AMBULANSTA ÇALIŞAN SAĞLIK PERSONELİNİN ELEKTROKARDİYOGRAM BİLGİ DÜZEYLERİNİN DEĞERLENDİRİLMESİ

Evaluation of Electrocardiogram Knowledge Level of Healthcare Staff Working in Ambulance

Erdal DEMİRTAŞ[1](0000-0003-0853-0623), Yusuf Kenan TEKİN[1] (0000-0001-8047-4836), İlhan KORKMAZ[1] (0000-0001-5182-3136), Fatma Mutlu KUKUL GÜVEN[2] (0000-0003-3755-6021), Sefa YURTBAY[3] (0000-0002-7373-1002), Esin DEMİRTAŞ[1] (0000-0001-7077-2629)

[1]Sivas Cumhuriyet Üniversitesi Tıp Fakultesi Acil Tıp Anabilimdalı

[2]Kastamonu Üniversitesi Tıp Fakültesi Acil Tıp Anabilimdalı

[3]Niğde Ömer Halisdemir Üniversitesi Eğitim Ve Araştırma Hastanesi

Erdal DEMİRTAŞ, Dr.Öğr. Üyesi
Yusuf Kenan TEKİN, Dr.Öğr. Üyesi
İlhan KORKMAZ, Doç. Dr.
Fatma Mutlu KUKUL GÜVEN, Doç. Dr.
Sefa YURTBAY, Uzm. Dr.
Esin DEMİRTAŞ, Asistan Dr.

ÖZET

Amaç: Akut koroner sendromlar tüm dünyada ani ölümlerin büyük bir kısmını oluşturmaktadır. Akut başlangıçlı göğüs ağrısı şikayeti olan hastada miyokard infarktüsü düşünülmüş ise en kısa zamanda perkütan koroner anjiyografi (PTCA) yapılan bir merkeze sevk edilmelidir. Akut koroner sendromlar ve ölümcül kardiyak aritmilere bağlı ölüm oranını azaltmak için, hastayı ilk değerlendiren, ambulansta çalışan sağlık personelinin elektrokardiyografi (EKG) bilgisi önemlidir. Biz bu nedenle, Sivas ilindeki ambulans personelinin elektrokardiyografi bilgi düzeyini değerlendirmek için bir anket çalışması planladık.

Materyal metod: Hemşireler, paramedikler ve acil tıp teknisyenleri olmak üzere, Sivas merkez ve ilçelerindeki ambulanslarda çalışan toplam yüz yetmiş sekiz sağlık personeli çalışmaya dahil edildi. Katılımcılardan, çalışma deneyimi, eğitimi, yaşı ,özel bir EKG kursunun tamamlanmasıyla ilgili sorulara cevap vermeleri istendi ve 12 farklı EKG'yi yorumlamaları beklendi.

Bulgular: Anket çalışmasında doğru tanı konulan EKG oranları şöyledir; anterior ST elevasyonlu miyokard infarktüsü (STEMI) %84.3 (n=150), inferior STEMI %89.9 (n=160), lateral STEMI %77.5 (n=138), normal EKG %64 (n=114), ventriküler fibrilasyon (VF), %28.1 (n=50), supraventriküler taşikardi (SVT) %57.3 (n=102), VT %17.4 (n=31), ve parazitli EKG %13.5(n=24). Elde edilen sonuçlara göre, paramediklerin sağ dal bloğu ve AV tam blokta doğru tanı oranlarının acil tıp teknisyenlerine ve hemşirelere göre daha yüksek olduğu (<0,001) ve acil tıp teknisyenlerinin sol ventrikül hipertrofisinin EKG bulgularını tanımada daha iyi olduğu saptandı (p=0,011).

Sonuç: Bizim çalışmamızda çalışanların mesleki alanı, çalışma tecrübesi ve son 1 yıl içinde aldıkları EKG eğitimlerinin EKG değerlendirme sonuçları üzerinde anlamlı bir fark yaratmadığı ve çalışanların hayatı tehdit eden ritimleri tanımadıkları gösterilmiştir.

