was found among the groups regarding the skin-spinous process distance values measured by computed tomography (Table 2).

The skin-ligamentum flavum distance measured by USG was statistically significantly shorter when compared to both the CT measurement of skin-ligamentum flavum distance and the epidural needle length in all three groups (p<0.001). The CT measurement of skin - ligamentum flavum distance was statistically significantly shorter than the needle length measurement only in the T9-10 group (Table 3). While there was a positive correlation between needle length and weight, BMI, neck circumference, waist circumference, USG, and CT measurements, any correlation between the needle length and age was not detected (Table 4).

Table 1. The data related to USG and CT measurements and epidural needle values of all patients participating in the study (n=96)

Variable (mm)	Mean±standard deviation	Min-max
USG Skin-spinous process	11.0±5.3	4.8-29.6
CT Skin-spinous process	18.1±7.7	5.0-36.0
USG Skin-lig. Flavum	37.35±9.2	22.9-61.7
CT Skin-lig. Flavum	44.31±8.2	27.0-66.0
Needle length	47.33±10.0	3.0-74.0

Table 2. Statistical comparison of the groups regarding USG, CT measurements, and needle length

Variable	T9-10	T10-11	T11-12	p
USG Skin-spinous process	11.3 (8.0-15.4)**	9.6 (6.9-12)	8.6(6.4-10.0)**	0.024
CT Skin-spinous process	19.4±7.7	18.0 ±8.3	16.8 ±6.7	0.299

*** The USG skin-spinous process distance of the T9-10 group is statistically significantly different compared to the value of the T11-12 group only.*

Table 3. The results of USG and CT measurements of skin-lig. flavum distance and needle length according to the groups

GROUP	USG skin-lig. flavum	CT skin-lig. flavum	Needle length
T 9-10 (n=35)	36.1* (30.8-45.8)	43 α(39-50)	51 (44-56)
T 10-11 (n=30)	33* (30.8-37.9)	43.5 (39-51.2)	46 (37-48.2)
T 11-12 (n=31)	36.3* (32.2-40.0)	42.5 (38-49.2)	44 (40-52)

** p<0.001 (In all three groups) USG skin-lig. flavum different from CT skin-lig. flavum and needle size.*
α p=0.001 (In T9-10 group) Difference between CT skin-lig. flavum and needle length

Table 4. Intragroup evaluation of correlations of needle length with USG / CT measurements and anthropometric data

	T9-10		T10-11		T11-12	
	R	**P**	**R**	**p**	**R**	**P**
USG skin-spinous process	0.451	**0.002**	0.699	**0.001**	0.795	**0.001**
CT skin-spinous process	0.361	**0.033**	0.493	**0.006**	0.599	**0.001**
USG skin-lig. flavum	0.571	**0.001**	0.684	**0.001**	0.879	**0.001**
CT skin -lig.flavum	0.552	**0.001**	0.604	**0.001**	0.730	**0.001**
Age	0.162	0.288	0.058	0.703	0.022	0.886
Height	0.085	0.579	0.400	**0.006**	0.061	0.699
Body weight	0.644	**0.001**	0.607	**0.001**	0.828	**0.001**
BMI	0.596	**0.001**	0.485	**0.001**	0.447	**0.003**
Neck circumference	0.409	**0.005**	0.731	**0.001**	0.698	**0.001**
Waist circumference	0.623	**0.001**	0.579	**0.001**	0.644	**0,001**

DISCUSSION

As far as we know, this study has been the first in the literature comparing ultrasonographic, CT, and anthropometric measurements to predict the skin-epidural depth before epidural intervention at lower thoracic levels (T9-12). The skin-epidural space distance measured with USG was shorter than the CT skin-ligamentum flavum distance, and needle length measurements in all patients. Besides, positive correlations of the epidural needle length with anthropometric measurements (body mass index, neck and waist circumferences) and skin-epidural space distance measured with USG and CT were determined.

In the study conducted by Rasolian A. et al [2], an epidural intervention was performed at levels of T5-9 in 20 patients, and the needle lengths were compared to skin-ligamentum flavum distances measured with CT and USG. It was reported that the USG and CT measurements were shorter than the needle length (the mean needle length was 55±7 mm). In our study, an epidural intervention was performed at T9-12 levels in 96 patients, and the needle length was found as 47.14±10 mm. The cause of this significantly longer needle length used at the T9-10 level (51 mm) compared to the other groups (T10-11 and T 11-12) might be the more angled approach used for epidural intervention in higher-level thoracic vertebrae, similar to the study conducted by Rosalian et al. In our study, we also found that longer needle length was used compared to USG measurements at all levels. The cause of this

result might be that, due to its curved tip, the Tuohy needle we used might have pushed the dura a little after piercing ligamentum flavum, and this distance might have been added to our measurement. In their study, Rosalian A. et al. found that USG measurements were 4.49 mm shorter than CT measurements. In our study also, the epidural distance measured by USG was significantly shorter than the CT measurement at all levels. This result might have been related to a decrease in distance due to compression of the skin and subcutaneous tissues by the USG probe and changing thickness of ligamentum flavum while measuring the skin-epidural distance with USG.

Three approaches are commonly used at one vertebral level in conventional ultrasonography: transverse, median longitudinal, and paramedian longitudinal. We obtained the best images with the median transverse approach and measured the ligamentum flavum distance using this approach in all patients. In the study conducted by Grau T. et al. [8] , USG was performed using all three approaches at the L3-4 level, and the widths, epidural spaces, and the images of ligamentum flavum were compared in 60 patients. As a result, it was reported that the highest visibility of the ligamentum flavum and dura was achieved through the widest window using the paramedian approach. On the other hand, studies in the literature have reported successful results with the transverse approach, supporting our study. [9,10,11] Chauhan A. K. et al. [9] compared epidural depth measurement by USG performed in the transverse plane with epidural needle lengths and concluded that taking measurements from the needle insertion site increased the quality and success rate of the procedure.

Similarly, other studies have reported that simultaneous USG-guided interventions in transverse and paramedian sagittal oblique windows were possible and comfortable. [10,11] Another study conducted by Salman et al. [12] in 2011 investigated the usability of USG at levels of mid-lower thoracic vertebrae by approaching in the paramedian sagittal oblique plane. Patients who were planned to undergo upper abdominal surgery were included in the study. Images were obtained in the paramedian sagittal oblique plane, and the skin- epidural space distance was measured in all patients. In that study, it was concluded that for mid-lower level thoracic vertebrae (T6-7), performing USG in the paramedian sagittal oblique plane would be beneficial regarding the prediction of skin - epidural space distance. We also performed USG for lower-level thoracic vertebrae and determined its strongest correlation with the needle length, particularly at the T11-12 level, in the transverse median plane. Thus, we can suggest that a transverse median window is a practical approach for predicting the skin-epidural space distance in lower-level thoracic vertebrae. The relative anatomical similarity of lower-level thoracic and lumbar vertebral structures might have been significant regarding the visualization of ligamentum flavum in the transverse approach. In neuraxial anatomy, caudal angling of spinous processes of upper thoracic vertebrae and narrow interspinous and interlaminar spaces in the mid-thoracic region might have led to the formation of a narrow acoustic window during the transverse USG approach and thus, limited visibility. [4] However, we still think that selection between the transverse and paramedian approaches depends on the experience, and skill of the performer.

Our study used superficial anatomy and confirmation with USG to determine the thoracic vertebral levels. Besides, similar to the literature [13], we did not confide in the information about considering the vertebral level corresponding to the lower scapular tip as T7. We determined the level by palpating upwards, starting from the 12th rib level, and rapidly confirmed this level with USG, significantly reducing the error margin.

Currently, CT measurement of the skin-epidural space distance has been performed in numerous studies. [7,14] In the studies conducted by Kosturakis et al. [7] and Nathaniel et al. [14], associations of needle length measurements with CT measurements and anthropometric characteristics at levels from T3-4 to T11-12 were investigated. CT measurements were reported to be significantly shorter than needle lengths in both studies. The authors stated that its cause might be the supine position used for CT imaging, leading to compression exerted by skin and subcutaneous tissues. CT measurements were not corrected according to needle insertion angles in these studies.

On the contrary, in the study conducted by Carnie J et al. [15], the actual epidural depth was estimated using the Pythagorean theorem (needle length=the distance measured with CT/the cosine of the insertion angle). However, in the study of Kosturakis [7], et al. ,it was stated that it was not possible to know and calculate the needle angling definitely during the epidural intervention. In our study, a significant difference was present between CT measurements and needle lengths in the T9-10 group only. We also did not correct our USG and CT measurements according to the needle insertion angles, considering that we would not be able to calculate the needle angles definitely and standardize them for 96 patients; however, we determined strong correlations between needle length and our measurements.

The distance of the epidural space from the skin and the width of the epidural space are affected by numerous factors. Studies performed to date have investigated various factors such as race, ethnic and geographical origins, age, gender, body weight, height, foot size, BMI, and BSA (body surface area). [16,17,18,19,20] In the study conducted by Cantürk M et al. [21] on 130 pregnant women, the skin-to epidural space distance was measured with USG at the L3-4 intervertebral space. Then a combined epidural-spinal block was performed through this space, and the waist circumference, BMI, age, height, and body weight were recorded in all patients. The correlation coefficient between the epidural space and waist circumference was calculated as 0.797, and strong correlations with BMI and body weight were also determined. On the other hand, no correlation with either height or age was present.

Similarly, our study determined extraordinarily strong correlations of epidural depth with waist circumference and body weight in all patients, particularly at the T11-12 level; this might be because abdominal fat and weight affect the lower thoracic region. Similar to the study conducted by Cantürk M et al., we were not able to determine the correlation of epidural depth with height and age. Besides, unlike other studies, we determined strong correlations between epidural depth and neck circumference at all levels.

The complication rate is low in central neuraxial blocks, and most of the complications resolve within six months. [22,23,24] In a study that a thoracic epidural block was performed in 2059 patients, accidental dural puncture and inability to place an epidural catheter were found to occur with a rate of 0.7-1.2%, and none of these patients developed neurological sequela. [23] In our study, an epidural intervention was performed in a total of 136 patients, and consistent with the literature, an accidental dural puncture occurred in two (1.4%) patients. Following the dural puncture, the epidural intervention was tried again at the next higher level. No pathology was encountered during the neurological follow-up of these patients.

One limitation of our study might be not to record the total duration of the procedure. We tried to complete the whole procedure involving USG measurement and epidural catheterization in less than ten minutes; however, we did not keep time precisely. Because MR images of our patients were not present in our system, our other limitation was the inability to make MR measurements. If we could have made those measurements, we would be able to compare the epidural depths in CT and MRI. No obese patient was present in our study group. Since most of our study group consisted of cancer patients, we did not have the chance to measure many overweight patients. Another limitation was failure to intervene simultaneously with USG. Since we did not have experience on this subject and did not want to prolong the procedure , we did not prefer simultaneous intervention. Even though use of real-time USG during neuraxial procedures is promising, it would be challenging if performed by a single person and necessitates high-degree hand skill and hand-eye coordination. Besides, the gel used for USG may cause an infection during the neuraxial block.

In conclusion, we can state that in clinical practice, epidural depth at levels of T9-12 can be predicted by pre-procedural USG or CT, and these measurements can be correlated with needle length. Besides, we think that visualization can be performed using the transverse medial approach in lower thoracic vertebrae. We also think that, among anthropometric measurements, neck circumference can also help us

to predict the skin-epidural space distance in addition to body weight and waist circumference. In thoracic epidural anesthesia, more studies investigating the use of USG at all levels and the data of a large number of patients are required.

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Araştırma/*Research Article*

An Outbreak of Urinary Tract Infections due to Myroides Spp. in Adult Intensive Care Unit: Risk Factors and Control Procedures

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Erişkin Yoğun Bakım Ünitesinde Myroides Spp'ye Bağlı İdrar Yolu Enfeksiyonu Salgını: Risk Faktörleri ve Kontrol Yöntemleri

Etik Kurul Onayı: Ankara Şehir Hastanesi Başhekimliği etik kurul onayı alınmıştır. (17.01.2020; 2831)
Çıkar Çatışması: Yazar(lar) bu makalenin araştırılması, yazarlığı ve/veya yayınlanması ile ilgili olarak herhangi bir potansiyel çıkar çatışması beyan etmemiştir.
Finansal Destek: Yazar(lar) bu makalenin araştırılması, yazarlığı ve/veya yayınlanması için herhangi bir mali destek almamıştır.
Hasta Onamı: Tüm çalışma katılımcıları bilgilendirilmiş onam verdi.

Ethics Committee Approval: Ankara City Hospital Chief Physician ethics committee approval was obtained. (17.01.2020; 2831)
Conflict of Interest: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.
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Informed Consent: All study participants provided informed consent.

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ABSTRACT

Objective: *Microorganisms of the Myroides genus are common in the environment, especially in water but rarely seen as an infectious agent in humans. It was described uncommonly in immunocompetent patients. Their treatment is challenging due to their resistance to many antibiotics. Herein, we report the Myroides spp-associated nosocomial urinary tract infection outbreak occurring in tertiary intensive care.*
Methods: *A total of 9 Myroides spp reproductions in 7 patients were included in the study between July 2019 and December 2019.*
Results: *For Myroides species known to have multi-drug resistance, response to the combined treatment of ciprofloxacin and rifampicin was achieved in 5 out of 7 patients.*
Conclusion: *We would like to point out that poorly controlled diabetes can cause outbreaks. Also, ciprofloxacin and rifampicin may be effective options in treatment.*

Keywords: *Myroides, Outbreak, Nosocomial infection, Urinary tract infection, Flavobacterium.*

ÖZ

Amaç: *Myroides cinsi mikroorganizmalar başlıca su olmak üzere doğal ortamda yaygın olarak bulunur, ama insanda bir enfeksiyon ajanı olarak nadiren görülür. İmmünkompetan hastalarda nadir olarak tanımlanmıştır. Bir çok antibiyotiğe direnç nedeniyle tedavisi zordur. Burada üçüncü basamak yoğun bakımda meydana gelen Myroides spp. ile ilişkili nozokomiyal üriner sistem enfeksiyonu salgını bildirildi.*
Yöntem: *Temmuz 2019 ile Aralık 2019 tarihleri arasında 7 hastada toplam 9 Myroides spp. üremesi çalışmaya dahil edildi.*
Bulgular: *Çoklu ilaca dirençli olduğu bilinen Myroides türleri için, 7 hastanın 5'inde siprofloksasin ve rifampisin kombine tedavisine yanıt alındı.*
Sonuç: *Biz kötü kontrollü diyabetin salgınlara neden olabileceğini saptadık. Ayrıca siprofloksasin ve rifampisin tedavide etkili seçenekler olabileceğini düşünüyoruz.*

Anahtar kelimeler: *Myroides, Salgın, Nozokomiyal enfeksiyon, İdrar yolu enfeksiyonu, Flavobakteri.*

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INTRODUCTION

The Myroides genus (Myroides spp.) are aerobic, yellow-coloured, immobile, non-fermented, gram-negative microorganisms, formerly classified as Flavobacterium odoratum. The most common species are Myroides odoratus and Myroides odoratimimus.

