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Determining Risk Factors for Delirium Among Elderly Patients in The Emergency Care Settings

Acil Servise Başvuran Yaşlı Hastalarda Deliryum İçin Risk Faktörlerinin Belirlenmesi

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ABSTRACT

Objective: *Delirium is reported as a common clinical state among elderly patients seeking care in the emergency departments (ED). However, it is commonly underdiagnosed in the ED. This study aimed to evaluate delirium prevalence and determine the risk factors for developing delirium in elderly patients in ED.*

Material and Methods: *The study included 238 patients who were ≥65 years old and visited the emergency department (ED). The emergency specialist used the 'Confusion assessment method (CAM)' to screen for delirium in the patient group. A psychiatrist then evaluated the patients according to DSM-5 criteria for delirium. Demographic data, vital signs, and laboratory findings of the patients were also recorded as part of the study.*

Results: *Delirium was identified in 10.9% of the patients through CAM and 11.8% of the patients according to DSM-5 criteria. No statistically significant difference was found between the groups with and without delirium in terms of age, gender, comorbidities, presence of dementia, and use of polypharmacy. A positive correlation between mean arterial blood pressure (MABP) ($r=0.373$, $p<0.001$), pulse rate ($r=0.208$, $p<0.001$), and respiratory rate ($r=0.284$, $p<0.001$) and a negative correlation between CRP levels ($r=-0.139$, $p=0.032$) and the presence of delirium were found. Logistic regression analysis showed that MABP>99 mmHg and respiratory rate>19/min are associated risk factors for delirium.*

Conclusion: *High MABP and respiratory rate could be related to delirium risk. Although the hemodynamic risk factors could contribute to the recognition of delirium, practical clinical screening tools are still the most important and reliable methods to detect delirium.*

Keywords:
Delirium
Emergency department
Elderly
Related factors

ÖZET

Amaç: *Deliryum, acil servislere başvuran yaşlı hastalarda sık görülen bir klinik durum olmakla birlikte, tanısı genellikle atlanmaktadır. Bu çalışmada acil servise başvuran yaşlı hastalarda deliryum prevalansının değerlendirilmesi ve deliryum için risk faktörlerinin belirlenmesi amaçlanmıştır.*

Gereç ve Yöntemler: *Acil servise başvuran 65 yaş üstü 238 hasta çalışmaya dahil edildi. Hasta grubu acil servis uzmanı tarafından 'Konfüzyon Değerlendirme Yöntemi (KDY)' kullanılarak deliryum açısından tarandı. Hastalar daha sonra bir psikiyatrist tarafından DSM-5 kriterlerine göre deliryum açısından değerlendirildi. Hastaların demografik verileri, vital bulguları ve laboratuvar bulguları kaydedildi.*

Bulgular: *KDY ile hastaların %10,9'unda, DSM-5 kriterlerine göre hastaların %11,8'inde deliryum tanısı saptandı. Deliryum olan ve olmayan gruplar arasında yaş, cinsiyet, ek hastalık, demans ve polifarmasi varlığı açısından istatistiksel olarak anlamlı bir fark saptanmadı. Ortalama arteriyel kan basıncı (OAKB) (r=0,373, p<0,001), nabız (r=0,208, p<0,001) ve solunum sayısı (r=0,284, p<0,001) ve deliryum arasında pozitif, CRP düzeyleri (r=-0,139, p=0,032) ve deliryum varlığı arasında ise negatif korelasyon saptandı. Lojistik regresyon analizi sonuçları, OAKB> 99 mmHg ve solunum hızı> 19/dk'nın üzerinde olmasının deliryum için risk faktörü olabileceğini gösterdi.*

Sonuç: *Yüksek OAKB ve solunum hızı deliryum riski ile ilişkili olabilir. Hemodinamik risk faktörleri deliryumun tanınmasına katkıda bulunabilse de, pratik klinik tarama araçları deliryumu saptamak için hala en önemli ve güvenilir yöntemlerdir.*

Anahtar Kelimeler:
Deliryum
Acil servis
Yaşlı
İlişkili faktörler

INTRODUCTION

Delirium is an acute neuropsychiatric syndrome characterized by various psychomotor disturbances and cognitive symptoms. It is a state of alteration in consciousness, and disorientation that can occur suddenly and fluctuate during the day and is often accompanied by changes in behavior and perception. Delirium is generally caused by an underlying medical condition and can not be caused by a preexisting or established neurocognitive disorder such as dementia (1).

