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Research Article / Araştırma Makalesi

The Effect of asymptomatic versus mild symptomatic COVID-19 infection on male athletic performance: A cross-sectional clinical research

Asemptomatik ve hafif semptomatik COVID-19 enfeksiyonunun erkek sporcu performansı üzerindeki etkisi: Kesitsel klinik araştırma

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ABSTRACT

Objective: Novel Coronavirus Disease 2019 (COVID-19) pandemic has affected the whole world and still host many obscurities. Researches involving athletes investigated the lifestyle, athletic performance and psychological alterations compared to pre-pandemics and returning-to-sports process. But, knowledge about the past symptomatic COVID-19 effects on athletic performance is immature. Athletes are prone to asymptomatic or mild symptomatic COVID-19 rather than severe form; so this study aimed to compare the muscular athletic performance, cardiorespiratory function and psychological condition after COVID-19 between asymptomatic and mild symptomatic athletes.

Materials and Methods: This case-control designed study recruited a total of 40 young adult male long-distance runners who survived COVID-19 asymptomatically (n=20), and with mild symptoms (n=20). All of the subjects had completed the isolation period and been approved to return-to-sports. The age, anthropometric properties, athletic license term and dominant hand and foot sides of the subjects were recorded. The muscular strength of upper limb, isokinetic and isometric muscular strengths of lower limb flexor and extensors, and VO_2max were measured. The self-reported depression, anxiety and COVID-19-related fear were evaluated.

Results: The values of all muscular strength parameters, VO_2max and anxiety level were similar between the groups ($p>0.05$). However, the levels of depression ($p=0.048$) and COVID-19-related fear ($p=0.012$) were significantly higher in mild symptomatic group in comparison with asymptomatic ($p<0.05$).

Conclusions: Mild symptomatic COVID-19 did not affect muscular athletic performance and cardiorespiratory fitness, but caused psychological disorder in comparison with asymptomatic infection. In case of COVID-19, the psychological state of the athlete should be paid close attention. We suggest the supply of adequate and quick psychological support while targeting the previous level of physical fitness and athletic performance in the returning-to-sports process.

Keywords: *COVID-19, muscular strength, return to sport, VO_2max*

ÖZ

Amaç: Yeni Koronavirüs Hastalığı 2019 (COVID-19) pandemisi, tüm dünyayı etkisi altına almıştır ve halen birçok bilinmezlik içermektedir. Sporcular üzerinde yapılmış çalışmalar; çoğunlukla pandemi öncesi dönem ile pandemi sırasında spora-dönüş-süreci arasındaki yaşam tarzı, sportif performans ve psikolojik durum değişikliklerini karşılaştırmıştır. Ancak, COVID-19 enfeksiyonunun semptomatik geçirilip geçirilmemesinin sportif performansa etkisi konusundaki bilgi yeterli değildir. Sporcuların, şiddetli semptomatik formdan çok asemptomatik veya hafif semptomatik COVID-19'a eğilimli olduğu bildirilmiştir; bu nedenle, COVID-19 enfeksiyonunu asemptomatik ve hafif semptomatik geçirmiş sporcular arasında enfeksiyon sonrası sportif kas performansını, kardiyorespiratuar fonksiyonu ve psikolojik durumu karşılaştırmayı amaçladık.

Gereç ve Yöntem: Bu vaka-kontrol tasarımlı çalışma, COVID-19'u asemptomatik (n=20) ve hafif semptomatik (n=20) geçirmiş toplam 40 genç yetişkin erkek uzun mesafe koşucusu ile gerçekleştirilmiştir. Deneklerin tamamının izolasyon süreci tamamlanmış ve spora dönüşleri onaylanmıştı. Deneklerin yaşları, antropometrik özellikleri, sporcu lisans süreleri ve baskın el ve ayak tarafları kaydedildi. Üst ekstremite kas kuvveti, alt ekstremite fleksör ve ekstansörlerinin izokinetik ve izometrik kas kuvvetleri ve VO_2max ölçüldü. Anketler yoluyla depresyon, anksiyete ve COVID-19-ilişkili korku değerlendirildi.

Bulgular: Tüm kas kuvvet parametreleri, VO_2max ve anksiyete düzeyi değerleri gruplar arasında benzerdi ($p>0.05$). Ancak hafif semptomatik grupta depresyon ($p=0.048$) ve COVID-19-ilişkili korku ($p=0.012$) düzeyleri, asemptomatik gruba göre anlamlı olarak yüksekti ($p<0.05$).