Microorganisms of the Myroides genus are common in the environment, especially in water [1]. Although they are common in the environment, they are rarely seen as an infectious agent in humans. It has been reported to cause urinary tract infection, endocarditis, ventriculitis, and cutaneous infections in severely immunocompromised patients as low-grade opportunistic pathogens. Their treatment is challenging due to their resistance to many antibiotics. Only 32 cases have been reported in the literature review conducted in 2010 [2]. There has been an increase in case reports in recent years [3].

We aimed to report the Myroides spp.-associated nosocomial urinary tract infection outbreak occurring in tertiary intensive care; and in the light of the literature, to examine this outbreak, which is the fourth outbreak as far as we know.

MATERIAL and METHOD

The study was conducted after the local ethics committee approval of the hospital was obtained. Our intensive care is a 16-bed tertiary mixed type intensive care. A total of 9 Myroides sp.p strains grown in 7 patients were included in the study conducted between July 24, 2019 and December 28, 2019. All isolates were of urine origin.

All isolates were first identified as Myroides spp. using the VITEK® 2 GN ID cards (BioMérieux, Marcy l'Etoile, France). The initial identification as Myroides spp was performed using a matrix- assisted laser desorption ionization -time of flight mass spectrometry (MALDI-TOF MS) according to the manufacturer's instructions. Antibiotic sensitivity was determined according to EUCAST (European Committee on Antimicrobial Susceptibility Testing) criteria and tested on VITEK 2 (Biomerieux, Marcy-l'Étoile, France) device.Sensitivity to aztreonam, cefepime, ceftazidime, ciprofloxacin, gentamicin, imipenem, levofloxacin, meropenem, netilmicin, piperacillin, pip-Tazo, tetracycline, amikacin, trimethoprim-sulfamethoxazole, and tobramycin discs was tested. (Table 1)

Table 1. In vitro susceptibility testing of the isolates of Myroides spp.

Antibiotic	MIC value	Interpretation S,I,R
Aztreonam	>=64.0	R
Cefepim	>=32.0	R
Ceftazidime	>=64.0	R
Ciprofloxacin	>=4.0	R
Gentamicin	>=16.0	R
Imipenem	>=16.0	R
Levofloxacin	>=8.0	R
Meropenem	>=16.0	R
Netilmicin	>=32.0	R
Piperacillin	>=128.0	R
Piperacillin/ Tazobactam	>=128.0	R
Tetracycline	>=16.0	R
Amikacin	>=64.0	R
Trimethoprim/ Sulfamethoxazole	>=320.0	R
Tobramycin	>=16.0	R

I:İntermediate, MIC: Minimum inhibitory concentration, R: Resistant, S: susceptible

The demographic data, underlying diseases, hospitalization periods, and antibiotic treatment of all patients who had myroides spp reproduction in their urine culture were recorded.

RESULTS

Nine Myroides spp. isolates were detected in urine samples for a total of 3 months. Pyuria accompanied 7 of the nine isolates. 2 isolates were considered as colonization. The patients' demographic data and clinical characteristics are shown in Table 2. Six (86%) patients were male, and one (14%) was female. The mean age of the patients was 77 years (age range 69-83). All patients had 4 to 6 comorbidities.

The mean hospitalization period of the patients was 80 days (min-max 29-139 days), the average hospitalization period before isolation was 48 days (min-max 13-97 days).All patients used up to 1 to 4 antibiotics before bacterial isolation was made (Table 2).

All patients had normal complete urine analysis findings upon hospitalization. For all patients, a Foley catheter was used for urinary catheterization. All cases had hospital-acquired urinary tract infections. For Myroides spp. known to have multi-drug resistance, response to the combined treatment of ciprofloxacin and rifampicin was achieved in 5 out of 7 patients. Treatment was not initiated for two patients who were considered as having bacterial colonization.

DISCUSSION

Myroides spp. are low-grade opportunistic pathogens that are not found in normal human microflora but are mostly present in the environment. Myroides spp. have been reported as the cause of opportunistic infections in severely immunosuppressed patients [1,4-6]. It was described rarely in immunocompetent patients [2,7]

As per our literature information, three outbreaks caused by Myroidess spp. have been reported so far (Table 2). Our study is the fourth outbreak. In the first outbreak reported by Yağcı et al., 9 of the cases had urinary stones, and 4 had urinary neoplasms [8]. In the second outbreak reported by Ktari et al., 6 of the 7 cases with urinary tract infection caused by M.odrathimimus had urinary calculus, and one patient had bladder cancer.[9] Besides, the cases had a long-term hospitalization and a history of endourological intervention in all except for one case. Licker et al. reported that all patients had a permanent urinary catheter in the UTI outbreak due to m.odoratimimus (Table 3).[10] All except one of their patients required long-term hospitalization.[10 As well as the underlying comorbidities, we think that prolonged urinary catheterization will pose a severe risk due to the morbidities caused by this bacterium.

Diabetes mellitus affects the immune system, leads to development of infections, and most importantly, predisposes to opportunistic pathogens. Therefore, one of the significant risk factors of Myroides spp. in UTI is diabetes mellitus (DM). However, only a limited number of UTI cases due to Myroides spp. in diabetic patients have been reported. As far as we know, 7 cases have been reported in the literature so far. All of our patients had DM for a long time, and their HbA1C levels were high, which led us to think that the uncontrolled diabetes of our patients was a serious risk factor for these infections.

However, nonfermenting gram-negative bacilli (NFGNB) can be easily identified at the species level by using the automatic identification system such as VITEK 2 Compact and MALDI-TOF today. It was noted that with these systems, NFGNB is increasingly isolated in major cases of bacteriuria.[11,12] We used the MALDI-TOF identification system in our cases.

It was reported that Myroides spp. mostly have multi-drug resistance properties and pan-resistance properties in some cases. However, the antibiotic resistance mechanism of Myroides spp. has not been fully explained. The treatment of infections caused by Myroides spp.is also of great importance because of its potential to cause serious nosocomial infections and its multi-drug resistance. Mammari et al. reported an intrinsic resistance to B lactams in M.odoratus and M.odoratimimus, due to chromosome-encoded B lactamases (MUS-1 and TUS-1). [12]

Many strains have been recognized as resistant to beta-lactams, monobactams, and carbapenems, while variable sensitivity to aminoglycosides, quinolones and trimethoprim/sulfamethoxazole has been demonstrated. [2,7,9]

Table 2. Clinical characteristics and treatment of the seven cases of UTIs due to Myroides species

Case No, Gender/ Age (years)	Department admitted to	Admission date	Sample Collection date	Days of hospi-talizatin	Comorbidities	HbA1c	Prior antibiotic treatment	Type of infecti-on	Treatment for Myroides UTIs	Outcome
C1 M/77	Intensive care,	.07.22.2019	09.02. 2019	97 days	HT, DM, AF,CHF, Aspiration Pneumonia,, AVR, CVD	6,9	teicoplanin, Meropenem	UTI	Rifampicin+ ciprofloxacin	Failure
C2 M/81	Intensive care,	08.20. 2019 09.17..2019	09.02. 2019	83 days	DM, BPH Parkinson's Disease, Chronic Subdural Hematoma Aspiration Pneumonia	7,2	Meropenem cmlistin	UTI	No treatment	Cured
C3 M/76	Intensive care,	08.26 .2019 10.02. 2019	09.07. 2019	56 days	DM, CAD, Hypoxic Ischemic Encephalopathy	6,8	Teicoplanin, Meropenem	UTI	No treatment	Cured
C4 M/83	Intensive care,	07.24. 2019	09..10. 2019	64 days	CVD, ARF Pneumonia	7,8	Meropenem	UTI	Rifampicin+ ciprofloxacin	Failure
C5 F/83	Intensive care,	07.24. 2019	1- 10.07. 2019 2- 11.18. 2019	139 days	HT, DM, Epilepsy Intracranial mass	5,9	1-Meropenem 2-Meropenem, Amikacin	UTI	Rifampicin+ ciprofloxacin	Cured
C6 M/69	Intensive care,	07.24. 2019 12.02. 2019	28.10.2019	132 days	CVD, Monier Chon sendromu, Aspiration Pneumonia	6,1	Imipenem, sul-famethoxazole and trimethoprim colistin tigecycline	UTI	Rifampicin+ ciprofloxacin	Cured
C7 M/73	Intensive care,	10.15. 2019	1-11.26. 2019 2-12.02. 2019	70 days	DM,HT ,CAD,ABY, Ludwig's Angin	7,1	1-Linezolid, sul-famethoxazole and trimethoprim, colistin	UTI	Rifampicin+ ciprofloxacin	Cured

HT:Hypertension; DM:Diabetes mellitus; AF:Atrial fibrillation; CHF:Congestive Heart Failure; AVR:AorticVvalve Replacement; CVH:cerebrovascular disease; BPH:Benign Prostatic Hyperplasia ;CAD: Coronary Artery Disease; ARD: Acute Renal Failure

Table 3. Comparison of outbreaks reported so far

Study	Number of Cases	Age (Year/Gender)	Underlying Conditions of Infections	Infection	Culture	Treatment	Outcome
Yağcı et al. 2000	13	Not reported	Urinary neoplasm (4 patients) and urinary stones (9 patients)	pyuria	Urine	Not reported	Not reported
Ktari et al. 2012	7	Range 44-80/ all M	6 patients with urinary calculi, 1 patient with bladder cancer	Group A: Urinary tract infection Group B:Bladder colonization Group C: Urinary tract infection	Urine	3 patients were successfully treated with ciprofloxacin (Group A) 3 patients without treatment (Group B) 1 patient was treated with imipenem+ colistin (Group C)	Group A: Cured Group B: Favourable Group C: Failure
Licker at al	4	Range 36-72/3M,1F	3 patients with urethro-vesical catheterization 1 patient with bilateral cutaneous ureterostomy	Group A: Urinary tract infection Group B: Urinary tract infection Group B:Bladder colonization	Urine	1 patient was treated with imipenem+ colistin+ amikacin (Group A) 2 patients were successfully treated with Tigecycline (Group B) 1 patients without treatment (Group C)	Group A: Cured Group B: Good clinical response Group C: Favourable

In the case series reported by Ktarı et al. three patients with UTI caused by Myroides spp.were given ciprofloxacin and rifampicin combination treatment, and treatment response was achieved.[9] Our patients had resistance to all laboratory tested antibiotics. In 5 of our patients, we changed Foley catheters and started ciprofloxacin and rifampicin combination treatment empirically, and we achieved treatment response. Therefore, we think that ciprofloxacin and rifampicin combination may be an appropriate and effective combination for the treatment of infections caused by Myroides spp..

During the period when Myroides sp.p isolates were detected, it was determined that new personnel (nurse, patient care staff) started to work in our intensive care unit. When the anamnesis of these employees was examined, it was found that they did not have intensive care experience and their working experience in the health sector was inadequate. Periodic training was given to these employees about hand washing, urinary catheter care, and patient care. No Myroides spp reproduction was detected in the following months. Our most important limitation of this study was that environmental cultures had not been taken. Another limitation was also the inability to perform statistics due to the small size of the patient group.

CONCLUSION

In this study, we wanted to show that Myroides spp., which is difficult to treat due to multi-drug resistance, can cause an outbreak of nosocomial urinary tract infection with long-term urinary catheterization in intensive care patients with uncontrolled DM, even if there is no urinary system pathology and to emphasize the importance of staff training and increasing compliance with infection control measures in outbreak control.

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Araştırma/*Research Article*

Pneumothorax in Coronavirus Disease-19 Patients: A Retrospective Case Series

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Koronavirüs-19 Hastalarında Pnömotoraks: Retrospektif Bir Olgu Serisi

Etik Kurul Onayı: Diyarbakır Gazi Yaşargil Eğitim ve Araştırma Hastanesi Yerel Etik Kurul onayı alındı (15.01.2021-629).
Çıkar Çatışması: Yazarlar herhangi bir çıkar çatışması beyan etmemiştir.
Finansal Destek: Yazarlar bu çalışmanın herhangi bir finansal destek almadığını beyan etmişlerdir.
Hasta Onamı: Çalışmadaki veriler hastanenin bilgi yönetim sistemindeki kayıtlardan ve hasta dosyalarından retrospektif olarak analiz edilmiştir.

Ethics Committee Approval: Diyarbakır Gazi Yaşargil Training and Research Hospital Local Ethics Committee approval was obtained (15.01.2021-629).
Conflict of Interest: The authors declared no conflicts of interest.
Funding: The authors declared that this study has received no financial support.
Informed Consent: Patient information was analyzed retrospectively from the records and patient files in the hospital's information management system.