Delirium is known to have a higher incidence in elderly patients, with the prevalence increasing with age. It is estimated that up to 50% of hospitalized elderly patients may experience delirium (2). Elderly patients are more susceptible to delirium due to age-related changes in the central nervous system, which include alterations in neurotransmitter functions, neurodegenerative changes, and reduced cerebral blood flow. Additionally, the prevalence of comorbidities, cognitive loss, and polypharmacy increases with age, which further increases

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the risk of delirium (3, 4).

Delirium is also a prevalent condition among elderly patients in emergency services. Several studies have reported the incidence of delirium in the emergency department (ED) ranging from 7 to 20% (5, 6). Delirium in emergency services is associated with longer hospital stays, higher healthcare costs, poorer functional outcomes, and increased mortality rates (7). However, it is often underdiagnosed in emergency settings due to the complexity of patient assessment and the lack of awareness among healthcare professionals (8). It is reported that the mortality rate in patients discharged from the ED with unrecognized delirium diagnosis is 3 times higher than in patients for whom delirium is detected, which shows that unidentified delirium in emergency care settings results in poor outcomes in elderly patients (9).

Determining the risk factors for delirium can allow the rapid recognition and management of this clinical state in emergency services and is crucial to improving patient outcomes and reducing the burden of it on healthcare systems. Therefore, this study aims to assess the delirium prevalance and determine the associated risk factors for developing delirium in geriatric patients admitted to emergency care settings.

MATERIAL AND METHODS

This study was conducted with elderly patients, 65 years and older, applied to the ED during weekdays for 6 months period. The patients were assessed by the psychiatrist within the working hours (from 9 am to 6 pm). All the patients able to undergo a psychiatric examination and whose informed consent was obtained were included in the study. The unconscious patients, who have unstable cardiovascular or respiratory conditions, severe burns or trauma, or refuse to involve in the study were excluded.

The Short Portable Mental Status Questionnaire (SPMSQ) was administered to determine the capacity of patients to give informed consent. The SPMSQ has 10 items to detect cognitive impairment by evaluating orientation, memory, and concentration (10). If the patient had 4 or fewer mistakes in the SPMSQ, informed consent was directly asked of the patient. For patients with more than 4 mistakes in the test, informed consent was taken from the caregiver of the patient.

Patients' sociodemographic characteristics, the reason for the application to the ED, medical history, number of medications used by the patient, presence of polypharmacy (≥5 drugs), vital values (body temperature, systolic and diastolic arterial blood pressure (SABP and DABP), mean arterial blood pressure ([SABP+2xDABP] / 3), pulse, respiratory rate), laboratory findings (sedimentation rate, C-reactive protein (CRP), and neutrophil/lymphocyte ratio (NLR)) and follow-up time in ED were recorded. The patients were examined first by the emergency physician using Clinical Assessment Method (CAM) to screen for delirium. CAM is a semi-structured tool that is sensitive and widely used to assess delirium in clinical settings (11). The patients were also examined by the psychiatrist to detect delirium according to the DSM-5 delirium criteria (reduced ability to focus or shift attention, disturbance of consciousness, the disturbance develops over a short period, tends to fluctuate during the day, and not due to dementia) (1). If there is a diagnosis of depression, psychosis, or dementia in the medical history, the differential diagnosis of delirium from the primary psychiatric condition was determined according to the psychiatric examination of the patient. The study adhered to the guidelines set forth in the Helsinki Declaration, and the research protocol was approved by the Clinical Research Ethics Committee of Bolu Izzet Baysal University (date: 22.05.2019 no:236).

Statistical Analysis

The statistical analysis was conducted using IBM SPSS 25.0 (Armonk, NY: IBM Corp.) and MedCalc 15.8 (MedCalc Software bvba, Ostend, Belgium) software packages. For the qualitative data, the Chi-Square ($\chi 2$) test was utilized, along with descriptive statistical methods including frequency, percentage, mean, standard deviation, median, min-max, and IQR. The distribution of data was assessed using the Kolmogorov-Smirnow test, skewness-kurtosis, and graphical methods such as histogram, Q-Q plot, stem and leaf, and boxplot. Independent Samples t-test was employed to analyze data with normal distribution, whereas the Mann-Whitney U test was used for data without normal distribution. The ROC curve (Receiver Operating Characteristic) analysis was performed to assess variable distinctiveness, and Binary Logistic Regression was used to estimate risk ratios. Finally, Spearman's Rho Correlation test was conducted to evaluate the relationships between variables. The significance level was set at $\alpha=0.05$.