Anahtar kelimeler: *Hastane öncesi; Elektrokardiyografi; Acil tıp teknisyeni; Paramedikal personel*

ABSTRACT

Background: Acute coronary syndromes compose a major proportion of sudden deaths globally. Patients diagnosed with myocardial infarction due to sudden chest pain should be immediately referred to percutaneous coronary angiography (PTCA) as soon as possible. In order to decrease the mortality rate due to acute coronary syndromes and deadly cardiac arrhythmias, the electrocardiography (ECG) knowledge of the ambulance staff, who evaluated as first, is important. We aimed to evaluate the level of electrocardiography knowledge by conducting a survey on the ambulance staff in the province of Sivas.

Material-methods: A total of one hundred seventy-eight healthcare professionals working in ambulances in the centre and districts of Sivas were included in the study, including nurses, paramedics, and emergency medical technicians. The participants were asked to answer survey questions about their working experience, education, age, and completion of a special ECG course and they were expected to interpret 12 different ECGs.

Results: The ratios of correct ECG diagnosis were as follows; anterior ST-elevation myocardial infarction (STEMI), 84.3% (n=150); inferior STEMI, 89.9% (n=160); lateral STEMI, 77.5% (n=138); normal ECG, 64% (n=114); ventricular fibrillation (VF) , 28.1% (n=50); supraventricular tachycardia (SVT), 57.3% (n=102); VT, 17.4% (n=31); and artificial ECG, 13.5% (n=24). According to the results, paramedics had higher correct diagnosis ratios in right bundle branch block and AV complete block compared to EMTs and nurses (<0,001), and EMTs were better in correctly diagnosing left ventricular hypertrophy (p=0,011).

Conclusion: In our study, it was shown that profession, working experience and status of ECG education in the recent year did not make a significant difference, also it has been shown that employees do not recognize life-threatening rhythms on ECG assessment results, suggesting to revise the in-service training.

Keywords: *Prehospital care; Electrocardiography; Emergency medical technician; Paramedics.*

İletişim:
Dr. Öğr. Üyesi Erdal DEMİRTAŞ
Sivas Cumhuriyet Üniversitesi Tıp Fakultesi Acil Tıp Anabilimdalı
Tel: 05418570644
e-mail:
demirtas.erdal@hotmail.com

Geliş tarihi/Received: 10.09.2018
Kabul tarihi/Accepted: 04.10.2018
DOI: 10.16919/bozoktip.458549

Bozok Tıp Derg 2019;9(2):30-6
Bozok Med J 2019;9(2):30-6

Introduction

Acute coronary syndromes compose a major proportion of sudden deaths in the whole world. Cardiovascular disease is the leading global cause of death, accounting for 17.3 million deaths per year, a number that is expected to grow to more than 23.6 million by 2030 (1). In Turkey, about 100,000 people die due to acute coronary syndrome (2). Patients diagnosed with myocardial infarction due to sudden chest pain should be immediately referred to percutaneous coronary angiography (PTCA). The shorter the time between the onset of symptoms and the angiography, the prognosis process is better. The mortality of the disease severely increases if this period is over 90 minutes (3).

One of the ways to shorten this period is to ensure that the team who first arrives at the patient makes a correct assessment of the electrocardiogram (ECG). In a study by Meadows-Pitt and Fields, duration of referral to PTCA of patients that came by themselves or via ambulance was investigated, and this duration was found to be significantly shorter in the patients transferred by paramedics. It was suggested that this may be explained by the fact that the assessment of the ECG recorded by the paramedics and priorly informing the hospital are important factors (4). According to the 2015 American Heart Society Guideline, patients suspected of ST-elevated myocardial infarction should be referred directly to centres with PTCA, if present (3). Since there is no PTCA center in every province in our country, patients applying to the hospital are referred fast to PTCA centres when ST-elevated myocardial infarction (STEMI) is suspected. The quickest information about acute coronary syndrome of the patient is provided by ECG; accurate assessment saves golden minutes in this limited time. Again, fast assessment and management of collapse rhythms that lead to sudden death are lifesaving. Mortal cardiac arrhythmia, ventricular fibrillation/pulseless ventricular tachycardia (VF/pulseless VT) are seen in 6% of all residential cardiac deaths (5). For example, diagnosing ventricular fibrillation (one of the most mortal rhythms in sudden cardiac deaths) at the time of the incident and early defibrillation (defibrillation in the first 3 minutes) decreases the mortality by more than 50% (6). In our country, a broad 112 ambulance service network is present, and the first evaluation of these patients is made by paramedics, nurses and emergency medical technicians (EMT) working at 112 ambulance stations. Studies have shown that accurate diagnosis of STEMI and transfer to the right centre by paramedics working in the field will decrease the door-to-balloon time (7-10). If ECG evaluation is made correctly, transfers to wrong centres that may cause serious delays in the treatment of the patient and time loss through referrals from these centres may be prevented or delay of lifesaving interventions including defibrillation can be made more easily studies conducted abroad determined that paramedics have inadequate knowledge about ECG (11).