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ABSTRACT

Objective: *Pneumothorax may develop secondary to alveolar damage and barotrauma in Covid-19 patients. In this study, in the light of the literature. we aimed to present Covid-19 patients who developed pneumothorax among whom we followed up in the intensive care unit.*
Methods: *Eleven patients among 2680 patients tested positive for Covid-19 in the PCR test and developed pneumothorax in the radiologic examination were included in the study. The data were obtsined from patient follow-up forms and electronic medical records. Demographic data, blood and biochemical parameters, blood culture results, time and location of development of pneumothorax, modality, and duration of pneumothorax treatment, and mortality data were recorded.*
Results: *The frequency of development of pneumothorax was found to be 0.41%. The most common complaint was dyspnea. Comorbidiites were observed in 9 (81.8%) patients and the most common comorbidity was hypertension. It was determined that 3 (27.2%) patients did not smoke, 4 patients(36.3%) were active smokers, and 4 (36.3%) patients were ex-smokers. The mean age was 69±14.8 years, the APACHE II score were 18.8±8.7, the female/male ratio was 3/8, and the the time to pneumothorax development was 10.7±11.8 days. Pneumothorax developed in 3 (27.27%) patients on noninvasive mechanical ventilation and 8 (72.7%) patients on invasive mechanical ventilation. The mean length of stay in the intensive care unit was 21.6±26.5 days. It was found that 10 (90.9%) patients died and the mean time to mortality was 19.5±27.0 days.*
Conclusion: *In Covid-19 infection, lung protective ventilation strategies should be adopted and it should be known that the development of pneumothorax is a late complication that increases mortality and morbidity.*

Keywords: *Covid-19, intensive care, lung-protective ventilation, mortality, pneumothorax*

ÖZ

Amaç: *Covid-19 hastalarında alveolar hasar ve barotravmaya sekonder pnömotoraks gelişebilir. Bu çalışmada, yoğun bakım ünitesinde takip ettiğimiz Covid-19 hastalarından pnömotoraks gelişenlerini literatür eşliğinde sunmayı amaçladık.*
Yöntem: *Çalışmaya PCR testi pozitif olduğu saptanan 2.680 hastadan radyolojik olarak pnömotoraks geliştiği belirlenen 11 hasta dahil edildi. Veriler hasta takip formları ve elektronik tıbbi kayıtlardan alındı. Demografik veriler, tam kan ve biyokimyasalparametreleri, kan kültür sonuçları, pnömotoraks gelişim zamanı ve lokasyonu, pnömotoraks tedavi şekli, mortalite ve süresi kaydedildi.*
Bulgular: *Pnömotoraks gelişme sıklığı %0,41 bulundu. En sık başvuru yakınmasının dispne olduğu saptandı. Dokuz (%81.8)hastada comorbidite olduğu ve en sık gözlenen comorbiditenin hipertansiyon olduğu görüldü. Üç (%27,2) hastanın sigara kullanmadığı, 4(%36,3) hastanın aktif sigara içicisi olduğu ve 4 (%36.3) hastanın sigarayı bıraktığı saptandı. Hastaların yaş ortalamaları 69±14,8 yıl, APACHE II skor ortalamaları 18,8±8,7, kadın/erkek oranı 3/8 ve pnömotoraks gelişene 10,7±11,8 gün bulundu. Üç hastada (%27.27) noninvaziv mekanik ventilasyonda ve 8 hastada (%72,7) invaziv mekanik ventilasyondayken pnomotoraks geliştiği saptandı. Yoğun bakım ünitesinde ortalama kalma süresi 21,6±26,5 gündü. On (%90,9) hastanın eks olduğu ve eks olana kadar ortalama 19,5±27,0 gün geçtiği saptandı.*
Sonuç: *Covid-19 infeksiyonu sırasında hipoksemi tedavi edilirken, akciğer koruyucu ventilasyon stratejileri benimsenmeli ve pnömotoraks gelişiminin mortalite ve morbiditeyi arttıran geç dönem komplikasyon olduğu bilinmelidir.*

Anahtar kelimeler: *akciğer koruyucu ventilasyon, Covid-19, mortalite, pnömotoraks, yoğun*

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INTRODUCTION

Covid-19 (SARS-CoV-2), a zoonotic virus that first appeared in Wuhan City , the capital of Hubei Province in China in December 2019, shows rapid transmission from person to person and causes severe pneumonia. [1,2] As a result of its rapid transmission, after it was seen in other countries of the world, it was declared as a Covid-19 pandemic by the World Health Organization on 11 March 2020. [3] As of now, the disease has infected 115,864,376, and killed 2,573,576 people. [4]

Despite vaccine and antiviral drug studies in the world, transmission has not yet been fully prevented and effective treatment has not been provided yet. Although Covid-19 infection generally shows a good prognosis in most patients, it progresses rapidly in some patients, leading to acute respiratory distress syndrome (ARDS). Hypoxemic respiratory failure, which is the most common complication of COVID-19, is tried to be treated with invasive and noninvasive mechanical ventilation support. However, during this supportive treatment, undesirable conditions such as pneumothorax, pneumomediastinum, subcutaneous emphysema or even pneumopericardium may develop in patients. [7-9]

During the treatment and follow-up of cases with Covid 19, it is necessary to kept in mind and state the importance of rapid diagnosis and treatment options of conditions such as pneumothorax, tension pneumothorax that may cause hypoxemia or mortality by deepening existing hypoxemia. Therefore, in our study, in the light of the literature we aimed to present the patients who were followed up in our level 3 intensive care unit due to Covid-19 and developed pneumothorax during treatment, since March 11, 2020, when the first Covid-19 case was seen in Turkey, until today.

MATERIAL and METHOD

The study was conducted as a single-center retrospective study. Approval of the hospital ethics committee was obtained (15/01/2021-629). In the study, out of 2680 patients who were followed up in our level 3 intensive care unit and tested positive for Covid-19 with the polymerase chain reaction (PCR) test by taking nasopharyngeal and oropharyngeal swap samples, 11 patients who were found to have developed pneumothorax during radiological examination were included in the study. The study was conducted in accordance with the Helsinki Declaration 2008 criteria.

The patients who were <18 years of age, whose final treatment had not been concluded at the time of the study, cases with incomplete data, and had a history of thoracic surgery and pneumothorax were excluded from the study.

The data were obtained from patient follow-up forms and electronic medical records by an experienced anesthesiologist in the intensive care unit. Demographic data, comorbidit(ies, blood group antigens, APACHE II scores, blood biochemistry parameters, neutrophil / lymphocyte ratios, platelet values, smoking history were recorded. Complaints of the patients during admission, blood culture results, need for noninvasive mechanical ventilation,and intubation, mechanical ventilation mode applied to the patients, PEEP values, and length of stay in the intensive care unit were recorded. The radiological images of the patients were examined and the duration of pneumothorax development and the location of the pneumothorax were determined. The pneumothorax treatment approach applied to the patients was recorded. Exited patients were identified and the time of mortality was recorded.

Statistical analysis

SPSS 22.0 for Windows program (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Numerical data were expressed as mean and standard deviation, while categorical data were expressed as frequency and percentage.

RESULTS

The study included 11 patients who were found to have developed pneumothorax as detected during radiological examination from 2680 patients who were followed up in the intensive care unit due to Covid-19. The prevalence of pneumothorax development in patients followed up in the intensive care unit was 0.41%. The demographic and clinical characteristics of the patients are shown in **Table I**.

The mean age of the patients was 69 ± 14.8 years. Three patients were female and 8 were male. Nine (81.8%) patients had comorbidities and hypertension was the most common comorbidity. It was determined that 3 (27.2%) patients did not smoke, 4 (36.3%) patients were active smokers, and 4 (36.3%) patients were ex-smokers.

Table I: Demographic and clinical characteristics of patients

Characteristics	n=11
Age (year)	69±14.8
>65 age	7
Gender (Male/Female)	8/3
Apache II score	18.8±8.7
Comorbidity (Yes/No)	9/2
Diabetes mellitus type 2	2
Coronary artery disease	3
Chronic obstructive pulmonary disease	1
Hypertension	6
Chronic renal disease	2
Smoking	
No smoking	3
Current smoking	4
Ex-smoker	3
ICU days	21.6±26.5
Mortality (Yes/No)	10/1
Time to exitus (day)	19.5±27.0

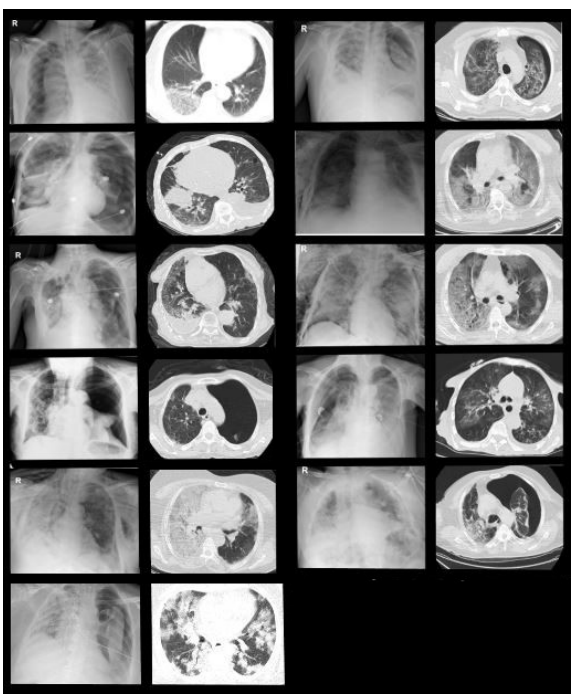
Abbreviation: ICU; Intensive care unit

The average length of stay in the intensive care unit was 21.6 ± 26.5 days. The mean APACHE II score was calculated as 18.8 ± 8.7. It was determined that 10 (90.9%) patients died and the mean time to mortality was 19.5 ± 27.0 days (Table I).The clinical characteristics of the patients are shown in **Table II.** When the complaints of the patients at hospital admission were examined, it was observed that dyspnea was the most common complaint. The time to develop pneumothorax after admission to the intensive care unit was 10.7 ± 11.8 days. It was found that pneumothorax developed during non-invasive mechanical ventilation in 3 patients (27.27%) and during invasive mechanical ventilation in 8 patients (72.7%). It was found that pneumothorax developed in the right lung in 6, and in the left lung in 5 patients (**Figure 1**). The most

Table II: Clinical features of patients with pneumothorax

	n=11
Symptoms at Presentation	
Fever	1
Cough	4
General status disorder	3
Dyspnoea	10
Time to development of pneumothroax (After ICU admission)	10.7±11.8
Location of Pneumothorax (Left/Right)	5/6
Mechanical ventilation (Yes/No)	8/3
Ventilation modes	
P-SIMV	6
PRVC	2
HFOV	2
CPAP	1
PEEP	7.7±4.2
Blood culture results	
Acinetobacter baumannii	6
Klebsiella pneumoniae	2
Sterile	3
Treatment	
Chest drain	10
Conservative	1

Abbreviations: CPAP; Continuous positive airway pressure ventilation, HFOV; High-frequency oscillatory ventilation, ICU; Intensive care unit, PEEP; Positive end expiratory pressure, PRVC; Pressure regulated volume control ventilation, P-SIMV; Pressure synchronized intermittent mandatory ventilation



commonly used mode of mechanical ventilation in intubated patients was P-SIMV (75%). The mean PEEP value of the patients was 7.7 ± 4.2. While chest tube was applied in 10 (90.9%)patients, conservative approach was preferred in 1 patient. When the bacterial growths in blood cultures were examined, Growth of *Acinetobacter Baumannii* was observed in 6 (54.5%) and *Klebsiella Pneumoniae* in 2 (18.1%) patients. No growth was detected in the blood culture of 3 (27.2%) patients. The laboratory parameters of the patients are shown in **Table III.**

Table III: Baseline laboratory data of patients (Mean ± (SD)

	n=11
White blood cells (x10^3/uL)	13.6±7.7
Neutrophil (x10^3/uL)	12.4±7.7
Lymphocytes (x10^3/uL)	0.77±0.45
Neutrophil/Lymphocyte ratio	24.7±25.2
Platelets (x10^3/uL)	221.8±70.0
Hematocrit (g/L)	43.2±4.6
Alanine aminotransferase (U/L)	45.7±41.4
Aspartate aminotransferas (U/L)	49.4±50.0
Lactate dehydrogenase (U/L)	547.5±309.6
Sodium (mEq/L)	135.4±2.9
Potassium (mEq/L)	4.4±0.8
Chlorine (mEq/L)	102.0±5.1
Lactate (mmol/L)	2.7±1.5
Ferritin (µg/L)	1023.0±785.2
D-dimer (ng/mL)	1865.4±3529.7
C-reactive protein (mg/L)	139.0±95.9

DISCUSSION

In this study, we evaluated 11 patients who were found to have developed pneumothorax radiologically among 2680 patients we followed up and treated for Covid-19 disease .

Pneumothorax is a clinical pathology that develops secondary to the accumulation of free air between visceral and parietal leaves in the pleural cavity due to various reasons and occurs as a result of lung collapse. It can be spontaneous or can be seen due to secondary causes. [10]

The mechanism of pneumothorax development in Covid-19 disease has not been fully elucidated. The most likely pathophysiological mechanism is necrotic and fibrotic changes occurring at the alveolar level secondary to infection. Increased intra-alveolar pressure caused by invasive and noninvasive mechanical ventilation applied by clinicians to correct hypoxemia observed as a result of loss of elasticity in the lung tissue and deterioration in oxygenation disrupts alveolar integrity and causes pneumothorax. [11-13] In addition, it is known that barotrauma caused by increased intrathoracic pressure during severe cough episodes in patients induces development of pneumothorax in the alveolar structure that is damaged secondary to infection. [14]

The deterioration of the alveolar structure, which predisposes to the development of pneumothorax, can be detected based on radiological findings such as frosted glass appearance, bilateral and peripheral consolidation, linear opacities, “crazy-paving” pattern and “reverse halo” sign. [15] There is a serious correlation between radiological findings and the prognosis of the disease. All of our patients who developed pneumothorax had radiological findings as a result of alveolar damage secondary to Covid-19 during admission to the hospital.

In the management of acute respiratory failure and ARDS that occur in patients with Covid-19 infection, besides invasive and noninvasive mechanical ventilation, high flow nasal oxygen therapy (HFNO) and oxygen therapy with balloon mask constitute the cornerstones of treatment. Although today’s mechanical ventilators have been technologically developed in accordance with the age of the patients, they may cause barotrauma and ultimately pneumothorax during ventilation depending on patient-induced factors or inappropriate ventilation strategies. It is known that ventilation with high tidal volume (> 12ml / kg), high PEEP pressure, high plateau airway pressure and driving pressure values causes alveolar rupture and ultimately pneumothorax by increasing intra-alveolar pressure. [16-19]

In addition to alveolar damage caused by the disease, barotrauma due to mechanical ventilation and oxygenation strategies, the underlying lung diseases of the patient are also predisposing factors in the development of pneumothorax. Examples of such diseases include chronic obstructive pulmonary disease, interstitial lung diseases, ARDS, other pathologies that can cause parenchymal damage, and obstructive diseases such as asthma. [20] It should be noted that there is a possibility of developing pneumothorax even in lower pressure and tidal volumes in patients with comorbid diseases, which are known to be a facilitating factor in the development of pneumothorax, so appropriate mechanical ventilation strategies should be preferred.

We routinely apply protective lung ventilation strategies, which have an important place in the treatment of patients with ARDS, in our clinical practice. [21] Although we applied a lung protective ventilation strategy (low tidal volume (6 ml / kg), low plateau pressure] and our PEEP pressure was not high (7.7 + 4.4), while 8 patients developed pneumothorax during invasive mechanical ventilation. When we examined the time to the development of pneumothorax , we observed that pneumothorax developed after the 10th day of admission to intensive care. The fact that PIP pressures and lung compliance were not recorded in our study is one of the limitations of our study.

We examined the literature, and found studies in which the development of pneumothorax in patients with Covid-19 was reported during treatment with HFNO, during the days after hospitalization, even after discharge or while taking nasal oxygen for treatment. [22-25] Patients whose primary indication for the patient's admission to the hospital was subcutaneous emphysema secondary to pneumothorax, cases that were admitted to the hospital due to isolated pneumothorax and those with PCR (+), who did not have Covid-19 symptoms have been reported in the literature,. [26,27] These patient groups, included patients with minor and self-limiting pneumothorax who did not require intervention, as well as patients who developed tension pneumothorax. [24] In our study, we found that pneumothorax developed in 8 patients during invasive mechanical ventilation and in 3 patients while applying noninvasive high-frequency oscillatory (HFO) and continuous positive airway pressure (CPAP) ventilation. While 10 patients were urgently treated with closed tube drainage, one male patient was followed up conservatively because he did not have a pneumothorax severe enough to require intervention.