Power analysis was made with the statistical package program G*Power 3.1.9.7 (Franz Foul, Universitat Kiel, Germany). Power was found as 99% with n1=210(91.6 ± 11.1), n2=28(106.9 ± 11.7), $\alpha=0.05$, effect Size (d)=1.2.

RESULTS

There were 238 patients included in the study. 55.5% of the patients were female (n=132), and the mean age was 76.0 ± 8.1 years. The mean follow-up time of the patients at the ED was 16.8±9.7 hours. Delirium is detected in 10.9% of the patients (n=26) by using CAM. Meanwhile, it was found that 11.8% of patients (n=28) had delirium according to DSM-5 criteria.

Table 1 presents a comparison of the sociodemographic characteristics and medical records of patients with and without delirium. The results showed that there were no statistically significant differences between the groups in terms of age, gender, place of residence, number of comorbid diseases, presence of dementia, number of drugs used, and presence of polypharmacy ($p>0.05$ for all). Furthermore, no significant differences were observed between the groups in terms of the reasons for their admission to the emergency department ($p>0.05$). Notably, metabolic, cardiovascular, and neurological disorders were identified as the most common problems leading to ED admission for both groups of patients.

Table 2 presents the vital signs and laboratory values of patients upon admission to the ED. The results showed that patients diagnosed with delirium had significantly higher systolic arterial blood pressure (SABP), diastolic arterial blood pressure (DABP), mean arterial blood pressure (MABP), pulse rate, and respiratory rate values ($p<0.001$ for all), while CRP values were significantly lower ($p=0.032$) compared to patients without delirium.

Table 1: Comparison of the sociodemographic and medical status of the patients with and without delirium

		Delirium		p
		No (n=210)	Yes (n=28)	
Sex	Female	115 (54.8%)	17 (60.7%)	0.694 a
	Male	95 (45.2%)	11 (39.3%)	
Age (year)		76.4 ± 8.1	73.1 ± 7.2	0.054 b
	65-74 Year-old	83 (39.5%)	16 (57.1%)	0.205 a
	75-84 Year-old	82 (39.0%)	7 (25.0%)	
	≥85 Year-old	45 (21.4%)	5 (17.9%)	
Residence	Home alone	49 (23.3%)	3 (10.7%)	0.248 a
	Home with others	126 (60.0%)	21 (75.0%)	
	Nursing homes	35 (16.7%)	4 (14.3%)	
Number of chronic diseases		2.0 (1.0 – 3.0)	3.0 (1.0 – 4.0)	0.185 c
Dementia Diagnosis	No	186 (88.6%)	24 (85.7%)	0.753 a
	Yes	24 (11.4%)	4 (14.3%)	
Total number of patient's medication		3.0 (1.0 – 5.0)	5.0 (2.0 – 6.0)	0.090 c
Polypharmacy	No	130 (61.9%)	12 (42.9%)	0.085 a
	Yes	80 (38.1%)	16 (57.1%)	
Reason for Application to Emergency Department	Metabolic disease	43 (20.5%)	6 (21.4%)	0.969 a
	Cardiovascular disease	32 (15.2%)	4 (14.3%)	
	Neurological disease	31 (14.8%)	5 (17.9%)	
	Respiratory disease	23 (11.0%)	3 (10.7%)	
	Urinary tract disease	19 (9.0%)	3 (10.7%)	
	Infection	18 (8.6%)	3 (10.7%)	
	Multiple	19 (9.0%)	2 (7.1%)	
	Malignancy	10 (4.8%)	0 (0.0%)	
	Trauma	8 (3.8%)	1 (3.6%)	
	Others	7 (3.3%)	1 (3.6%)	

a: Chi-Square Test (n (%)), b: Independent Samples t Test (Mean ± SD), c: Mann-Whitney U test (Median (Q1 – Q3))