Sonuçlar: Hafif semptomatik COVID-19, sportif kas performansı ve kardiyorespiratuar dayanıklılığı etkilememekle birlikte, psikolojik problemler yaratmıştır. Spora dönüş sürecinde önceki fiziksel zindelik ve sportif performans düzeyi hedeflenirken, yeterli ve hızlı psikolojik destek sağlanması uygun olacaktır.

Anahtar Sözcükler: *COVID-19, kas kuvveti, spora dönüş, VO_2max*

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INTRODUCTION

In December 2019, a contagious pneumonia of unknown origin arose in Hubei province of China and spread rapidly, alarming health authorities around the world. The causative agent of the disease was found to be "Severe Acute Respiratory Syndrome Coronavirus type 2" (SARS-CoV-2), and this infection was named Novel Coronavirus Disease 2019 (COVID-19) (1).

The incidence of COVID-19 has shown an increasing tendency in adult males (2). Several symptoms have been reported regarding the disease in a varying incidence and intensity individually (1,2), but patients with COVID-19 can be basically categorized as asymptomatic and symptomatic (3).

The confirmed diagnosis of COVID-19 infection is the positive (+) result for Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) with ribonucleic acid (RNA) isolation of SARS-CoV-2 virus in nasal and oropharyngeal swab sample, regardless of symptoms and clinical findings (2).

It is difficult to decide about the return to sports process (RtSP) of athletes who have been diagnosed with confirmed COVID-19, since the degree of cardiorespiratory system involvement could not be demonstrated clearly with strong evidence. The following evaluations and recommendations have been listed regarding the classification of cases and the RtSP (4,5):

- Asymptomatic case: RT-PCR testing due to suspicious contact or obligatory decision for the whole team, and (+) result. After two weeks of isolation, the athlete can return to sports after routine evaluation for sports participation.
- Mild symptomatic case: RT-PCR testing due to suspicious symptoms, (+) result and surviving the infection without hospitalization. After two weeks of isolation, the athlete can return to sports with normal findings of resting electrocardiography (ECG) and echocardiography (ECHO).
- Severe symptomatic case: RT-PCR testing due to suspicious symptoms, (+) result and surviving the infection with hospitalization. The athlete can return to sports with normal findings of resting ECG and ECHO 2-4 weeks after the discharge.

In the light of these reports, asymptomatic versus symptomatic COVID-19 infection can be declared to affect the RtSP. Numerous reports focusing on "the athlete and COVID-19" have made statements about the clinical presentation, follow-up period, RtSP and the influence of pandemics on athletic performance and psychological health compared to pre-pandemics, but the knowledge about the athletic performance after COVID-19 infection is still immature.

Long-distance running can be considered as a fine indicator of high-intensity physical activity, with being one of the most favorite and easy-accessible sports modality (6). In addition, due to the increased incidence of COVID-19 among adult males (2), the sample group of this study consisted of male long-distance runner athletes. Based on the hypothesis that the symptomatic COVID-19 infection may affect the athletic performance negatively in a similar way with RtSP, we aimed to compare the 1) level of physical fitness, 2) muscular functionality of upper limb, 3) muscular functionality of lower limb, 4) cardiorespiratory function, 5) psychological condition of athletes who were diagnosed with asymptomatic and mild symptomatic COVID-19 infection after the survival in this study.

MATERIAL and METHODS

Study design

The design of this clinical research is cross-sectional. The participants were all patients who admitted to outpatient clinic of sports medicine of a tertiary hospital, were volunteered to take part in the study and signed written informed consent. The study was conducted after approval of local ethics committee in full accordance with Declaration of Helsinki.

Sample size

As far as we searched the literature, there is no study investigating the physical fitness level of athletes who were infected with SARS-CoV-2. The present study consisted of total 40 subjects (being divided into two groups equally) who admitted to outpatient clinic of sports medicine between March 2021 and February 2022. A compromise power analysis for one-tailed hypothesis with a confidence level of 95%, effect size of 0.8 and β/α ratio of 4 determined power of 0.799 by GPower Software (ver. 3.1.9.4, Düsseldorf, Germany).