Eight of 11 patients who were included in our study and developed pneumothorax had severe ARDS developing on the background of Covid-19. We think that positive pressure invasive ventilation we applied due to severe alveolar injury contributes to the development of pneumothorax in this group.

When we examined the literature, we have encountered different rates in the prevalence of pneumothorax in patients with Covid-19. In the study conducted by Alessandro Belletti, who evaluated pneumomediastinum and pneumothorax together, they stated that pneumothorax developed in up to 24% of their patients. [28]

Nanshan Chen et al. evaluated pneumothorax alone, unlike Alessandro Belletti, and they stated that pneumothorax developed in 1 out of 99 patients (1%). [29] In another study with a large series of 3500 patients, it was reported that pneumothorax developed in 15 patients (0.43%). [30]

Zantah et al. examined over 3000 patients and stated that 6 of 900 patients with PCR (+) developed pneumothorax and the prevalence of pneumothorax development was 0.66%. [31] In our study, we found that 11 out of 2680 patients had pneumothorax and the prevalence of pneumothorax development was 0.41%, similar to the studies in the literature.

When we evaluated our patients with pneumothorax in terms of comorbidities, we think that smoking may contribute to the development of pneumothorax. Because, we found that 4 out of 11 patients who developed pneumothorax had a history of active smoking, and 4 were ex-smokers. Contrary to our study results, Sethi et al. reported that none of the 10 patients with subcutaneous emphysema and pneumomediastinum they followed up in their study had a smoking history. [32] In our literature review, we

could not find any evidence that smoking facilitates the development of pneumothorax in patients with Covid-19, but the fact that 72.6% of our patients who developed pneumothorax in our study had a smoking history indicates that more studies and data are needed.

Finally, the contribution of the presence of secondary infection to the development of pneumothorax during invasive ventilation by increasing the alveolar damage in our patients cannot be denied. The blood culture antibiograms taken from our patients with pneumothorax revealed *Acinetobacter Baumannii* in 6 patients and *Klebsiella Pneumoniae* in 2 patients, while no microorganism growth was detected in 3 patients. When the patients with no bacterial growth were examined, it was seen that they were transferred from an external center and received broad-spectrum antibiotic therapy. When we examined the patients who developed pneumothorax in terms of survey, we found that 10 patients died and only one of our patients could be discharged from the intensive care unit (90.9%). In our literature review, we found that in parallel with our study, the majority of patients who developed pneumothorax during Covid-19 infection died. [33-34]

In conclusion, pneumothorax is a rare finding that can be seen in patients during COVID-19 infection and treatment. In order to prevent the development of pneumothorax, maneuvers that will increase alveolar damage should be avoided in the ventilation strategies used for the correction of hypoxemia and lung protective mechanical ventilation strategies should be adopted. However, it should be kept in mind that pneumothorax may develop in patients during the application of lung protective mechanical ventilation strategies, even during noninvasive ventilation applications.

We recommend that the development of pneumothorax in the treatment of patients with Covid-19 should be recorded as a late-term complication that can lead to increased mortality and morbidity.

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Olgu Sunumu/*Case Report*

Karaciğer Nakli Yapılmış Hastada Konjenital Kalp Cerrahisinde Anestezi Yönetimi

Anesthesia Management in Congenital Heart Surgery in a Patient with Liver Transplantation

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ÖZ

Karaciğer nakli uzun yıllardan beri erişkin ve çocuk hastalarda başarılı bir şekilde uygulanmaktadır. Nakil yapılan hastaların sağkalım oranları arttıkça komorbidite ve nontransplant cerrahisi oranları da artmaktadır. Ailesel hiperkolesterolemi nedeniyle 7 yaşında iken önce koroner arter baypas cerrahisi, ardından (3 ay sonra) canlıdan karaciğer nakil ameliyatı geçiren 20 yaşındaki erkek hastaya aort kapak darlığı nedeniyle aort kök genişletme ameliyatı ve aort kapak replasmanı planlandı. Bu çalışmamızda, daha önceden karaciğer nakli yapılan hastada anestezi uygulaması deneyimimiz sunulmuştur.

Anahtar kelimeler: *Karaciğer nakli, konjenital kalp cerrahisi, anestezi*

ABSTRACT

Liver transplantation has been successfully applied in adult and pediatric patients for many years. As the survival rates of transplanted patients increase, the rates of comorbidity and nontransplant surgery also increase. In our case aortic root expansion and aortic valve replacement operation due to aortic valve stenosis was planned to 20-year-old male patient, who had undergone coronary bypass surgery at the age of 7 because of familial hypercholesterolemia, followed by a living donor liver transplant (3 months later). The goal of this study is to present our anesthesia experience with a patient who had a liver transplant before.

Keywords: *Liver transplantation, congenital heart surgery, anesthesia*

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GİRİŞ

Karaciğer nakli uzun yıllardan beri başarılı bir şekilde uygulanmaktadır. Nakil yapılan hastaların sağkalım oranları arttıkça ek hastalıkların ve nontransplant cerrahisi oranlarında da artış olmaktadır. İleri dönemde gelişen kalp ve diğer sistem patolojileri nedeniyle cerrahi uygulamaları artmıştır. Karaciğer nakilli hastalarda koroner arter hastalığının görülme sıklığı artmaktadır.[1] Bu çalışmamızda, 13 yıl önce ailesel hiperkolesterolemi nedeniyle karaciğer nakil ameliyatı ve koroner baypas uygulanmış olan hastaya aort darlığı nedeni ile aort kök genişletme ve aort kapak replasmanı ameliyatında uyguladığımız anestezi yönetimimizi sunmayı amaçladık.

OLGU SUNUMU

Yirmi yaşında, erkek hasta (175 cm, 55 kg), 13 yıl önce ailesel hiperkolesterolemi nedeniyle 3 ay ara ile açık kalp ameliyatı (sol ana koroner arter-sol internal mamarian arter anastomuzu) ve karaciğer nakil ameliyatı yapıldığı öğrenildi. Hastanın yapılan fizik muayenesinde patoloji saptanmadı. Hastanın preoperatif hemogram, biyokimya ve kanama testleri normal sınırlardaydı. Preoperatif kolesterol değerleri normal sınırlardaydı. Ekokardiyografide ejeksiyon fraksiyonu %70, aort kapağı biküspit ve kalın, aort kökü tubüler şekilde daralmış olarak izlendi. Orta derecede aort yetersizliği saptandı. Hastanın preoperatif dönemde yapılan koroner anjiyografisinde herhangi bir patoloji saptanmadı. Ameliyat sabahı premedikasyon için 2 mg iv midazolam yapıldı. Hasta ameliyat odasına alındı. Hastaya EKG, periferik oksijen satürasyonu (SpO_2), serebral near infrared spektroskopi (NIRS) ile monitorize edildi. 16G kanül ile periferik damar yolu açılarak invaziv arter monitorizasyonu (sağ radial arter) yapıldı. Kalp hızı 85/dk. (sinüs ritmi), TA 120/65 mmHg, SpO_2 %98 olarak gözlendi. Anestezi indüksiyonunda 0.1 mg/kg midazolam, 1,5 mg/kg propofol, 5 µg/kg fentanil ve 0.6 mg/kg rokuronyum bromür kullanılarak 7,5 mm endotrakeal tüp ile entübe edildi. Sağ internal juguler vene santral venöz kateter takıldı. % 60 O_2-hava karışımı ile mekanik ventile edilen hastanın anestezi idamesi 0.25 µg/kg/dk. remifentanil infüzyonu, 8 µg/kg/dk rokuronyum bromür infüzyonu ve 0.03 mg/kg/sa midazolam ile sağlandı. Hastamıza 100 mg/kg/gün asist infüzyonu başlandı. İndüksiyon sonrası 250 mg prednizolon intravenöz yapıldı. Ameliyat süresince ortalama arter basıncı 60 mmHg üzerinde tutuldu. Hemodinamik açıdan bir sorun yaşanmadı. Hasta kardiyopulmoner baypastan 0,5 µg/kg/dk. milrinone, 0.03 µg/kg/dk. adrenalin inotrop destek ve 0,5 µg/kg/dk nitrogliserin infüzyonu ile ayrıldı. Anestezi süresi 480 dk. kardiyopulmoner baypas süresi 283 dk., aortik kros klemp süresi 240 dk. olarak kaydedildi. İnotrop destek ile yoğun bakıma devredilen hasta postoperatif 15. saatte ekstübe edildi.

TARTIŞMA

Dünyada ilk karaciğer nakli (KC-N) 1963 yılında Thomas Starzl tarafından uygulanmıştır. Pediyatrik yaş grubunda da karaciğer nakli önemli bir yer tutmaktadır. Pediyatrik hastalarda karaciğer nakli, immünsüpresif ajanların kullanıma başlaması, cerrahi teknik ve deneyimlerdeki artış ile birlikte sağ kalım oranlarını arttırmıştır.

Karaciğer nakilli hastanın preoperatif değerlendirilmesi, diğer normal hastaların preoperatif değerlendirilmesinden bazı özellikler açısından farklıdır. Karaciğer nakilli hastanın preoperatif değerlendirilmesinde normal hastadan farklı olarak dikkate alınması gereken en önemli noktalar preoperatif greft fonksiyonu, immunosupresif ajan kullanımı, infeksiyon riski ve ameliyatın türüdür. Her hastada, kesinlikle iyi bir anamnez alınması ve fizik muayene yapılması şarttır.[2] Bizim hastamız da preoperatif dönemde gastroenterolog tarafından greft fonksiyonları normal olarak değerlendirildi. Hastanın alınan immunsupresif ajan kullanmadığı öğrenildi.

Karaciğer nakilli hastalarda tüm anestezi ve analjezi yöntemleri kullanılabilir. Bu hastalarda eğer eritrosit transfüzyonu yapılacaksa hedef hemotokrit değeri hepatik arter stenozu riskini azaltmak için %25-30 arasında tutulmaya çalışılmalıdır. Biz de hastamızda ameliyat süresince hemotokrit değerini %25-30 aralığında olmasına dikkat ettik.

Küçük cerrahilerde EKG, SpO_2, non-invaziv kan basıncı gibi standart monitörizasyon teknikleri yeterlidir. Ancak, hastanın anamnezi, klinik durumu, planlanan cerrahi ve kanama beklentisi gibi durumlarda monitörizasyon genişletilmeli ve gerekiyorsa invaziv yöntemler kullanılmalıdır. İnvaziv arteryel basınç

takibi, santral venöz kateter, pulmoner arter kateteri (PAK) kardiyak problemi olanlarda, majör batın cerrahisi ameliyatlarında ve hemodinamik instabilite beklenen olgularda uygulanmalıdır. Standart monitorizasyona ek olarak, invaziv girişler yapılırken infeksiyon riski akıldan çıkarılmamalıdır.[2]

Karaciğer nakilli ve açık kalp cerrahisi uygulanacak hastalar için önemli olan bir diğer konu ise steroid stres dozunun uygulanıp uygulanmayacağına karar verilmesidir. Bu konuda kabul edilmiş ortak bir görüş birliği yoktur. Steroid dozu uygulanan ve uygulanmayan gruplar arasında yara yeri iyileşmesi ve infeksiyon açısından bir fark bulunmamıştır.[3] Bu çalışmalar küçük olgu gruplarında yapılmıştır, daha sağlıklı bir değerlendirme için daha geniş olgu serilerine gereksinim vardır. Biz de kliniğimizde, antiinflamatuar olarak preoperatif prednizolon rutin olarak uyguluyoruz. Karaciğer nakil sonrası açık kalp cerrahisi uygulanan hastalarda karşılaşılan en önemli sorun karaciğer fonksiyonlarının bozulmasıdır. Deb ve ark.[4] 13 karaciğer nakli yapılmış hastada açık kalp cerrahisi yapıldığını, bu hastaların 6'sında (%46) postopratif erken dönemde geçici greft oklüzyonuna bağlı karaciğer enzimlerinde artış olduğunu ve taburculuk öncesinde hepsinin normal değerlerine döndüğünü bildirmişlerdir.[5] Hastamızda da postoperatif 1. günde karaciğer fonksiyon testlerinde (KCFT) artış görüldü. N-asetilsistein infüzyonuna devam edildi. Postoperatif 2. günden sonra KCFT de düşme görüldü.

Postoperatif dönemde yakın ve yoğun tıbbi takip gerektiren karaciğer nakli yapılmış hastalarda, normal kalp cerrahisi sonrası görülen atriyal fibrilasyon, akciğer ödemi, plevral efüzyon gibi komplikasyonların görüldüğü bildirilmektedir.[5] Hastamızda bu tür komplikasyonlarla karşılaşmadık.

Sonuç olarak, yeterli sayıda olgu olmamasına rağmen, pediyatrik karaciğer nakli yapılmış hastalarda gerekli önlemler alınarak başarılı bir şekilde açık kalp cerrahisi uygulanabilmektedir. Bu hasta grubunda karaciğer fonksiyonlarının postoperatif erken dönemde yakın takip ve tedavisi gerekmektedir.

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Olgu Sunumu/*Case Report*

Multitravmaya Eşlik Eden Torasik Aort Diseksiyonu: Olgu Sunumu

Throracic Aortic Dissection Concomitant Multitrauma : A Case Report

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ÖZ

Toraksın künt travmaları sonrası %90-95 oranında aortun istmus bölümünde aort yaralanmaları görülmektedir. Travma sonrası aortada meydana gelen lezyonlar; basit kontüzyon, intramural hematom, rüptüre bağlı diseksiyon veya psödoanevrizma şeklindedir. Hastaların çoğunda göğüs ön duvarında ağrı, sırt ağrısı, dispne, öksürük, ses kısıklığı, hipotansiyon, uyumsuz nabız, şok, koma görülebilirken yaklaşık ¼'i asemptomatik ve/veya multitravmayla ilişkili diğer semptomlar tarafından gölgelenmiş durumdadır. Bu yaralanmalara aortadaki akselerasyon ve deselerasyon mekanizmaları neden olmaktadır. Tedavide ise endovasküler onarım, açık cerrahiye göre iyi bir alternatiftir. Olgumuzda, yaklaşık 10 metre yükseklikten düşme sonucu acil servisimize getirilen 34 yaşındaki multitravma hastasındaki torasik aort diseksiyonuna yaklaşımımızı ve yapılan endovasküler girişimi sunmayı amaçladık.

Anahtar kelimeler: *aort diseksiyonu, travmatik aort yaralanması, endovasküler girişim, TEVAR (torasik endovasküler aort tamiri)*

ABSTRACT

Aortic injuries are seen in the isthmus part of the aorta at a rate of 90-95% after blunt trauma to the thorax. Post-traumatic lesions in the aorta; simple contusion, intramural hematoma, dissection due to rupture or pseudoaneurysm. In most of the patients, pain in the anterior chest wall, back pain, dyspnea, cough, hoarseness, hypotension, maladaptive pulse, shock, coma may be seen, while approximately of them are asymptomatic and / or overshadowed by other symptoms associated with multitrauma. These injuries are caused by acceleration and deceleration mechanisms in the aorta. In treatment, endovascular repair is a good alternative to open surgery. In our case; We aimed to present our approach to thoracic aortic dissection and endovascular intervention in a 34-year-old multitrauma patient who was brought to our emergency department after a fall from a height of approximately 10 meters.