Table 2: Comparison of vital signs and laboratory findings of the patients with and without delirium upon admission to the emergency department

	Delirium		p
	Yes (n=210)	No (n=28)	
Systolic arterial blood pressure (mmHg)	116.0 (107.8 – 126.0)	135.0 (128.0 – 138.0)	<0.001 c
Diastolic arterial blood pressure (mmHg)	77.0 (71.0 – 84.0)	93.0 (86.0 – 103.3)	<0.001 c
Mean arterial blood pressure (mmHg)	90.0 (83.0 – 97.0)	106.5 (101.3 – 114.8)	<0.001 c
Pulse rate (/min)	91.0 ± 17.8	102.5 ± 13.1	<0.001 b
Respiratory rate (/min)	17.4 ± 3.0	21.0 ± 4.4	<0.001 b
Temperature (°C)	36.6 (36.2 – 37.1)	36.7 (36.3 – 37.2)	0.514 c
C-reactive protein (CRP) (mg/l)	4.0 (1.7 – 10.3)	0.4 (0.1 – 5.9)	0.032 c
Sedimentation (mm/h)	16.0 (6.0 – 24.0)	18.5 (3.0 – 28.0)	0.899 c
Neutrophil/leukocyte ratio (NLR)	2.4 (1.7 – 3.1)	2.6 (1.6 – 3.2)	0.638 c
Follow-up time in the ED (hours)	14.0 (9.0 – 21.0)	17.0 (9.5 – 23.0)	0.300 c
Mortality rate during follow-up in the ED	7 (%3.3)	2 (%7.1)	0.286 a

a: Chi-Square Test (n (%)), b: Independent Samples t Test (Mean ± SD), c: Mann-Whitney U test (Median (Q1 – Q3)), ED: Emergency Department

However, no significant differences were observed between the groups in terms of body temperature, sedimentation rate, and NLR values (p>0.05 for all). Moreover, there was no statistically significant difference between the groups in terms of mean follow-up time in the ED and mortality rates at the end of the follow-up (p=0.300 and p=0.286, respectively).

Subsequently, a correlation analysis was performed to identify any associations between these variables and the presence of delirium. Results indicated positive correlations between SABP (r=0.368, p<0.001), DABP (r=0.366, p<0.001), MABP (r=0.373, p<0.001), pulse rate (r=0.208, p<0.001), respiratory rate (r=0.284, p<0.001), and the presence of delirium, whereas a negative correlation was found between CRP levels (r=-0.139, p=0.032) and the presence of delirium. Logistic regression analysis including variables that were statistically correlated with the presence of delirium (MABP, CRP, pulse, and respiratory rate) revealed a statistically significant relationship between delirium and MABP and respiratory rates (p<0.001 and p=0.002, respectively) (Table 3). The model indicated that approximately 38% of the presence of delirium could be explained (Nagelkerke R2=0.375) and that the risk of delirium increased by approximately 1.1 times in those with higher MABP values and approximately 1.3 times in those with higher respiratory rates.

The variables identified as risk factors were assessed through ROC analysis, which revealed that MABP had a cut-off point of >99 mmHg (AUC=0.834, p<0.001, 95% CI: 0.781-0.879), while the cut-off point for respiratory rate was >19/min (AUC=0.752, p<0.001, 95% CI: 0.692-0.805) (Figure 1 and 2).

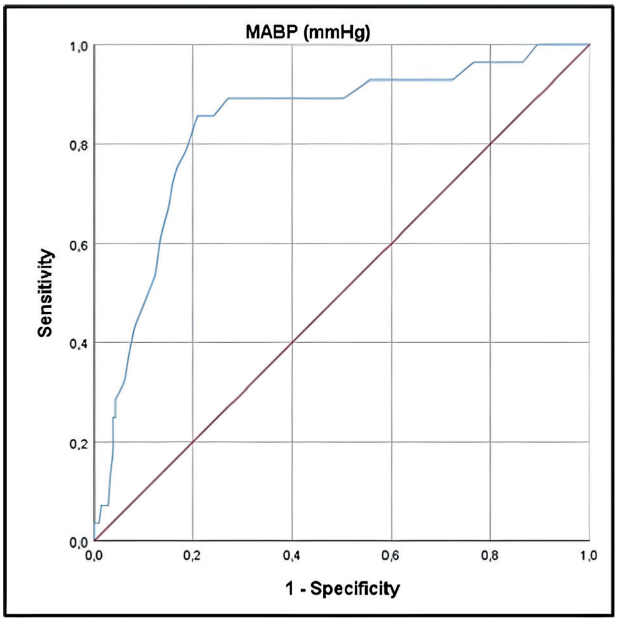

Figure 1: ROC analysis of the mean arterial blood pressure (MABP) to predict delirium