Materials and Methods

In our country, emergency health care services are coordinated by the direction of central or regional ambulance stations. Patients can reach the main central by using the 112 emergency phone number. After the call, the ambulance at the closest 112 stations is directed to the case by the main centre, ensuring that the patient benefits from the emergency health service. In ambulances, a nurse (4 years post graduate), a paramedic (4 years high school plus 2 years associate degree) and emergency medical technicians (4 years high school graduate) are employed. Two of the employees in the cabin and one driver are employed in every case. This study is a cross-sectional cohort study, which aims to measure the ECG-knowledge of paramedics, nurses and emergency medical technicians working in 112 emergency health services in Sivas, Turkey. Participants were asked to answer survey questions about their working experience, education, age, and whether they had taken a special ECG course or not. 12 different ECGs with findings of anterior MI, inferior MI, lateral MI, normal ECG, ventricular fibrillation, supraventricular tachycardia, ventricular tachycardia, parasitical ECG, atrial fibrillation, AV complete block, right bundle branch block, and left ventricle hypertrophy were prepared by our department. Participation was set on a volunteering basis, and individuals who did not want to participate were excluded. Since paramedics, EMTs and nurses working in central and district 112 stations of Sivas were included on a volunteering

Bozok Tıp Derg 2019;9(2):30-6
Bozok Med J 2019;9(2):30-6

basis, there was no need for sampling and sample size determination. The statistics were conducted by a reviewer and were controlled by the Department of Biostatistics at the Cumhuriyet University. In this study, every staff member (paramedics, nurses, and EMTs) were asked to participate in the survey. The questionnaire was conducted in a face-to-face setting and the participants answered the questions by writing their answers down. The answers have been evaluated by an Assoc. Prof. from the Department of Cardiology.

Statistical Methods

The data of our study were registered to the SPSS 23 software, and in the data evaluation, frequency analysis was conducted, using chi-square in 2x2 layouts and multiple layouts. A confidence interval was set at 95%, and a p-value < 0.05 was considered statistically significant.

Results

A total of 178 healthcare professionals working in ambulances in the centre and districts of Sivas were included in the study. Of these, 148 (83.1%) were aged between 20-30 years and 30% (16.9%) were aged between 30-40 years. According to their years in working, 142 (79.8%) of them have been serving for 1-6 years and 36 (20.2%) for 7-12 years. When investigating their occupation, it was seen that 88 (49.4%) of them were working as emergency medical technicians, 76 (42.7%) as paramedics and 14 (7.9%) as nurses. The number of participants with any ECG education in the recent years was identified as 132 (74.2%). The responses to the ECG images were assessed as “true” and “false”. The ratios of correct ECG diagnosis are shown in table 1. It was seen that the diagnosis rate of inferior MI ECG was the highest and that the correct diagnosis rate of the mortal VF rhythm ECG was substantially low. The question of the ECG of complete AV block was answered correctly by 41.6% (n=74) of the participants. While the recognition ratio of the right bundle branch block was only 5.6% (n=10), and 32 (18%) participants answered the left ventricular hypertrophy question correctly. There was no significant difference between the two groups (participants working between 1-6 year or 7-12 years) in all rhythms (Table 2).

Table 1: Electrocardiogram Assessment Results

ECG TYPE	Responses	N(%)
Anterior STEMI	Correct	150(84,3%)
	İncorrect	28(15,7%)
İnferior STEMI	Correct	160(89,9%)
	İncorrect	18(10,1%)
Lateral STEMI	Correct	138(77,5%)
	İncorrect	40(22,5%)
Normal ECG	Correct	114(64,0%)
	İncorrect	64(36,0%)
Ventricular Fibrillation	Correct	50(28,1%)
	İncorrect	128(71,9%)
Supraventricular Tachycardia	Correct	102(57,3%)
	İncorrect	76(42,7%)
Ventricular Tachycardia	Correct	31(17,4%)
	İncorrect	147(82,6%)
Artifical ECG	Correct	24(13,5%)
	İncorrect	154(86,5%)
Atrial Fibrillation	Correct	60(33,7%)
	İncorrect	118(66,3%)
3rd Degree AV Complete Block	Correct	74(41,6%)
	İncorrect	104(58,4%)
Right Bundle Branch Block	Correct	10(5,6%)
	İncorrect	168(94,4%)
Left Ventricular Hypertrophy	Correct	32(18,0%)
	İncorrect	146(82,0%)