Keywords: *Aortic dissection, traumatic aortic injury, endovascular intervention, TEVAR (thoracic endovasculer aort repair)*

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GİRİŞ

Travmaya bağlı torasik aort yaralanmaları yüksek mortalite ile seyretmekte olup, travma hastalarında intrakranial kanamadan sonra en sık ikinci ölüm nedenidir [1]. Torasik aort diseksiyonu genellikle trafik kazası veya yüksekten düşmenin neden olduğu ani akselerasyonu (travmanın hızlı ivmesine bağlı) takip eden ani deselerasyona (çarpma veya düşmenin tamamlanması sonrası ani durma) bağlı olarak gelişmektedir. [2]. Yaralanma genellikle sol subklavyen arterin distalindeki aortanın istmus bölgesinde oluşur. Arkus aorta dalları, lig. arteriozum, interkostal arterler ve plevra inen aortanın yerinde sabit kalmasına katkıda bulunur. Ancak, yatay ya da düşey travmalar sırasında gövdeye sıkı sabitlenmiş olan inen aortanın istmus bölgesinde, travma sırasında oluşan kinetik enerjinin oluşturduğu gerilme ve torsiyon sonucunda diseksiyon gelişmektedir. [3].

Aort diseksiyonları anatomik olarak De Bakey ve Stanford sınıflamalarına göre ayrılır. De Bakey ve ark.'nın sınıflamasına göre, proksimal aortadan başlayıp tüm aortayı tutan diseksiyonlar Tip I, yalnızca asendan aortayı tutanlar Tip II, yalnızca desenden aortayı tutanlar Tip III olarak adlandırılır [4]. Stanford sınıflamasına göre ise, asendan ve arcus aortayı tutan diseksiyonlar Tip A, desenden aortayı tutanlar Tip B olarak adlandırılır [5]. Tedavide açık cerrahi uygulanabildiği gibi endovasküler girişim de tercih edilebilmektedir. TEVAR (torasik endovasküler aort tamiri) çeşitli torasik aort patolojileri için uygulanabilen, endovasküler bir stent greftin görüntüleme yardımıyla torasik aortaya uzak bir periferik konumdan yerleştirilmesi işlemidir. Açık cerrahiye göre daha az invaziv bir işlem olması, düşük doz heparin kullanılması gibi nedenlerle yüksekten düşmeye bağlı akut çoklu travma hastalarının yönetiminde dahi iyi bir seçenek olarak uygulanabilir [2]. TEVAR yapılan hasta gruplarında mortalite ve morbidite oranlarının daha düşük olduğu yapılan çalışmalarda gösterilmiştir.

Bu olgu sunumunda, yüksekten düşme sonucu kafa travması, intrakranial kanama ve çoklu fraktürler (kot, pelvis ve ekstremite) ile acil servise gelen multitravma olgusunda saptanan ve hayatı tehdit eden travmatik torasik aort diseksiyonu olgusuna yaklaşımımız ele alınacaktır.

OLGU SUNUMU

Otuz dört yaşında bilinen ek hastalığı olmayan erkek hasta, yaklaşık 10 metre yükseklikten düşme sonucu multitravma ile acil servise getirildi. Acil servisteki muayenesinde, genel durumu kritik, bilinç açık, kooperasyon ve oryantasyonu sınırlı olan hastanın Glaskow Koma Skoru:1 0, ışık refleksi bilateral pozitif, anizokorisi mevcut ve göz kapakları bilateral ekimotik idi. Solunum muayenesinde, dinlemekle solunum sesleri azalmış, sağ 3 ve 4. kosta hizasında krepitasyon mevcuttu. Batın muayenesi olağandı. Ekstremite muayenesinde, sağ ayak bileğinde açık kırığı saptandı. Vital bulguları; TA: 105/62 mmHg (inotrop veya vazopressör desteği almıyor), kalp hızı: 130/dk. veSpO_2 %97 (oda havasında) olarak izlendi. ISS (injury severity score): 47 olarak hesaplandı. Laboratuvar tetkiklerinde acil servise geliş Hb: 10.8 g/dL, Hct: %31.7, Plt:110.000 10^3/µL, Laktat: 4,5 mmol/L. Yapılan tüm vücut bilgisayarlı tomografi görüntülemelerinde, sol frontal ve temporal lob anterior bölümünde parankimal ve epidural kanama, solda daha fazla olmak üzere frontal lobta pnömosefali odakları, frontal kemikte çoklu ve parçalı kırık, nazal kemikte ince fissür hattı, sol zigomatik arcusta kırık hattı, frontalde solda daha belirgin olmak üzere subgaleal hematom, solda zigomatik bölgede ciltte laserasyon ve ciltaltı amfizemleri, arkus aorta distal bölümü ile desenden parçanın proksimal bölümünde aortik diseksiyon, sağ hemitoraksta çoklu kot fraktürleri, sol femurda subtrokanterik fraktür, sağ distal tibia ve fibula fraktürü mevcut idi. Toraks BT'sinde aort diseksiyonu saptanan hasta hızla kalp damar cerrahisi tarafından değerlendirildikten sonra acil TEVAR girişimi planlandı. Hasta ivedilikle ameliyat odasına alındı. Rutin anestezi monitorizasyonu sonrası, invaziv arter kanülü ve sağ juguler venöz santral kateter yerleştirildi. Preoksijenize edilen hasta, İV 200 mcg fentanil, 200 mg propofol ve 50 mg rokuronyum ile anestezi indüksiyonu sonrası entübe edildi. Anestezi idamesinde sevofluran, oksijen ve hava (%2, %50, %50) ve remifentanil infüzyonu kullanıldı. Mekanik ventilasyon volüm kontrollü mod ile sağlandı. Başlangıçta mevcut olan taşikardi (120/dk.) ve hipotansiyon (70/30 mmHg), 30 dk. sonra geriledi (90/ dk., 100/50 mmHg). İşlem sırasında hemodinami stabil seyretti, inotrop veya vazopressör gerektirmedi. Ameliyat sırasında 2 ünite ERT, 1 ünite TDP replasmanı yapıldı. İşlem sonunda Hb 11.1 mg/dl, CVP 5 mmHg, idrar çıkışı normal idi. Arkus aorta distal bölümü ve desenden parçanın proksimal bölümüne greft implan-

tasyonu yapıldı. TEVAR sırasında intrakraniyal kanama bulgusu da göz önüne alınarak hastaya 1250 IU heparin uygulandı. Açık ameliyat yapılsaydı heparin dozu 300 U/kg olacaktı. İşlem sonrasında heparinin nötralizasyonuna gerek duyulmadı (ACT<200). İşlem sonrası ortopedi hekimleri olgunun femur subtrokanterik fraktürüne yönelik çivi, distal tibia fraktürüne yönelik ise plak ve external fiksatör uyguladı. Ameliyatın bitiminde, hasta entübe şekilde anestezi yoğun bakım ünitesine yatırıldı. Hastanın postoperatif beyin BT'si çekildikten sonra beyin cerrahisi, kalp damar cerrahisi, genel cerrahi ve ortopedi birimleri ile konsülte edilerek, önerilen tedavilere uyuldu. Yoğun bakımda günlük arteryel kan gazı, serum elektrolit, hemogram, koagulasyon ve biyokimyasal kontrollerine uygun olarak gerekli kan ürünü replasmanı ve diğer tedavileri sürdürüldü. Hasta yoğun bakım yatışının 2. gününde ekstübe edildi. Bilinç açık koopere olan hasta maske O_2 desteğinde izleme alındı. Postoperatif 3. günde oral sulu gıda ile beslenmesi başlandı. Yaklaşık 1 hafta yoğun bakım takibi sonrası ortopedi ve travmatoloji servisine devredildi. Ortopedi ve travmatoloji servisinde 6 gün boyunca izlenen hasta gerekli tüm tedavileri tamamlandıktan sonra evine taburcu edildi.

TARTIŞMA

Toraksın künt travmasına bağlı torasik aort diseksiyonları ender görülen fakat ciddi ve yaşamı tehdit eden durumlardır. Torasik aort yaralanmalarının %96.7'sinden motorlu taşıt kazaları, kalan %3.3'ünden yüksekten düşmeye bağlı künt travma sorumludur [2]. Künt travmatik aort yaralanmalarında hasar; aorttaki kayma ve gerilme kuvvetleri [6], hızlı deselerasyon ve artmış intravasküler basınç [7], aortun ön göğüs duvarı ile vertebralar arasında sıkışması nedenleriyle meydana gelebilmektedir [8]. Yaralanma, tüm aort boyunca, çıkan aorttan iliak bifurkasyona kadar meydana gelebilir fakat tipik olarak duvar gerilim kuvvetinin yüksek olduğu aortik istmustta meydana gelir. Künt travmaya bağlı aort yaralanmasında mekanizmayı açıklayan 3 ana teori bulunmaktadır [9]. İlk teoriye göre; aortik istmus, sabit olmayan arkus aortadan sabit inen aorta geçiş bölgesinde yer alır ve hızlı bir deselerasyon sırasında bu bölge zıt yönlere gitmeye yatkındır. Bu durum da intimada yırtılmaya yol açabilir. İkinci teoriye göre, aortik istmus dokusu daha zayıf gerilme kuvveti nedeniyle yapısal olarak yaralanmaya karşı daha savunmasızdır [10-11]. Üçüncü teoriye göre ise, toraksın kemik yapıları ile omurga arasındaki bir kompresyon noktası, deselerasyon travması sırasında aortu sıkıştıracak şekilde etki eder [10-12].

Travmatik aort yaralanması sıklıkla 1'den fazla organ yaralanması ile birlikte görülür. Fabian, Wahl ve ark. hastaların %51'inde kapalı kafa travması, %24'ünde intrakraniyal kanama, %46'sında çoklu kot fraktürü, %38'inde pulmoner kontüzyon, %20'sinde üst ekstremite fraktürleri, %31'inde pelvik yaralanma, %22'sinde karaciğer yaralanması, %4'ünde vertebral kemik fraktürü, %4'ünde medulla spinalis yaralanmaları ve %13'ünde maksillofasiyal travma gibi yüksek oranlarda çoklu travma bildirmişlerdir[13-14]. Bizim olgumuzda da benzer şekilde kafa travması, intrakranial hemoraji, maksillofasial kırıklar, çoklu kot fraktürü, pulmoner kontüzyon, femur ve tibiada kırık mevcuttu. Tüm bu bilgiler göz önüne alındığında, travmatik aort yaralanması bulunan multitravma hastalarında travmanın ciddiyetini değerlendirmek aort hasarından şüphe etmek açısından kritiktir ve Injury Severity Score (ISS) kullanılarak belirlenebilir. ISS skoru 16'dan büyük ise major travma olarak değerlendirilir. Fabian ve ark.'nın yürüttüğü prospektif çalışmada aort hasarı bulunan tüm hastalarda yüksek ISS değerleri yani major travma mevcuttu. Bu olgularda ISS aralığı 17-66 olarak bulunmuştu. Ortalama ISS değeri ise 42.1 idi. [13]. Olgumuzun ISS değeri ise bu ortalamadan da büyük olarak 47 olarak hesaplanmıştı.

Tanıda en önemli faktör şüphedir. Hastalar genellikle eşlik eden diğer yaralanmalara dair semptomlar gösterirler. Diseksiyonun kendisine ait olabilecek en sık semptom; adventisya tabakasının diseksiyonu veya gerilmesine bağlı retrosternal veya interskapular ağrıdır. Daha ender olarak hematoma bağlı disfaji, dispne, ses kısıklığı gibi bası semptomları görülebilir. Tanı için akciğer grafisi, toraks BT, transözofageal ekokardiyografi kullanılabilir. Kesin tanı ise anjiyografi ile konur. Yaralanmaların ciddiyetinin değerlendirilmesi uygun acil cerrahi tedaviyi belirlemek için de kritik öneme sahiptir.

TEVAR özellikle stabil olmayan çoklu travmalı hastalarda tercih edilmektedir. Torasik aort yaralanmalarında özellikle istmus bölgesi etkilediğinden, bu alana yerleştirilen endovasküler grefttin proksimal ve distal tutunma bölgeleri çoğunlukla yeterli olmaktadır. Bu sayede diseksiyon alanı, stent greft ile kolaylıkla kapatılabil-

mektedir. 2001'den beri künt aort yaralanmaları için açık cerrahiye üstün olduğu görülmektedir[15]. TEVAR sırasında torakotomi gibi büyük kesi oluşturulmaz, intraoperatif kan kaybı daha azdır ve özellikle medulla spinalis başta olmak üzere diğer organlarda görülebilecek iskemik olaylar riski daha az olur. Ayrıca yüksek doz heparinle sistemik antikoagülasyon gerektirmediğinden intrakranial veya abdominal kanamanın eşlik ettiği olgularda faydalıdır. Bizim olgumuzda da açık cerrahiye göre daha düşük doz heparin uygulanmış ve protamin sülfat ile nötralizasyone gerek duyulmamıştır. Böylece hem heparinin hem de protaminin yüksek dozla ilişkili yan etkilerinden kaçınılmıştır. Ayrıca, TEVAR işlemi postoperatif rehabilitasyon açısından da açık cerrahiye oranla daha iyi sonuçlara sahiptir.

SONUÇ

Yüksekten düşme ve trafik kazalarında oluşan çoklu travmaya eşlik eden aort yaralanmalarının erken tanısında klinik şüphe ve radyolojik görüntüleme önemli rol oynar. Kafa travması, intrakranial kanama, çoklu fraktürün (kot, pelvis ve ekstremite) birlikte olduğu ISS skorlaması yüksek (> 16) multitravma olgularına, klinik şüphe ile travmatik aort diseksiyonunun da eşlik edebileceği mutlaka akla getirilmelidir. Travmaya eşlik eden diğer bulgular, bu şüpheyi doğrulayıcı fizik muayene bulgularını maskeleyebilmekte ya da ender de olsa olgumuzda olduğu gibi, olgu asemptomatik olabilmektedir. Özellikle ISS skorlama sistemi yüksek olgularda, klinik şüphe ile tüm vücut bilgisayarlı tomografi görüntüleme protokolü uygulanması, torasik aort diseksiyonu tanısının atlanmasını önleyerek erken tanı ve tedaviye olanak sağlayacaktır.