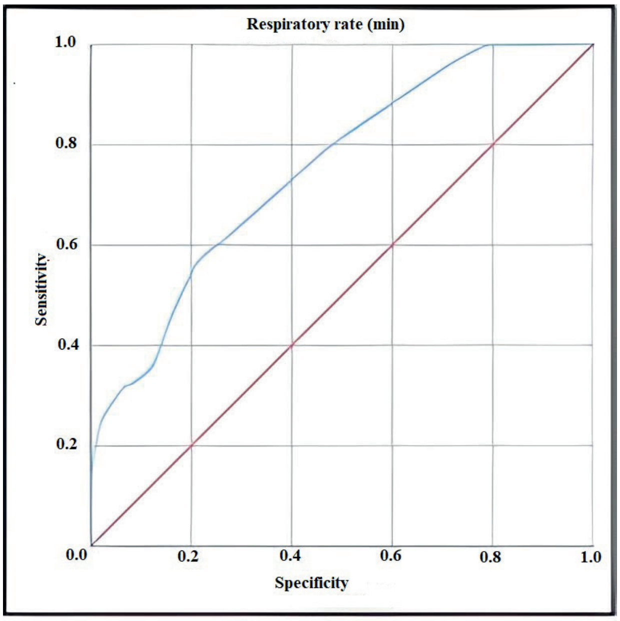

Figure 2: ROC analysis of the respiratory rate to predict delirium

Table 3: Logistic regression analysis of the variables contribute to the presence of delirium

Risk Factor	β	SE	Wald	Odds	%95 GA	p*
MABP (mmHg)	0.081	0.018	20.025	1.08	1.05 - 1.12	<0.001
Pulse rate (/min)	-0.001	0.017	0.007	1.00	0.97 - 1.03	0.932
Respiratory rate (/min)	0.251	0.080	9.796	1.29	1.10 - 1.50	0.002
CRP (mg/l)	-0.042	0.037	1.298	0.96	0.89 - 1.03	0.255
Constant	-14.369	2.275	39.879			

**Binary Logistic Regression Test, Nagelkerke R2 = 0.375, Hosmer and Lemeshow Test = 0.127 MABP: Mean-arterial blood pressure, CRP: C-reactive protein*

Table 4: Accuracy of prediction of the cases according to the created model including MABP and respiratory rate

		Predicted delirium status of the patients with the created model		Accuracy (%)
		No (n)	Yes (n)	
Real patient group	Without delirium (n)	205	5	97,6
	With delirium (n)	20	8	28,6
Overall accuracy of correctly classified cases (%)				89,5

The estimation table was performed according to the created model created with MABP and respiratory rate, and 97.6% of patients without delirium diagnosis and 28.6% of patients with delirium diagnosis were predicted correctly with this model (Table 4). The overall accuracy rate was found to be 89.5%.

DISCUSSION

Our study revealed that delirium is a common condition in elderly patients applied to the ED. While no correlation was found between sociodemographic features, comorbid diseases, presence of polypharmacy or dementia, and delirium; it was shown that there was a positive correlation between delirium and MABP, pulse rate, respiratory rate, and a negative relationship with CRP levels. In the model established with MABP and respiratory rate, the sensitivity for detecting delirium was 28.6%, while the specificity was 97.6%. Furthermore, logistic regression analysis shows that MABP>99 mmHg and respiratory rate>19/min are associated risk factors for delirium.