Participants

The sample group consisted of male, long-distance runners (licensed athletes) who were diagnosed with confirmed COVID-19 infection by (+) result of RT-PCR and RNA isolation. 40 athletes were recruited in the study; 20 athletes who survived COVID-19 asymptomatically were in the asymptomatic group (AG), and 20 who survived with mild symptoms were in the symptomatic group (SG). All subjects were evaluated within the RtSP recommendations (4,5) two weeks after the (+) result of RT-PCR testing and approved to participate in sports activities before performing the tests.

The exclusion criteria were: being in isolation period, abnormal findings of ECG and ECHO which did not comply with the RtSP recommendations (4,5), myocardial infarction, unstable angina pectoris, uncontrolled arrhythmia causing symptomatic hemodynamic instability, severe symptomatic aortic stenosis, suspicious dissecting aortic aneurysm, acute endocarditis, myocarditis, or pericarditis, acute heart failure, acute respiratory failure, acute pulmonary thromboembolism, presence of any disease impairing athletic performance or that could be worsened by exercise, syncope, uncontrolled asthma, and mental disorder restricting cooperation.

Evaluation procedure

The age and anthropometric characteristics of all subjects including height, weight, fat-free mass (FFM) and the athletic license term were evaluated. Total body weight and FFM were recorded by the body composition analyzer device (Tanita TBF-300M, Tanita Corporation of America, Inc., Illinois, USA), as these two parameters indicate the physical fitness level together (7). Body mass index (BMI) and fat-free mass index (FFMI) parameters were calculated by normalizing the obtained values of total body weight and FFM to height, respectively (7).

The dominant hand of the subjects was determined by the valid and reliable version of Edinburgh Handedness Inventory in our native language and the resulting Geschwind score (8). This self-reported inventory including 10 items of daily activities evaluates the preferred hand side while performing these activities. The resulting Geschwind score ranges between -100 (strongly preference of left hand) and +100 (strongly preference of right hand). Right-handed subjects are presumably considered to prefer right foot, and similarly the left-handed ones their left foot (9), thus the dominant foot of subjects was determined by the recorded Geschwind score.

Dominant hand grip strength (HGS) of all subjects was measured by a standard hydraulic hand dynamometer (Baseline 12-0240, Johnson Scale CO. Inc, Pine Brook, NJ.), as this parameter evaluates the muscular functionality of upper limb (10). Adjusting the dynamometer at the second handle position, the subject was told to grip the handle at the maximum level and keep it for 5 seconds. The mean value of three consecutive measurements with 1-minute breaks was accepted as HGS data (10).

Isokinetic muscular strength of dominant knee extensor and flexor of all subjects were measured by a computerized dynamometer (Isomed 2000, Pukang Sports & Medical Co., Ltd., Beijing China), as this parameter indicates the muscular functionality of lower limb (11,12). Since mild-to-moderate COVID-19 has been reported to be one of the basic restricting factor of exercise due to muscle fatigue among young and middle-aged individuals, the sole angular velocity of 180^0/sec was preferred rather than low ones considering the SG (13). Initially, 5 minutes of warm-up exercise was performed by 50 Watts-loaded bike ergometer (h/p/cosmos torqualizer ef med 600, h/p/cosmos sports & medical GMBH, Deutschland) (14). The subject was placed onto the dynamometer seat in a 70^0-flexed hips and 90^0-flexed knees position following the warm-up, and the stabilization of shoulder, waist and thigh regions with the adjustment of dynamometer were performed as described elsewhere (15,16). Subsequently, the subject was instructed to breath freely, and not to change the posture during the test with grasping the handles at the sides of dynamometer seat (Figure 1) (17). Practice trials were performed as four series of knee flexion-extension cycles with submaximal loading (70-90% of maximal) (18), followed by five maximal contractions at the velocity of 180^0/sec for isokinetic muscular strength testing procedure (19). Peak (maximum) torque normalized to FFM (PT/FFM) value was accepted as the isokinetic muscular strength data, because FFM is considered to be a physical fitness level indicator (7).

Figure 1. The positioning of the subject and device setting for isokinetic muscular strength measurement (The subject did not wear mask during the test).