Majör çoklu fraktürlü ve kafa içi kanamalı travmaya eşlik eden torasik aort diseksiyonu olgularının tedavisinin, açık cerrahi ile tamire oranla daha düşük antikoagülasyon gerektirmesi, daha az kan kaybına neden olması, daha iyi hemodinamik stabilite sağlaması ve optimal distal perfüzyon sağlayarak iskemi riskini düşürmesi nedenleri ile TEVAR uygulanmalıdır düşüncesindeyiz.

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Olgu Sunumu/*Case Report*

Cutis Laxa Tip-IC Sendromlu Bir Çocuk Hastada Ameliyathane Dışı Anestezi Deneyimi

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Experience Of Outpatient Anesthesia in a Pediatric Patient With Cutis Laxa Type-IC Syndrome

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ÖZ

Urban-Rifkin-Davis sendromu olarak da bilinen Cutis Laxa Tip 1C erken çocukluk döneminde yaygın bağ dokusu bozukluğu ile karakterize otozomal resesif ender görülen bir hastalıktır. Bu çalışmamızda, Cutis Laxa'lı çocukta sedasyon ile ameliyathane dışı anestezi uygulaması deneyimimiz sunulmuştur.

Anahtar kelimeler: *Cutis Laxa sendromu, sedasyon, çocuk hasta*

ABSTRACT

Cutis Laxa Type 1C, also known as Urban-Rifkin-Davis syndrome, is an autosomal recessive disease characterized by common connective tissue disorder in early childhood. In this study, our experience of outpatient anesthesia with sedation in a child with Cutis Laxa is presented.

Keywords: *Cutis Laxa Syndrome, Sedation, Pediatric Patient*

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GİRİŞ

Urban-Rifkin-Davis sendromu olarak da bilinen Cutis Laxa Tip-IC erken çocukluk döneminde pulmoner amfizem, periferal pulmoner arter stenozu, inguinal herni, visseral divertiküller ve yaygın bağ dokusu bozukluğu ile karakterize otozomal resesif ender görülen bir hastalıktır.[1] Pulmoner bulgular sonucu solunum sıkıntısı ve solunum yetmezliği gelişebilir. Anestezik yaklaşım, bu durumun daha da ağırlaşmasına neden olabilir. Periferik pulmoner stenoz tanısı olan Cutis Laxa Tip-IC'li 5 yaşında bir çocuk hastada katater anjiyografi laboratuvarında görüntüleme amacı ile anjiyo planlandı. Bu çalışmamızda, anjio planlanan Cutis Laxa'lı çocukta sedasyon ile ameliyathane dışı anestezi uygulaması deneyimimiz sunulmuştur.

OLGU SUNUMU

Beş yaşında, 18 kg ağırlığında, 105 cm boyunda Cutis Laxa Tip-IC sendromu tanılı bir kız çocuğuna periferik pulmoner stenoz tanısı ile kateter anjiyografi yapılması planlandı. Bu amaçla hastaya ameliyathane dışı sedoanaljezi uygulandı. Cutis Laxa tanısını 6 aylık iken aldığı öğrenildi. Fizik muayenede gevşek ve ince cilt dokusu, el ve ayak dorsal yüzlerde ve göz altlarında yaygın ödem vardı. Preoperatif değerlendirmede kalp tepe atımı 130/dk., kan basıncı 95/60 mmHg, vücut sıcaklığı 37°C olarak ölçüldü. Hastanın vital bulguları stabildi. Biyokimyasal testlerde herhangi bir anormal sonuca rastlanmadı. Olgumuzda göğüs radyografisinde bir patoloji yoktu. Sedasyon öncesi zor entübasyon şartları sağlandıktan sonra damar yolu erişimi zor olan hastaya 0.06 mg/kg midozolam, 0,5 mg/kg ketamin, 0.01 mg/kg atropin im olarak uygulandı. Anjiyografi laboratuvarında 24G intravenöz kanül ile damar yolu açıklığı sağlandı. 2 mL/kg/sa'den isolyte-P infuzyonu başlandı. EKG, periferik oksijen satürasyonu (SpO_2), noninvazif kan basıncı monitörizasyonu yapıldı. 5 lt/dk.'dan maske O_2 verildi. 1 mg/kg iv bolus pantoprazol yapıldı. Hastanın işlem boyunca hareketsiz kalması için 1 mg/kg/sa propofol infizyonu başlandı. Sedasyon sonrası SpO_2 %99 olan hastada, solunum distresi gelişmesi ile SpO_2 %80'e düştü. Jaw Thrust manevrası yapıldı. Yüzde 100 oksijen ile ambu maske ventilasyonuna geçildi. Trakeal stridoru olan ve ürtiker gelişen hastaya 2 mg/kg metilprednisolon verildi. Salbutamol ve adrenalin inhalasyon yoluyla uygulandı. İşlem boyunca SpO_2 %92-100 arasında, kalp atım hızı 130-140/dk. ve kan basıncı 115/70 mmHg arasında seyretti. İşlem 45 dk. sürdü ve komplikasyonsuz sonlandırıldı. Hasta pediyatri yoğun bakım ünitesinde 6 saat takip edilerek sorunsuz servise verildi. İkinci gün sorunsuz olarak taburcu edildi.

TARTIŞMA

Bu olgu sunumunda, periferik pulmoner stenoz tanısı olan Cutis Laxa Tip-IC sendromlu 5 yaşında kız çocuğu hastaya katater anjiyografi yapılmak üzere sedoanaljezi ile ameliyathane dışı anestezi uygulaması sunulmuştur.

Cutis Laxa gevşek deri ile karakterize bir bağ dokusu hastalığıdır. Klinik ve genetik olarak heterojendir.[2] Geçmişte Cutis Laxa tanısı klinik olarak konulurken, günümüzde artık bozukluğun molekül temeline göre alt tiplere ayrılmaktadır.[3] Bizim olgumuz da otozomal resesif geçişli Tip-IC sendromudur. Prevalansı tam olarak bilinmemekle birlikte, çok ender (<1:1.000.000) görülmektedir.[1] Bu sendromla ilişkili solunumsal ve kardiyovasküler bulgular bu hasta popülasyonunun perioperatif yönetimi için dikkatli bir biçimde ameliyat öncesi değerlendirmeyi zorunlu kılar. Cutis Laxa Tip-IC erken çocukluk döneminde pulmoner amfizem, perifer arter stenozu, inguinal herni, gastrointestinal sistem divertikülleri gibi yaygın bağ dokusu bozukluğu hastalığıdır.[1] Hastalarda deri semptomlarına ek olarak etkilenen kişilerde eklem gevşekliği, hipotoni, büyüme geriliği, pulmoner, gastrointestinal ve üriner sistemi etkileyen ciddi komplikasyonlar gelişebilir. Kardiyovasküler tutulum nispeten hafiftir.[3] Bu hastalarda anormal deri bulguları damar yolu erişimini zorlaştırabilir. Bu nedenle damar yolu erişiminin zor olduğunu akılda tutularak işlem sırasında stres artışına bağlı pulmoner arter basıncının yükselebileceği ve kardiyak yönden hemodinamiyi bozabileceği göz önünde bulundurularak, buna göre önlem alınmalıdır.[4] Bu nedenle hastamızda damar yolu erişiminin zor olacağını öngörerek intramuskuler sedasyon uyguladıktan sonra damar yolu açıklığını sağladık. Cutis Laxa Tip-IC'li hastalarda mikrognati, alnın çekilmesi, geniş ön fontaneller, hipertelorizim de olabilir.[3] Olgumuzda kraniofasial anomali yoktu.

Etkilenen kişiler akciğerdeki kistik değişikliklerin yanı sıra atelektazi gelişmesiyle ilgili şiddetli solunum güçlükleri geliştirebilirler. Bazı durumlarda pulmoner sorunlar, pulmoner arterin daralması, diyafragmatik herni oluşumu, trakeomalezi varlığıyla daha da kötüleşebilir bu da potansiyel olarak hava yolu pasajında kollapsa neden olabilir. Şiddetli amfizem gelişebilir. Sonuç olarak, bu hastalarda solunum yetmezliği gelişebilir.[3] Pulmoner arter hipertansiyonu ya da kor pulmonaleden hasta korunmalıdır.[4] Kullanılan anestezik ajanlar pulmoner ve kardiyovasküler sorunların daha da ağırlaşmasına neden olabilir. Hastamız preoperatif, pediyatrik göğüs hastalıkları uzmanı tarafından konsülte edilip, göğüs radyografisi normal olarak değerlendirildi. Uygulanan sedasyon sonrası hastada solunum sıkıntısı başladı, hasta $Sp0_2$ %80 olarak desatüre oldu ve maske oksijen ventilasyonundan ambu maske ventilasyonuna geçilerek solunum desteklendi. Atropin ve selektif B2 adrenerjik bronkodilatör ilaçlar kullanıldı.

Sonuçta, Cutis Laxa Tip-IC'li hastalarda anestezik yönetim kardiyak ve pulmoner değerlendirmeyi içermelidir. Aort anevrizması ve pulmoner amfizem dışlanmalıdır.[4] Bronşiyolitis, pnömoni, pozitif basınçlı ventilasyon, trakeomalezi, pulmoner hipertansiyon ve konjenital diafragmatik herni, respiratuvar problemleri arttırabilir.[1]

Cutis Laxa Tip-IC sendromlu hastalar sıklıkla tanısal ve cerrahi prosedürlere gereksinim duyarlar, ancak bu hastalar için tanımlanmış özel anestezik tekniklerin değerlendirilmesi ve göz önünde tutulacak özel durumlar literatürde son derece enderdir. Karapurkar ve ark. yaptıkları çalışmada, genel anestezi altında konjenital lober amfizem ve akciğer kisti için lobektomi ameliyatı geçiren beş çocuktan birinde ekstübasyon sonrası şiddetli hırıltı ve interkostal çekilmeler olduğunu ve hastaya hidrokortizon, aminofilin ve terbutalin verilmesine rağmen, yanıt alınamayarak yine entübe edildikten ancak 48 saat sonra extübe edildiğini bildirmişlerdir. Cutis Laxa tanısı konulan hastalarda, pulmoner amfizemin bu hastalıkla ilişkili olduğunu belirtmişlerdir.[5] Olgumuza sedoanaljezi yapıldı. Hırıltı, interkostal çekilmesi olan hastamıza salbutamol ve adrenalin inhalasyon uygulamasına ve ambu maske ventilasyonuna (%100 O_2 ile) tedavisine yanıt verdi. Bildiğimiz kadarıyla kateter anjiyo laboratuvarında görüntüleme amacıyla periferik pulmoner arter stenozlu Cutis Laxa Tip-IC sendromlu hastaya sedasyon uygulanması daha önceden yayınlarda bildirilmemiştir.

GİS bulguları olarak divertikül ve gastroözefagiyal reflü olabilir.[3] Pandey ve ark.'nın olgu sunumunda, Cutis Laxa'lı hastalarda gastroözefagial reflü ile ilgili aspirasyon profilaksisi vurgulanmamış olmasına rağmen, olgularında bu durumu öngörerek bir hafta önceden domperidon başladıklarını belirtilmiştir .[6] Bizim hastamızda da gastroözefagial reflü olabileceği öngörülerek koruma amaçlı pantoprazol yapılmıştır. Ayrıca bu hastalarda mesane divertikülleri de olabilir. Bizim hastamızda da mesane divertikülü olduğundan mesane sonda uygulaması yapılmıştır.

Tanısal ve cerrahi müdahale gerektiren özellikli bu grup hastaların takibinde, bu alanda uzmanlaşmış ve tecrübeli anesteziyologların bulunmasının, mortalite ve morbidite üzerine etkisi büyük olacaktır.

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Yayın Politikaları ve Yazım Rehberi

www.gkdaybd.org
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AMAÇ KAPSAM

Derginin amacı; göğüs, kalp ve damar cerrahisi anestezisi ve yoğun bakımıyla ilgili yeni gelişmeleri içeren klinik ve deneysel çalışmaları yayınlayarak ilgili hekimlerle paylaşmaktır. Ayrıca konusunda deneyimli yazarların derlemelerinin ve olgu deneyimlerinin sunulmasıdır.

AÇIK ERİŞİM POLİTİKASI

Logos Yayıncılık, yayınladığı dergilerde, Budapeşte Açık Erişim Bildirgesinde yer alan, hakemli dergi literatürünün açık erişimli olması girişimini destekler ve yayınlanan tüm yazıları herkesin okuyabileceği ve indirebileceği bir ortamda ücretsiz olarak sunar.

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Bu etik ilkeler, COPE (Committee on Publication Ethics) tarafından hazırlanan yönerge esas alınarak, Logos Tıp Yayıncılık tarafından benimsenmiş ve paydaşlar tarafından da benimsenmesi önerilerek, bir kısmı aşağıda sunulmuştur. Detaylı bilgi için web sayfamızı incelemeniz önerilir.

Bilimsel araştırma ve yayın etiğine aykırı olduğu düşünülen eylemlerden bazıları:

- İntihal: Başkalarının özgün fikirlerini, metotlarını, verilerini veya eserlerini bilimsel kurallara uygun biçimde atıf yapmadan kısmen veya tamamen kendi eseri gibi göstermek,
- Sahtecilik: Bilimsel araştırmalarda gerçekte var olmayan veya tahrif edilmiş verileri kullanmak
- Çarpıtma: Araştırma kayıtları veya elde edilen verileri tahrif etmek, araştırmada kullanılmayan cihaz veya materyalleri kullanılmış gibi göstermek, destek alınan kişi ve kuruluşların çıkarları doğrultusunda araştırma sonuçlarını tahrif etmek veya şekillendirmek,
- Tekrar yayım: Mükerrer yayınlarını akademik atama ve yükselmelerde ayrı yayınlar olarak sunmak,
- Dilimleme: Bir araştırmanın sonuçlarını, araştırmanın bütünlüğünü bozacak şekilde ve uygun olmayan biçimde parçalara ayırıp birden fazla sayıda yayımlayarak bu yayınları akademik atama ve yükselmelerde ayrı yayınlar olarak sunmak,
- Haksız yazarlık: Aktif katkısı olmayan kişileri yazarlar arasına dâhil etmek veya olan kişileri dâhil etmemek, yazar sıralamasını gerekçesiz ve uygun olmayan bir biçimde değiştirmek, aktif katkısı olanların isimlerini sonraki baskılarda eserden çıkartmak, aktif katkısı olmadığı halde nüfuzunu kullanarak ismini yazarlar arasına dâhil ettirmek,
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İNTİHAL POLİTİKASI

İntihal (aşırma) kasti olup olmaması önemsenmeksizin, bir etik ihlalidir. Bu sebeple yayın politikaları gereği Logos Yayıncılık tüm dergilerinde, yayınlanacak olan bütün çalışmalar için, intihal denetimini zorunlu kılar.

Dergilerimize yapılan tüm başvurularda kör hakem değerlendirmesini tamamlayan çalışmalar, Turnitin veya iThenticate yazılımları aracılığıyla tarafımızdan değerlendirmeye alınır.