In this study, delirium was diagnosed in 11.8% of the patients based on DSM-5 criteria. A recent meta-analysis reported a prevalence of 15.2% among elderly patients in the ED (12). In the same meta-analysis, a negative correlation was found between the sample size of the study and the prevalence of delirium, therefore, the prevalence of delirium may be lower in our study. The ability of emergency physicians to identify delirium using the CAM was also assessed, and it was found that most patients with delirium could be identified using this screening tool. Previous research has shown that up to one-third of patients with delirium can be identified by emergency physicians in the absence of a screening tool (13). Although there are several different tools developed for the assessment of delirium, their superiority to each other has not been proven (14). CAM is accepted as a very sensitive and practical tool that can determine the patient's delirium status (11). The use of such assessment tools facilitates the recognition of patients and the necessary interventions for patients.

When the conditions that contribute to the development of delirium in elderly patients who apply to the ED are examined, different risk factors are reported in the literature. In a meta-analysis, being a nursing home resident, cognitive impairment, hearing loss, and a history of stroke are the factors associated with delirium in ED (15). Some studies also showed that pain, urinary catheterization, dehydration, the presence of infection, and a chaotic ED environment may also cause delirium (16). However, our study did not reveal any difference in terms of the rate of nursing home residents or the presence of cognitive decline. The reason for this result may be that some cases with a diagnosis of neurocognitive disorder were not diagnosed yet or the diagnosis was missed due to lack of confident anamnesis. In addition, improvements in nursing home conditions with regular supervision policies may have improved the quality of care for elderly patients and therefore did not affect the risk of delirium.

The most frequent reasons for seeking medical attention in patients with delirium were metabolic, neurological, and cardiovascular diseases, although there was no significant difference in terms of the reason for admission between the two groups. Metabolic and neurological disorders were the most commonly associated medical conditions with delirium. These conditions are believed to cause delirium either by directly damaging the central nervous system (CNS) or indirectly by causing functional disturbances and altering neuronal transmission (17).

The laboratory findings and vital signs at admission were evaluated, and it was found that SABP, DABP, MABP, CRP values, and respiratory rate were correlated with the presence of delirium. However, the logistic regression analysis revealed that higher MABP and respiratory rate are associated with delirium. Specifically, a MABP higher than 99 mmHg and a respiratory rate greater than 19/min were found to be related to delirium. Previous studies have reported that vital signs such as heart rate, SABP, respiratory rate, body temperature, and oxygen saturation at the triage have moderate effects on delirium clinics. (15). Another study included low SABP, high DABP, low (<16/min), and high (>24/min) respiratory rates in a model to estimate delirium risk. (18). Additionally, another study showed that a respiratory rate greater than 20/min is related to an increased risk of delirium (19).

However, the model created based on MABP and respiratory rate higher than the determined cut-off levels have unfavorable results in detecting delirium. Whereas, it has a high specificity to exclude non-delirium cases. The direct effect of hypertension on cerebral vascular structure is known as an important risk factor for delirium (20). Moreover, hemodynamic changes in different clinical states could cause dysfunction in cerebral autoregulatory functions and may lead to hypoxia. Hypoxia is also reported as an important clinical finding related to delirium (21).

Although there are some sensitive prediction models related to delirium, the selected variables vary considerably, and accessing information about some of these variables in the ED can be difficult and not accessible (18, 19, 22). Therefore, using delirium assessment tools taking less than a few minutes such as CAM, The 3-Minute Diagnostic Confusion Assessment Method (3D-CAM), The '4A' Test (4AT) is a quick and reliable method to screen the presence of delirium (23).

The study has several limitations that should be considered when interpreting the results. One limitation is that it was conducted in a single center, which may limit the generalizability of the findings to other healthcare settings. Another limitation is that the study participants were recruited during weekdays and working hours, which may not be representative of all elderly patients who visit the ER at different times. Furthermore, clinically unstable patients were excluded from the study, which could lead to an underestimation of the prevalence of delirium since this group is at higher risk for delirium. In addition, the fluctuating symptoms of delirium may have led to some cases being missed. Finally, the medications administered during the ED stay were not taken into account in the analysis, which could have influenced the development of delirium.

In conclusion, delirium is a common clinical syndrome seen in elderly patients in the ED. Vital signs such as higher

MABP and respiratory rate are related to the increased risk of delirium. Although the hemodynamic risk profile of the individuals could contribute to the recognition of delirium, practical clinical screening tools are still the most important and reliable methods to assess delirium.

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Ethics: The study was approved by the Clinical Researches Ethics Committee of Bolu Izzet Baysal University (date: 22.05.2019 no:236).
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