Again in our evaluations, it was realized that paramedics were better in diagnosing right bundle branch block and AV complete block in ECG assessment compared to EMTs and nurses and that EMTs were better in diagnosing left ventricular hypertrophy. It was seen that participants without any course for ECG in the recent year were more successful in diagnosing SVT and artificial ECG and that individuals educated in the recent year were more successful in diagnosing right bundle branch block (Table3, Table4).

ECG Type	Responses	ECG education in the recent last year				p
		1-6 years		7-12 years		
		N	%	N	%	
Anterior STEMI	Correct	118	(83,10%)	32	(88,90%)	0,394
	İncorrect	24	(16,90%)	4	(11,10%)	
Inferior STEMI	Correct	128	(90,10%)	32	(88,90%)	0,824
	İncorrect	14	(9,90%)	4	(11,10%)	
Lateral STEMI	Correct	106	(74,60%)	30	(83,30%)	0,48
	İncorrect	34	(23,90%)	6	(16,70%)	
Normal ECG	Correct	88	(62,00%)	26	(72,20%)	0,252
	İncorrect	54	(38,00%)	10	(27,80%)	
Ventricular Fibrillation	Correct	42	(29,60%)	8	(22,20%)	0,38
	İncorrect	100	(70,40%)	28	(77,80%)	
Supraventricular Tachycardia	Correct	80	(56,30%)	22	(61,10%)	0,605
	İncorrect	62	(43,70%)	14	(38,90%)	
Ventricular Tachycardia	Correct	23	(16,20%)	8	(22,20%)	0,395
	İncorrect	119	(83,80%)	28	(77,80%)	
Artificial ECG	Correct	20	(14,10%)	4	(11,10%)	0,641
	İncorrect	122	(85,90%)	32	(88,90%)	
Atrial Fibrillation	Correct	48	(33,80%)	12	(33,30%)	0,958
	İncorrect	94	(66,20%)	24	(66,70%)	
3rd Degree AV Complete Block	Correct	56	(39,40%)	18	(50,00%)	0,251
	İncorrect	86	(60,60%)	18	(50,00%)	
Right Bundle Branch Block	Correct	8	(5,60%)	2	(%5,6%)	0,985
	İncorrect	134	(94,40%)	34	(94,40%)	
Left Ventricular Hypertrophy	Correct	22	(15,50%)	10	(27,80%)	0,086
	İncorrect	120	(84,50%)	26	(72,20%)	

Table 2: ECG Assessment Results According to Working Years

ECG Type	Responses	ECG education in the recent last year				p
		yes		no		
		N	%	N	%	
Anterior STEMI	Correct	36	(78,26%)	114	(86,36%)	0,194
	İncorrect	10	(21,74%)	18	(13,64%)	
Inferior STEMI	Correct	44	(95,65%)	116	(87,88%)	0,132
	İncorrect	2	(4,35%)	16	(12,12%)	
Lateral STEMI	Correct	38	(82,61%)	98	(74,24%)	0,423
	İncorrect	8	(17,39%)	32	(24,24%)	
Normal ECG	Correct	26	(56,52%)	88	(66,67%)	0,217
	İncorrect	20	(43,48%)	44	(33,33%)	
Ventricular Fibrillation	Correct	12	(26,09%)	38	(28,79%)	0,726
	İncorrect	34	(73,91%)	94	(71,21%)	
Supraventricular Tachycardia	Correct	18	(39,13%)	84	(63,64%)	0,004
	İncorrect	28	(60,87%)	48	(36,36%)	
Ventricular Tachycardia	Correct	6	(13,04%)	25	(18,94%)	0,364
	İncorrect	40	(86,96%)	107	(81,06%)	
Artificial ECG	Correct	2	(4,35%)	22	(16,67%)	0,035
	İncorrect	44	(95,65%)	110	(83,33%)	
Atrial Fibrillation	Correct	18	(39,13%)	42	(31,82%)	0,366
	İncorrect	28	(60,87%)	90	(68,18%)	
3rd Degree AV Complete Block	Correct	16	(34,78%)	58	(43,94%)	0,278
	İncorrect	30	(65,22%)	74	(56,06%)	
Right Bundle Branch Block	Correct	8	(17,39%)	2	(1,52%)	<0,001
	İncorrect	38	(82,61%)	130	(98,48%)	
Left Ventricular Hypertrophy	Correct	6	(13,04%)	26	(19,70%)	0,312
	İncorrect	40	(86,96%)	106	(80,30%)	