Isometric muscular strength of dominant knee extensor and flexor of all subjects were measured by a computerized device (Diers Myoline, DIERS International GmbH, Schlangenbad, Germany) two minutes after isokinetic muscular strength testing (17), as this parameter evaluates the muscular functionality of lower limb (11). The subject was placed onto the device seat in an approximately 40^{o} or 50^{o}-flexed-knees position (depending on the subject's height), fixing to the device. Similar to the isokinetic testing, the subject was instructed to grasp the handles at the sides of device seat and not to move in a contra-direction during the test (Figure 2) (17). Practice trials were performed as two series of submaximal isometric flexion of the knee joints initially, followed by three maximal contractions each lasting for 2 seconds with 30-second-breaks for isometric muscular strength testing (20,21). The same procedure was performed with isometric extension of the knee joints. The tension threshold was adjusted to 10 Nm (17). The highest peak force normalized to FFM (PF/FFM) value of three maximal contractions (21) was accepted as the isometric muscular strength data.

Figure 2. The positioning of the subject and device setting for isometric muscular strength measurement (The subject did not wear mask during the test).

Maximal oxygen uptake (VO_2max) of all subjects was measured indirectly due to pandemic conditions and contagion probability (22), as this parameter indicates the cardiorespiratory function (12). All subjects performed the 20-meter shuttle run test and the completed lap numbers were recorded (23). Two locations apart of 20 meters were determined and the subject was instructed to run from one to the other at a certain time interval. The required running speed was 8,5 km/h initially, increasing 0,5 km/h per minute (24). Completed lap number was used for calculating VO_2max through a particular converting table (25) and equation (23).

All subjects fulfilled the valid and reliable versions of the following questionnaires in our native language, to determine the psychological condition: Beck Depression Inventory (BDI) (26), Beck Anxiety Inventory (BAI) (27), and Fear of COVID-19 Scale (FoC-19S) (28). These self-report scales measure the emotional status of the subject by 21, 21 and 7 items; of which the total score ranges between 0-63, 0-63 and 7-35, respectively. Higher scores associate with concerning levels of depression, anxiety and COVID-19-related fear.

Outcome measures

The primary outcome measures were HGS, PT/FFM value of isokinetic muscular strength testing, PF/FFM value of isometric muscular strength testing and VO_2max.

The secondary outcome measures were the scores of BDI, BAI, and FoC-19S.

Statistical analyzes

PASW (Predictive Analytics SoftWare) Statistics 18.0 for Windows (IBM Corp., New York) was used for statistical analyzes. The continuous variables were expressed as mean ± standard deviation (SD), whereas the categorical variables were reported as frequencies and percentages. The normality of distribution of continuous variables was tested by Kolmogorov-Smirnov and Shapiro-Wilk tests. Student's t-test and paired samples t-test with Mann-Witney U and Wilcoxon signed-rank tests (where appropriate) were used for comparison of the variables between the AG and SG. The value of $p<0.05$ was considered to be statistically significant.

RESULTS

A total of 40 male subjects with a mean age of 35.15±5.55 (26-44) years, a mean BMI of 24.17±1.21 (21.60-26.80) kg/m^2, a mean FFMI of 22.15±1.13 (19.60-24.70) kg/m^2, a mean license term of 8.65±2.94 (3-14) years and a mean Geschwind score of +94.25±5.38 (+80 and +100) were recruited to the study. All of the subjects were right-handed, and likewise all of them were considered to be right-footed. Age and anthropometric properties of AG and SG were similar (Table 1).

Table 1. The anthropometric data of subjects compared between the groups

Characteristic	AG (n=20)	SG (n=20)	p
Age (year), mean (SD)	34.900 (5.046)	35.400 (6.134)	0.780
Height (m), mean (SD)	1.764 (0.038)	1.775 (0.033)	0.316
Weight (kg), mean (SD)	74.610 (4.109)	76.995 (5.068)	0.110
BMI (kg/m^2), mean (SD)	23.985 (1.140)	24.355 (1.284)	0.342
FFM (kg), mean (SD)	68.262 (3.755)	70.627 (4.638)	0.084
FFMI (kg/m^2), mean (SD)	21.940 (1.104)	22.362 (1.152)	0.244
License term (year), mean (SD)	9.150 (3.313)	8.150 (2.497)	0.288
Geschwind score, mean (SD)	94.250 (4.940)	94.250 (5.910)	1
Dominant side, number (%)			
Right	20 (100)	20 (100)	
Left	0 (0)	0 (0)	

AG: asymptomatic group; BMI: body mass index; FFM: fat-free mass; FFMI: fat-free mass index; SD: standard deviation; SG: symptomatic group

The comparison of primary outcome measures between AG and SG are presented in Table 2. HGS, PT/FFM values of isokinetic muscular strength, PF/FFM values of isometric muscular strength and VO_2max were not significantly different between the groups ($p<0.05$). Despite the insignificance, all primary outcome measures tended to decrease in the SG compared to AG.