Yayın Kurulu, dergiye gönderilen çalışmalarla ilgili aşırma, atıf manipülasyonu ve veri sahteciliği iddia ve şüpheleri karşısında COPE kurallarına uygun olarak hareket edebilmektedir.

TELİF HAKKI DEVRİ

Kişiler çalışmalarını gönderirken, çalışmanın kısmen veya tamamen, herhangi başka bir platformda daha önce yayınlanmadığı, yayın için değerlendirmede bulunmadığını beyan etmekle yükümlüdür. Aksi bir durumla karşılaşıldığında ilgili yaptırımlar uyarınca yazar durumdan sorumlu tutulacaktır.

Yazarlar çalışmalarının telif hakkından feragat etmeyi kabul ederek, değerlendirme için gönderimle birlikte çalışmalarının telif hakkını Göğüs-Kalp-Damar Anestezi ve Yoğun Bakım Derneği'ne devretmek zorundadır. Bu devir, yazının yayına kabulü ile bağlayıcı hale gelir. Basılan materyalin hiçbir kısmı yayınevinin yazılı izni olmadıkça bir başka yerde kullanılamaz.

Yazarların telif hakkı dışında kalan bütün tescil edilmemiş hakları, çalışmayı satmamak koşulu ile, kendi amaçları için çoğaltma hakkı, yazarın kendi kitap ve diğer akademik çalışmalarında, kaynak göstermesi koşuluyla, çalışmanın tümü ya da bir bölümünü kullanma hakkı, çalışma künyesini belirtmek koşuluyla kişisel web sitelerinde veya üniversitesinin açık arşivinde bulundurma hakkı gibi hakları saklıdır.

Dergimize çalışma gönderecek yazarlar, "Telif Hakkı Devir Formu" belgesini doldurmalıdır. Yazar(lar) doldurdukları formu ıslak imza ile imzalamalıdır. İmzalanan form tararanarak sistem üzerinden çalışma gönderim adımlarında ek dosya yükleme seçeneği ile yüklenmelidir.

ÇIKAR ÇATIŞMASI

Ekonomik veya kişisel fayda sağlanan durumlar çıkar çatışmasını meydana getirir. Bilimsel sürecin ve yayınlanan makalelerin güvenilirliği, bilimsel çalışmanın planlanması, uygulanması, yazılması, değerlendirilmesi, düzenlenmesi ve yayınlanması sırasında çıkar çatışmalarının objektif bir şekilde ele alınmasıyla doğrudan ilişkilidir.

Makaleler hakkında son kararı veren bu editörlerin de karar verecekleri konulardan hiçbiri ile kişisel, profesyonel veya finansal bağlarının olmaması gerekir. Kişiler makalelerin etik ilkeler çerçevesinde değerlendirilebilmesi ve bağımsız bir süreç yürütülebilmesi için olası çıkar çatışmalarından yayın kurulunu bilgilendirmelidir.

Yayın kurulumuz bütün bu durumları göz önünde bulundurarak değerlendirme sürecinin tarafsız bir şekilde yürütülebilmesi için özverili bir şekilde çalışmaktadır.

Daha detaylı bilgi almak ve çıkar beyan etmek için web sayfamızı, çıkar çatışması formunu ve linki inceleyebilirsiniz.

YAZIM REHBERİ (SEKME)

KÖR HAKEMLİK VE DEĞERLENDİRME SÜRECİ

Göğüs-Kalp-Damar Anestezi ve Yoğun Bakım Derneği Dergisine (GKDAYD), gönderilen tüm çalışmalar çift-kör hakem değerlendirmesine tabi tutulmaktadır. Gönderilecek her çalışmayı, alanında uzman, en az iki hakem değerlendirir. Makalelerin hızlı bir şekilde değerlendirilebilmesi için editörler tarafından her türlü çaba gösterilir. Bütün makalelerin değerlendirme süreçlerinde son karar yetkisi editördedir. Değerlendirme sürecine ait alt başlıklar aşağıda verilmiştir. Detaylı bilgi için web sayfamızı ziyaret edebilirsiniz.

İlk Değerlendirme
Ön Değerlendirme Süreci
Hakem Değerlendirme Süreci
Hakem Raporları
İstatistik İnceleme
Yayın Basım Süreci

YAZARLAR İÇİN KONTROL LİSTESİ

- Çalışmanın içinde yazar adı, kurum bilgisi, etik kuruluna dair teşekkür yazısı vb olmadığından emin olunuz. Çalışmanızın hakem değerlendirmesinde "blind review" ilkesince tarafsız bir şekilde ele alınabilmesi açısından bu önemlidir.
- Çalışmanızın konu bakımından yeterli ve uygun bulunması durumunda intihal denetimine alınacağını unutmamalı ve çalışmayı hazırlarken intihal kapsamına girecek alıntılar yapmaktan kaçınmalısınız.
- Makaleniz; tez, bildiri özeti, poster vb bir çalışmadan üretilmişse, bunu tarihini belirterek dip not olarak verdiğinizden emin olun.
- Çalışmanızın telif hakkı devir formunu sisteme yüklemeden bir sonraki aşamaya geçemeyeceğiniz için lütfen formu doldurun ve sisteme yükleyin.
- Çalışmanız size revizyon için geri geldiğinde kontrolünüzü yaptıktan sonra, çalışmanızın başlık ve özet kısmında değişiklik olmuş ise, makale adımlarında bu içeriği güncelleyiniz.
- Çalışmanızın yayınlanması için yayınevi tarafından size gelen son bilgilendirmede çalışmanızı dikkatlice kontrol ettiğinizden emin olmanız gerekmektedir. Çalışma yayınlandıktan sonra üzerinde herhangi bir değişiklik yapmak mümkün olmayacaktır.

MAKALE HAZIRLAMA

Yazılar tercihen Microsoft Word programı kullanılarak yazılmalıdır. Makaleler 12 punto Times New Roman karakterleri kullanılarak yazılmalıdır. Yazılar A4 (21x29.7 cm) beyaz dosya kağıdının bir yüzüne, tüm yazı boyunca (başlık, Türkçe ve İngilizce özetler, makale, kaynaklar, tablolar ve altyazılar da dahil olmak üzere) çift satır aralıklı olarak ve sayfanın tüm kenarlarından üçer santimlik boşluk bırakılarak (Kelime işlemcinin sayfa düzeni ayarlarından) yazılmalıdır.

Journal Agent Online Makale Toplama ve Değerlendirme Sistemi'ne yazı online yüklenirken Makale ve Özet Bilgileri, Kurum Bilgileri, Yazar Bilgileri, Sorumlu Yazar Bilgileri, Makale Başlığı, Makale Türkçe ve İngilizce Özeti, Türkçe ve İngilizce Anahtar Kelimeler, Editöre Not, Dosya Yükleme (Tam Metin – Kaynaklar- Tablo - Resim - Grafik - Editöre not) sisteme ayrı ayrı aşamalarla kaydedilmektedir.

Dergimize çalışma gönderecek yazarların ORCID numaralarını www.orcid.org adresinden edinerek bu aşamadaki ilgili alanda belirtmeleri rica edilmektedir. Özet ve tam metin içinde çalışmaya ait kişi ve kurum bilgileri bulunmamalıdır. Dosyalar aşağıdaki sıra ile yüklenmelidir.

1. **Elektronik makale dosyası (Tam Metin)** büyük harfle makale başlığı ile isimlendirilmelidir. Sadece sırasıyla **"Başlık (Türkçe – İngilizce)- Kısa Başlık (Türkçe –İngilizce)", "Giriş", "Gereç ve Yöntem", "Bulgular", "Tartışma", "Teşekkür (varsa) – Çıkar Çatışması"** içermelidir. Bölümlerin her biri ayrı sayfalarda başlayacak şekilde sunulmalıdır. Yazı bölümlerinin başlıkları büyük harfle sayfanın sol başında yer almalıdır Tüm sayfalar sağ alt köşeden sırayla numaralandırılmalıdır.
2. **Kaynaklar** dosyası ayrıca kaydedilmelidir.
3. **Tablolar** iki satır aralıklı olarak her biri ayrı bir sayfada hazırlanmalı ve her tablonun üstünde numarası ve başlığı olmalıdır. Tabloda kısaltmalara yer verilmişse bu kısaltmaların açılımı altyazı şeklinde tablonun altında ve alfabetik sıraya göre yer yazılmalıdır. Daha önce basılı veya elektronik olarak yayınlanmış tablolardan yararlanıldığında hem yazarı hem de basımevinden yazılı izin alınmalıdır ve bu, dergi editörlüğüne faks veya posta ile gönderilmelidir.
4. **Şekil, grafik, resim ve altyazıları** iki satır aralıklı olarak ayrı bir sayfaya yazılmalıdır. Metin içerisindeki sıralarına göre numaralandırılmalı ve şekil, grafik ve resimlerde kısaltmalara yer verilmişse, bu kısaltmaların açılımı altyazının altında ve alfabetik sıraya göre yazılmalıdır. Daha önce basılı veya elektronik olarak yayınlanmış şekil, grafik ve resimlerden yararlanıldığında hem yazarı hem de basımevinden yazılı izin alınmalıdır ve bu, dergi editörlüğüne faks veya posta ile gönderilmelidir.
5. **Telif hakkı devir formu**

   Yazarlar; çalışmanın içindeki materyalin tamamı ya da bir kısmının daha önce herhangi bir yerde yayınlanmadığını, ve halihazırda da yayın için başka bir yerde değerlendirilmede olmadığını beyan etmelidirler.

Her yazar, araştırmaya, içeriğinin sorumluluğunu paylaşmaya yetecek boyutta katıldığını beyan etmelidir. Bu katılım şu konularda olabilir:

- Deneylerin konsept ve dizaynlarının oluşturulması,
- Verilerin toplanması, analizi ya da ifade edilmesi;
- Makalenin taslağının hazırlanması veya bilimsel içeriğinin gözden geçirilmesi
- Makalenin basılmaya hazır son halinin onaylanması.
- Etik kurul onam yazısı
- Orijinal makaleler ve derlemeler 10, olgu sunumu 4, editöre mektuplar 1 sayfayı geçmemelidir (kaynaklar, tablo ve grafikler hariç).

Yazılarda, konu bölümleri ve içerikleri aşağıda belirtildiği gibi olmalıdır.

Başlık: Mümkün olduğunca kısa bir başlık kullanılmalıdır. Yazının başlığı araştırma ve inceleme yazılarında 95 karakteri (her harf ve boşluk bir karakter sayılır), olgu sunumları, mektuplar ve cerrahi teknik yazılarında ise 80 karakteri geçmemelidir. Başlıkta kısaltma kullanılmamalıdır. Başlık Türkçe ve İngilizce olarak yazılmalıdır. Başlığın hemen altına 40 karakteri geçmeyecek bir kısa başlık eklenmelidir.

Çalışmayı destekleyen fon ve kuruluşlar burada belirtilmeli, çalışmanın herhangi bir kongrede sunulması planlanıyor ya da daha önce sunulmuş ise kongre adı, zaman (gün-ay-yıl) ve yer belirtilerek yazılmalıdır.

Özetler, araştırma yazılarında 250 kelimeyi geçmemelidir. Özetlerde başlık kullanılmamalıdır (başlığın İngilizcesi Başlık sayfasına yazılmalıdır). Türkçe (Amaç, Gereç ve Yöntem, Bulgular, Sonuç) ve İngilizce **"abstract"**lar (Aim, Methods, Results, Conclusion) olmak üzere dört bölümden oluşmalıdır. Olgu sunumları, derlemelerde bu bölümlere gerek olmayıp özetler 100 kelimeyi geçmemelidir. İngilizce başlık ve özet, Türkçe başlık ve özetle eşdeğer olmalıdır Editöre mektuplar ve editöryel yazılar için özet gerekmemektedir.

Özetlerde kısaltma kullanılmasından mümkün olduğunca kaçınılmalıdır. Kısaltma kullanılması mutlaka gerektiğinde, ilk geçtiği yerde parantez içinde tanımlandıktan sonra kullanılmalıdır. Özette kaynak kullanılmamalıdır.

Anahtar Kelimeler: Türkçe ve İngilizce özetin altında "Index Medicus Medical Subject Headings (MeSH)"e uygun olarak en fazla beş adet olmalıdır. Yeni girmiş terimlere uygun "Index Medicus" tıbbi konu başlıklarına ait terimler yoksa var olan terimler kullanılabilir.

Giriş: Çalışmanın genel koşulları, problemin yapısı ve anlamı, çalışma veya gözlemde test edilen özgün amaç veya araştırma amacı belirtilir. Çalışmanın ana ve ikincil amaçları açıkça belirtilmeli ve önceden belirlenmiş alt grup analizleri aktarılmalıdır. Sadece konuyla ilgili kaynaklar kullanılıp, sunulan çalışmanın veri veya sonuçları bu kaynaklara dahil edilmemelidir.

Gereç ve Yöntem: Hastanın bilgilendirilmiş onamı ve Etik kurul onayının alındığı belirtilmelidir. Klinik araştırmalarda bilgilendirilmiş onamın her katılımcıdan alındığına dair bir ifade de eklenmelidir. Deneysel çalışmalarda tüm hayvanların Laboratuar Hayvanlarının Bakım ve Kullanımı Kılavuzuna (Guide for the Care and Use of Laboratory Animals - www.nap.edu/catalog/5140.html) uygun olarak insancıl bir muameleye tabi tutulduğu belirtilmelidir. Çalışmaya uygun koşullar, dışlama ölçütleri ve kaynak popülasyonun tanımı; gözlemde veya deneyde yer alan katılımcılar açıkça belirtilmelidir. Araştırmanın amacıyla ilgili yaş ve cinsiyet gibi değişkenlerin konu ile ilgisi her zaman belirgin olmadığından, yazarlar bir çalışma makalesinde bulunan bu değişkenlerin kullanım amacını açıklamalıdır. Çalışmanın nasıl ve neden böyle bir yöntem kullanılarak yapıldığını belirleyen ana prensipler açık olmalıdır. Yerleşmiş yöntemler için kaynak gösterilmeli, yeni yöntemler için kısa açıklama verilmelidir. Yöntemler, aletler (üretici adı ve adresi parantez içinde yazılır) ve yapılan işlemler, sonuçların yorumlamasına yetecek ölçüde detaylı olarak tanımlanmalıdır. İlaç isimlerinin baş harfleri küçük harf olmalı, ilaçların farmakolojik isimleri kullanılmalı ve ilk geçtikleri yerde parantez içinde "Jenerik adı, Üretici firma adı" ile birlikte yazılmalıdır. Örn: "midazolam (Dormicum, Roche)". Kısaltmalar ilk kullanıldıklarında açık olarak yazılmalı ve parantez içinde kısaltılmış şekli gösterilmelidir. Sık kullanılan kısaltmalardan (iv, im, po ve sc) şeklinde kullanılmalıdır. Birimler Uluslararası Sisteme (SI) göre kullanılmalıdır. Örnek: mg/kg, µg/kg, mL, mL/kg, mL/kg/sa, mL/kg/dk, mmHg vb.