Table 3: ECG Assessment Results According to Education in the Recent Year

Table 4: ECG Assessment Results According to Higher Education

ECG Type	Responses	Higher Education						p
		Emergency medial tecnician		Paramedic		Nurse		
		N	%	N	%	N	%	
Anterior STEMI	Correct	76	(86,40%)	76	(81,60%)	12	(85,70%)	0,695
	İncorrect	12	(13,60%)	12	(18,40%)	2	(14,30%)	
Inferior STEMI	Correct	76	(86,40%)	76	(94,70%)	12	(85,70%)	0,179
	İncorrect	12	(13,60%)	12	(5,30%)	2	(14,30%)	
Lateral STEMI	Correct	60	(68,20%)	60	(86,80%)	10	(71,40%)	0,059
	İncorrect	26	(29,50%)	26	(13,20%)	4	(28,60%)	
Normal ECG	Correct	54	(61,40%)	54	(65,80%)	10	(71,40%)	0,702
	İncorrect	34	(38,60%)	34	(34,20%)	4	(28,60%)	
Ventricular Fibrillation	Correct	26	(29,50%)	26	(23,70%)	6	(42,90%)	0,311
	İncorrect	62	(70,50%)	62	(76,30%)	8	(57,10%)	
Supraventricular Tachycardia	Correct	54	(61,40%)	54	(50,00%)	10	(71,40%)	0,183
	İncorrect	34	(38,60%)	34	(50,00%)	4	(28,60%)	
Ventricular Tachycardia	Correct	11	(12,50%)	11	(23,70%)	2	(14,30%)	0,161
	İncorrect	77	(87,50%)	77	(76,30%)	12	(85,70%)	
Artificial ECG	Correct	14	(15,90%)	14	(10,50%)	2	(14,30%)	0,6
	İncorrect	74	(84,10%)	74	(89,50%)	12	(85,70%)	
Atrial Fibrillation	Correct	26	(29,50%)	26	(36,80%)	6	(42,90%)	0,463
	İncorrect	62	(70,50%)	62	(63,20%)	8	(57,10%)	
3rd Degree AV Complete Block	Correct	28	(31,80%)	28	(50,00%)	8	(57,10%)	0,029
	İncorrect	60	(68,20%)	60	(50,00%)	6	(42,90%)	
Right Bundle Branch Block	Correct	2	(2,30%)	2	(10,50%)	0	(0,00%)	0,046
	İncorrect	86	(97,70%)	86	(89,50%)	14	(100,00%)	
Left Ventricular Hypertrophy	Correct	18	(20,50%)	18	(10,50%)	6	(42,90%)	0,011
	İncorrect	70	(79,50%)	70	(89,50%)	8	(57,10%)	

Discussion

During a cardiac problem, lifesaving applications or resuscitation through cardioversion/defibrillation are based on the correct diagnosis of the ECG (12), and in the field, 112 staff members evaluate the ECGs.

In a study by Mechl et al., who investigated the STEMI diagnosis skills of paramedics, 78% correctly diagnosed anterior MI, 51% lateral MI and 94% inferior MI. (11) In a study by Trivedi et al. which included 3 STEMI and 2 non-STEMI cases, 94% of the paramedics correctly diagnosed the cases, ensuring the activating of the PTCA team (13). Again, in a study by Sheldon Cheskes et al., it was shown that paramedics failed to diagnose a prehospitally recorded single ECG with STEMI with 20% (14). Abdeljalil Khelassi et al. used a computer-aided detection of cardiac arrhythmias and the ECG analysis resulted in correct answers at 97% for anterior MI and at 95% for inferior MI (15). In our study, accurate diagnosis rate of anterior MI was 84%, inferior MI 89%, and lateral MI 77%. Although it seems proportionally successful and the studies seem similar, we consider that a higher level for the vitally important MI diagnosis should be yielded, especially for the staff members who work in the field. Moreover, given the diagnostical challenge of prehospitally recorded single ECG, the importance of emphasizing the clinical correlation with ECGs in educations emerges.