Table 2. The primary outcome measures of subjects compared between the groups

	AG (n=20)	SG (n=20)	p
HGS (kg), mean (SD)	47.100 (4.700)	44.400 (4.569)	0.073
Flexor isokinetic PT/FFM (Nm/kg), mean (SD)	1.209 (0.182)	1.169 (0.129)	0.430
Extensor isokinetic PT/FFM (Nm/kg), mean (SD)	1.995 (0.363)	1.890 (0.277)	0.308
Flexor isometric PF/FFM (N/kg), mean (SD)	3.014 (0.873)	2.678 (0.892)	0.236
Extensor isometric PF/FFM (N/kg), mean (SD)	7.475 (1.620)	7.019 (1.457)	0.355
VO_2max (mLO_2/kg/min), mean (SD)	44.250 (3.911)	42.220 (3.261)	0.083

AG: asymptomatic group; FFM: fat- free mass; HGS: Hand grip strength; PF: peak force; PT: peak torque; SD: standard deviation; SG: symptomatic group; VO_2max: maximal oxygen uptake

The comparison of secondary outcome measures between AG and SG are presented in Table 3. The scores of BAI was not significantly different between the groups, displaying higher values in the SG. However, the scores of BDI and FoC-19S were significantly increased in SG, indicating the depressive disorder and COVID-19-related fear ($p<0.05$).

Table 3. The secondary outcome measures of subjects compared between the groups.

	AG (n=20)	SG (n=20)	p
BDI (score), mean (SD)	5.000 (3.464)	7.450 (4.084)	0.048*
BAI (score), mean (SD)	3.200 (1.794)	4.550 (2.564)	0.062
FoC-19S (score), mean (SD)	8.900 (1.293)	10.550 (2.416)	0.012*

AG: asymptomatic group; BAI: Beck Anxiety Inventory; BDI: Beck Depression Inventory; FoC-19S: Fear of COVID-19 Scale; SD: standard deviation; SG: symptomatic group

* Statistically significant data (p<0.05)

DISCUSSION

This is the first study comparing the effects of asymptomatic vs mild symptomatic COVID-19 infection on the athletic performance and psychological health of the male long-distance runners to the best of our knowledge, and represented new and remarkable results. The main findings of this clinical cross-sectional research indicated that mild symptomatic COVID-19: 1) did not alter the level of physical fitness, 2) did not alter the muscular functionality of upper limb, 3) did not alter the muscular functionality of lower limb, 4) did not alter the cardiorespiratory function, and 5) did not cause anxiety, but led to depression and COVID-19-related fear when compared with asymptomatic COVID-19 infection in male long-distance runners. We can conclude that the mild symptomatic COVID-19 may not impair the muscular athletic performance and cardiorespiratory function, but influence the psychological condition of the athlete negatively.

Effects on muscular athletic performance

The expiration of league competitions and sports injuries result in ordinary reduction of athletic performance (29). But recent researches have pointed out that COVID-19 quarantine also reduced most of the physical performance parameters among athletes (29,30) by increased sedentary time and decreased daily total physical activity (30), despite indoor training (29). García-Aliaga et al. has observed the 20 professional soccer teams of LaLiga™, comparing the first 11 matches of the season in the pre-quarantine period and the first 11 matches afterwards the re-opening of the league in the post-quarantine period (29). The authors have reported the significant lower rates of medium and high-speed running with maximum acceleration and deceleration in the post-quarantine period. Similarly, da Silva Santos et al. have observed 15 young badminton athletes in the pre-COVID-19 period and exactly one year later in the COVID-19 pandemic period, and concluded the significant increase of sedentary time and significant decrease of total daily physical activity and moderate to vigorous activity in the COVID-19 pandemic period compared to pre-COVID-19 (30). Since the subjects of our study were from the same city and underwent the same quarantine procedures, our findings can be attributed to COVID-19 infection itself.