İstatistik yöntemleri, okuyucuların orijinal verilere ulaşıp bildirilen sonuçları değerlendirebilmesi için yeterince detaylı olarak verilmelidir. Bulgular mümkün olduğunca ölçülmeli ve beraberinde uygun hata ve belirsizlik payları (güven aralıkları gibi) belirtilmelidir. Sadece etkilerin boyutları hakkındaki önemli bilgileri aktarmada yetersiz kalan istatistiksel hipotez ölçümlerine -p değerleri gibi- güvenmekten kaçınılmalıdır. P değerleri açık olarak verilmelidir. İstatistik terimleri, kısaltmalar ve semboller tanımlanmalıdır. Bölümün son paragrafında, kullanılan istatistikî analizlerin neler olduğu ve aritmetik ortalama veya orandan sonra (±) işareti ile verilen değerlerin ne olduğu belirtilmelidir.

Bulgular: Çalışmada elde edilmiş olan bulgular, tablo ve görsel malzemeler, metnin içinde öne çıkanlar ve en önemlileri öncelikli olacak şekilde belirli bir mantık sırasıyla yazılmalıdır. Grafik, tablo, resim ve şekiller yazıda geçiş sırasına göre numaralandırılmalıdır. Metin içinde parentez içinde gösterilmelidir. Tablo ve görsel malzemelerde yer alan veriler metnin içinde tekrarlanmamalıdır. Sadece önemli gözlemler vurgulanmalı ya da özetlenmelidir. Tablolar ve şekiller toplu olarak yazının bitiminde kaynaklardan sonra yerleştirilir. Metin içindeki yerinde sadece tablo- grafik üst başlığı ya da şekil-resim-fotoğraf alt başlığı yazılır.

Veriler bulgular bölümünde özetlenirken rakamsal sonuçlar sadece türevsel (örneğin yüzdeler) olarak değil, kesin rakamları belirterek verilmelidir; bunları analiz ederken kullanılan istatistiksel yöntemler belirtilmelidir. Bilimsel olarak uygun olduğu durumlarda, yaş ve cinsiyet gibi değişkenler üzerinden verilerin analizi yapılmalıdır. Tablo ve resimler, yazının tartışmasını açıklamak ve desteklemek için gerekli olanlarla sınırlandırılmalıdır. Tablolara alternatif olarak, üzerinde birçok giriş yapılabilecek türde grafikleri kullanılmalı; grafikte ve tablolarda veriler yinelenmemelidir. İstatistik bölümünde "rasgele", "belirgin", "bağlantılar" ve "örnek" gibi teknik olmayan terimleri kullanmaktan kaçınılmalıdır.

Tartışma: Çalışma sonuçları, yerli literatür de göz önüne alınarak, literatür ile karşılaştırılarak değerlendirilir. Çalışmanın ve bundan çıkan sonuçların yeni ve önemli yönleri vurgulanmalıdır. Giriş ve bulgular bölümünde sunulan veriler ve diğer bilgiler yinelenmemelidir. Deneysel çalışmalarda kısaca ana bulguları özetleyerek başlangıç yapmalı, sonra olası mekanizmalarla açıklamaları incelemeli ve diğer benzer çalışmalarla karşılaştırmalıdır. Çalışmanın sınırlarını belirtmek, gelecekteki araştırmalar ve klinik uygulamalar için bu bulguların ne anlama geleceğini yorumlamak uygun olacaktır.Çalışmanın amaçları sonuçlarla ilişkilendirilmelidir. Ancak, veriler tarafından yeterince desteklenmeyen, ölçülemeyen durum ve sonuçlardan kaçınılmalıdır. Sonuç olarak varılan karar, tartışmanın son paragrafında belirtilmelidir. Yazı, uygun ekonomik verileri ve analizleri içermiyorsa, ekonomik çıkarlar ve maliyetler üzerinde özellikle yorum yapılmamalıdır. Tamamlanmamış bir çalışma üzerinde hak iddia etmekten kaçınılmalı, yeni hipotezler doğrulandıkları zaman belirtilmeli ve açıkça yeni oldukları vurgulanmalıdır.

Teşekkür (varsa): Yazarlık için gerekli ölçütleri yerine getiremeyen; fon alma, sadece teknik yardımda bulunma, veri toplama, araştırma grubunun üst denetçiliğini yapma, yazımda yardım etme veya sadece genel destek sağlayan bölüm şefleri, finans ve materyal desteği sağlama gibi özellik taşıyanlara, ayrıca çalışma ile ilgili teşekkür edilmek isteniyorsa, yazının sonuna "Teşekkür" başlığı adı altında kısa bir paragraf yazılabilir. Katkıda bulundukları veri ve sonuçlardan anlam çıkarılabileceği için, teşekkür edilecek kişilerden yazılı onay alınması gerekir.

Çıkar Çatışması: Yazarlardan makaleleriyle ilgili olarak menfaat çatışması potansiyeli olabilecek herhangi bir mevcut ticari birlikteliği beyan etmelerini istemektedir. (örneğin, istihdam edilme, doğrudan ödemeler, hisse senedine sahip olma, muhafaza etme, konsültanlık, patent lisans ayarlamaları veya onorasyon). Çalışmayı destekleyen tüm finansal kaynaklar da dipnot olarak beyan edilmelidir.

Tablolar ve Grafikler: Grafikler tek bir grafikler dosyasında, tablolar tek bir tablolar dosyasında her bir sayfaya bir tanesi yerleştirilecek şekilde kaydedilebilir. Başlık, açıklama ve dip notları her birinde yerleştirilmelidir.

Tablolar bilgileri öz ve etkili bir biçimde yansıtır-

lar. Ayrıca, istenilen nitelikte ve kesinlikte bilgi sağlarlar. Verilerin metinden daha çok tablolarda verilmesi, genellikle metnin kısaltılmasına olanak sağlar. Tablolar yazı içerisindeki bilginin tekrarı olmamalıdır.

Metinde parantez içinde gösterilmelidir. Kısa-öz bir başlık taşımalıdır. Metindeki geçişlerine göre, her birine, sol üstten başlanıp, Romen rakamı ile sırasıyla numaralandırılarak kısa bir başlık verilmelidir. Zemininde çizgiler olmamalı, zemin beyaz olmalıdır. Tablo içinde yatay ve dikey çizgiler kullanılmamalıdır. Her sütuna kısa veya özet bir başlık verilir. Açıklayıcı bilgiler başlığa değil, dipnotlara konulmalıdır. Kısaltmalar dipnotlarda açıklanmalıdır. Kısaltmaların açılımı altyazı şeklinde tablonun altında ve alfabetik sıraya göre yer almalıdır. Dipnotlarda sırasıyla şu semboller kullanılmalıdır: *, †, ‡, §, ||, ¶, **, ††,‡‡. Standart sapma ve standart ortalama hata gibi istatistik değişkenlerinin ölçüleri tanımlanmalıdır. Her tablo ve grafiğin metin içinde geçtiğinden emin olunmalıdır. Grafiklerin çevresinde çerçeve, zemininde çizgiler olmamalı, zemin beyaz olmalıdır. Tablolar üzerinde istatistiksel verilerin tablo kurallarına uygun olarak verilmesi.

Daha önce basılı veya elektronik olarak yayınlanmış tablo ve grafiklerden yararlanıldığında hem yazarı hem de basımevinden yazılı izin alınmalıdır ve teşekkür edilmelidir. İzin, dergi editörlüğüne faks veya posta ile gönderilmelidir.

Resim, Fotoğraf ve Şekiller: Şekiller profesyonel olarak çizilmeli, fotoğraflanmalıdır. Dijital kamera ile çekilmiş fotoğraflar ve taramalar en az 300 dpi çözünürlükte, 1280x960 piksel boyutunda çekilmiş, jpg veya tiff formatlarında kaydedilmiş olmalıdır. Zorunlu olmadıkça resim üzerinde yazı bulunmamalıdır.

Resim ve şekiller ayrı bir resimler, şekiller, fotoğraflar dosyasında her sayfaya 1 adet yerleştirilmelidir. Her birinde altyazı olarak isim ve numaralandırması yapılmalıdır. Yazının içerisine yerleştirilmemeli, metin içinde kullanım sıralarına göre Arabik rakamla numaralandırılmalı ve metinde parantez içinde gösterilmelidir.

Resmin belirli bölümlerini işaret eden sembol, ok veya harfler kullanıldığında bunlar alt yazıda açıklanmalıdır.

Varsa kısaltmaların açılımı altyazının altında ve alfabetik sıraya göre yer almalıdır.

Mikroskobik resimlerde büyütme oranı ve boyama tekniği açıklanmalıdır.

Daha önce basılı veya elektronik olarak yayınlanmış şekil ve resimlerden yararlanıldığında hem yazarı hem de basımevinden yazılı izin alınmalıdır ve bu, dergi editörlüğüne faks veya posta ile gönderilmelidir.

Yüzü saklanmamış ve tanınabilir şekilde görünen şahısların resimlerini kullanırken kendilerinden yazılı izin alınmalıdır.

Kaynaklar: Kaynakların kullanılmasında seçici davranılmalı ve çalışmayla doğrudan ilgili kaynaklara yer verilmelidir. Türkçe kaynaklardan da yararlanılmalı ve yazarlar bu konuda duyarlı olmalıdır. Derleme makalelerinin kaynak olarak gösterilmesi, okuyucuları literatürün özüne yeterli bir şekilde yönlendirdiği halde, bu makaleler orijinal çalışmayı her zaman doğru bir biçimde yansıtmazlar. Dolayısıyla okuyuculara olabildiğince orijinal araştırma kaynakları verilmelidir. Özetleri kaynak olarak kullanmaktan kaçınmalıdır.

Yazarlar, yayımlanmış makalelerde bazen ortaya çıkan kaynak yanlışlarını en aza indirmek için kaynakları, orijinal makaleler ile karşılaştırmalıdır. Yazarlar, kaynakların ve yazılışlarının doğruluğundan sorumludurlar.

Yazarlar, eğer geri çekme konusu ile ilgili bir kaynak göstermiyorlarsa, atıf yaptıkları kaynakların geri çekilmiş makalelere ait olmadığını kontrol etmekle yükümlüdür. MEDLINE'da dizinlenen dergilerdeki makaleler için, ICMJE geri çekmeler ile ilgili güvenilir bilgi kaynağı olarak PubMed'i (http://www.pubmed.gov) dikkate alır. Yazarlar MEDLINE'da geri çekilen makaleleri şu arama terimi ile tanıyabilirler; kare parantez içindeki pt, yayın tipi (publication type) anlamına gelir: Pubmed'de geri çekilmiş yayın [pt] (retracted publication [pt] in pubmed).

Kollektif ve güncel derleme yazıları dışında kaynak listelerinin çok geniş tutulması yer israfına neden olmaktadır. Genel bir kural olarak araştırma makalelerinde kaynak sayısı en fazla 40, olgu bildirimi 15, derlemelerde en fazla 80 ve editöre mektuplarda en fazla 5 olmalıdır.

Kişisel temaslardaki bilgi-alışverişleri, hazırlık aşamasındaki makaleler ve diğer basılmamış veriler kaynak olarak gösterilmemelidir.

Kaynaklar iki satır aralıklı olarak ayrı bir sayfaya yazılmalıdır. Metinde, tablolarda ve resim alt yazılarında kaynaklar, Arabik numaralarla nitelendirilir. Sadece tablo veya resim alt yazılarında kullanılan kaynaklar, tablo veya resmin metindeki ilk yer aldığı sıraya uygun olarak numaralandırılmalıdır.

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Dergi Makale:

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Tosun Z, Akin A, Guler G, Esmaoglu A, Boyaci A. Dexmedetomidine-ketamine and propofol-ketamine combinations for anesthesia in spontaneously breathing pediatric patients undergoing cardiac catheterization. J Cardiothorac Vasc Anesth. 2006;20:515-19. doi:10.1053/j.jvca.2005.07.018

Ulusal kaynaklar için:

Toraman F, Ustalar Özgen S, Sayın Kart J, Arıtürk C, Erkek E, Güçlü P ve ark. Koroner arter baypas cerrahisinde fentanil ve midazolamın hedef kontrollü infüzyon (hki) şeklinde kullanımının anestezi düzeyi ve ilaç tüketimi üzerine etkileri. GKDA Derg. 2013;19:113-17. doi:10.5222/GKDAD.2013.113

Dergi Ek sayı:

Solca M. Acute pain management: unmet needs and new advances in pain management. Eur J Anaesthesiol. 2002; 19 Suppl 25:3-10.

Kahveci FŞ, Kaya FN, Kelebek N ve ark. Perkutan trakeostomi sırasında farklı havayolu tekniklerinin kullanımı. Türk Anest Rean Cem Mecmuası 2002; Kongre ek sayısı: 80.

Kitap

Murray PR, Rosenthal KS, Kobayashi GS, Pfaller MA. Medical microbiology. 4th ed. St. Louis: Mosby; 2002.

Kitap Bölümü

Meltzer PS, Kallioniemi A, Trent JM. Chromosome alterations in human solid tumors. In: Vogelstein B, Kinzler KW, editors. The genetic basis of human cancer. New York: McGraw-Hill; 2002. p. 93-113.

Tez

Gurbet A. Off-pump koroner arter cerrahisi sonrası morfin, fentanil ve remifentanil'in hasta kontrollü analjezi (HKA) yöntemi ile karşılaştırılması. (Uzmanlık Tezi). Bursa, Uludağ Üniversitesi, 2002.

Elektronik Ortam Kaynağı

United Kingdom Department of Health. (2001) Comprehensive Critical Care Review of adult critical care services. The web site: http://www.doh.gov.uk/compcritcare/index.html

İnternet Adresi

1996 NRC Guide for the Care and Use of Laboratory Animals. Available at:

http://www.nap.edu/readingroom/books/labrats/contents. html. Accessed October 20, 2003.

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Journal Articles

References from International Journals

Tosun Z, Akin A, Guler G, Esmaoglu A, Boyaci A. Dexmedetomidine-ketamine and propofol-ketamine combinations for anesthesia in spontaneously breathing pediatric patients undergoing cardiac catheterization. J Cardiothorac Vasc Anesth 2006;20:515-19. doi:10.1053/j.jvca.2005.07.018

For national references

Toraman F, Ustalar Özgen S, Sayın Kart J, Arıtürk C, Erkek E, Güçlü P ve ark. Koroner arter baypas cerrahisinde fentanil ve midazolamın hedef kontrollü infüzyon (hki) şeklinde kullanımının anestezi düzeyi ve ilaç tüketimi üzerine etkileri. GKDA Derg 2013;19:113-17. doi:10.5222/GKDAD.2013.113

Supplement Issue

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