Again, in a study by Mechl et al., the diagnosis ratio of normal ECG was 97-100%, and in a study by Khelassi et al., it was seen that the diagnosis ratio of normal ECG in a software was 56% (11,15). Yet, in our study, this ratio was detected as 64%. The low diagnosis rate of normal ECG and the accuracy similar to software level is considerable. Alongside the negative effect of pathology pursuit with an "if it is asked, there is a pathology, certainly"-expectation and only commenting on ECG without a patient, the significance

of re-education in basic ECG knowledge is accentuated. Additionally, we suggest that the error rate in normal and pathological ECG could minimize if specialists would evaluate the patient's ECG remotely with the help of developing the technology.

The most significant cause of death in adults is VF/pulseless VT, which is classified among mortal rhythms. In these patients, spontaneous recirculation of the heart is only ensured with early defibrillation. In a study by Niemann et al., it was found that survival declines by approximately 7% to 10% for each minute without defibrillation, while according to the 2015 European Resuscitation guideline, an increase of 50-70% in survival was seen in defibrillations made in 3-5 minutes, however, it was found that the survival decreased at 10-12% for each minute delay (16,17). In an analysis by Osei-Ampofo et al. that included two cases, it was suggested that the paramedics should transfer the patients with acute coronary syndrome with the defibrillator pads mounted. While successful defibrillation is achieved after 27 seconds in VF developing in patients transferred by this way, defibrillation was obtained after 2 minutes 43 seconds in patients that were not transferred with the pads-on protocol (18). In our study, the VF diagnosis rate on ECG by 112 staff was found as 28%. Although the low diagnosis rate of VF - a mortal rhythm - by the healthcare staff that first encounters the patient in the field is dismal, it is a gain that the necessity of intensifying educations arose, especially those supported with case scenarios. In particular, we included noisy display ECGs in our study. Our aim was to establish the knowledge of paramedics in this situation, which is commonly encountered in ECGs recorded in an ambulance due to the motion. Only 13% of the participants answered correctly. However, we considered if this low rate would reoccur on condition that the ECG would be recorded during patient transport, particularly in moving ambulances and during shaking. We could find no study establishing the knowledge of ambulance staff on noisy display ECGs. Upon this low rate, we assessed the incorrect answers and found that it was diagnosed with VT/VF at 12.3%, which need defibrillation for diagnosis. In our study, it was also found that the rate of correct interpretation by the paramedics in other rhythm analyses (SVT, VT, right bundle branch block, left bundle branch block) was low. In a study by Daudelin et al., it was demonstrated that in case of the ambulance staff confirmed the diagnosis of patients with STEMI earlier, the door-balloon time of the patients decreased and referral to PTCA increased after education (19). In our study, it was shown that the profession of the staff, working experience and status of ECG education in the recent year was not significantly effective on the ECG assessment results, suggesting to revise the in-service training.

Limitations

The most limitation of our study was that we requested the ambulance staff to assess ECG without any patient and physical examination. We suggest that clinical signs and history would contribute positively to the ECG assessment results.

Conclusion

Patients with acute coronary syndromes can easily be rescued with quick and correct interventions. Reduction in time leads to a reduction in myocardial damage and mortality. Cardiologists may perform PTCA very well and emergency service specialists may have a good knowledge on ECG, however; if the case is delayed, if the correct intervention is not done, if VF defibrillation is delayed, it may not be possible to reduce the mortality rate in patients. Inadequate ECG knowledge of 112 staff working in the field is very serious and should be emphasized. It is unacceptable that some life-threatening rhythms are unknown. The causes of the poor knowledge on rhythms in which rapid intervention may be vital should be further investigated and deliberated over and over in educational programs.

Ethics and declaration:
There are no conflicts of interest or funding source to declare. The study was approved by the Cumhuriyet University Ethical Committee in Sivas, Turkey (2016-12/08).
The study adhered to the tenets of the Declaration of Helsinki.

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