The reduction of athletic performance during COVID-19 pandemic was associated with reduced fast-twitch muscle fiber number (29). The lack of either a control group or the pre-COVID-19 pandemics measurement outcomes of the subjects prevent us from concluding on the effect of COVID-19 on fast-twitch muscle fiber number. However, this type of muscle fiber is activated by both low and high angular velocities (11), including the value we preferred for the muscular strength testings. Thus, we can conclude that the activation of these muscle fibers might not be affected by asymptomatic versus mild symptomatic COVID-19. Athletes are prone to asymptomatic/mild symptomatic infection rather than severe symptomatic in comparison with general population (5). Our findings that support the unaltered muscular performance between the two groups might be associated with the mild course of infection.

Effects on cardiorespiratory function

The factors limiting VO_2max are not clear yet (31), however individual properties (e.g., age, sex and genetics) with training factors (e.g., type, volume and intensity of exercise) are prominently suggested and plausible ones (32). "Voluntary termination due to fatigue" design of VO_2max measurement, which was also present in our study, may be insufficient to reveal the limiting effects of the systems (33). But the similarity of the age, sex and the time involved with the same sport branch between the AG and SG suggested that the findings might be attributed to COVID-19 infection itself. Thus, we can conclude that mild symptomatic COVID-19 might not impair cardiorespiratory function compared to asymptomatic infection.

Effects on psychological condition

The quarantine process of COVID-19 had also psychological effects on athletes. The suspension of sports activities, competitions and leagues have induced overt sorrow, disappointment, anxiety, and depression among athletes (30,34)and complicated the management of existing ones (34). Pillay et al. have evaluated a total of 692 athletes from 15 sport branches including long-distance running in the last phase of quarantine period, using online Google Form survey, and reported significant increase of sedentary behavior and change of sleep pattern due to COVID-19 quaranti–

ne, moreover 52% of the participants declared depressive feelings (35). The authors have associated the depression with the lack of energy and enthusiasm. Similarly, García-Aliaga et al. have reported that COVID-19 quarantine caused chronic physical and psychological fatigue among athletes (29). Even though we did not evaluate the sleep parameters of subjects, our findings of increased depression and COVID-19-related fear among SG suggest that mild symptomatic COVID-19 may increase the probable quarantine-induced psychological fatigue in comparison with asymptomatic infection. However, increase of COVID-19-related fear in mild symptomatic athletes might be a triggering factor of depressive symptoms.

Strengths and limitations

This study is the first, focusing on the potential effects of asymptomatic and mild symptomatic COVID-19 on athletic performance and psychological condition of professional male long-distance runners. The findings are remarkable, however with some limitations. The male gender and single sports branch of the sample group might restrict a general conclusion about the athletes. The differences in incidence, clinical manifestations and prognosis of COVID-19 between male and female genders should be considered. Additionally, other sports branches that require aerobic, anaerobic or mixed power should be involved. The lack of a control group and also pre-COVID-19 pandemics and pre-infection measures of the subjects might limit the findings. However, we have used FFM to normalize the PT and PF values to evaluate the isokinetic and isometric muscular strengths unlike other researches (16-20). FFM should be addressed as a better indicator than total body weight. In addition, the evaluation of dominant upper and lower limb sides for muscular strength testings and the similarity of dominance between the groups add strength to our study. Moreover, the similarity of license periods of subjects in their athletic history between the groups is considerable.

CONCLUSION

This study paves the RtSP way of athletes after COVID-19 infection and emphasizes the factors that should be kept in mind. The entire team dealing with the athlete (sports medicine practitioners, coaches, sports team managers, teammates, family etc.) should pay attention to mental health support with sports psychologists, telemedicine usage and social interactions. COVID-19 in athletes is still an obscure iceberg (and seems to keep for a while), new approaches will be inspired from the "tip" we have uncovered.

Ethics Committee Approval / Etik Komite Onayı

The approval for this study was obtained from Ankara City Hospital No.2 Ethics Committee, Ankara, Turkey (Decision no: E2-21-46).

Conflict of Interest / Çıkar Çatışması

The authors declared no conflicts of interest with respect to authorship and/or publication of the article.

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Author Contributions / Yazar Katkıları

Concept – OK, NKOG, EA; Design – OK, NKOG, EA; Supervision – OK, NKOG; Materials – OK, NKOG, EA; Data Collection and/or Processing – OK, BU, NE; Analysis and Interpretation – OK; Literature Review – OK; Writing Manuscript - OK; Critical Reviews - OK, NKOG, EA, BU, NE

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