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Predictive value of the interface pressure and ferquency of pressure ulcer in elderly patients in the internal medicine intensive care units

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Abstract

Aim: Pressure ulcers develop frequently in immobile elderly. Pressure is extrinsic factor and ıt plays a major role in ulcer development. Nurses use a pressure ulcer risk assessment tools and risk assessment effectives as a means to ulcers preventing. To determine frequency and predictive value of interface pressure in pressure ulcer development in elderly patients hospitalized in internal medicine intensive care units.

Materials and Methods: The study involved 140 patients admitted to internal intensive care clinics between April 2018 and August 2018 without pressure ulcers and who stayed in the ICU for more than 72 hours. Participants were scored using the Braden scale and were examined for the risk level of pressure ulcers. The inclusion criteria were age over 65 years and having a high risk of developing pressing ulcers. Patients were evaluated by "Questionnaire Form,"Braden Risk Assessment Scale" and "Palm Q-Portable Interface Pressure Sensor" every two days during their stay in the clinic.

Results: Pressure ulcer developed in 22.1% of the patients but it didn't develop in any of the oral feeding patients. The mean time for ulcer to develop was 6.90±2.9 days. In patients with pressure ulcers, while the mean interface pressure value was 47.75±6.79 mmHg at the beginning of the final evaluation position, 51.25± 6.71mmHg at the end of the position.

Conclusion: In all interface pressure measurements of patients who developed pressure ulcer, the interface pressure values increased at the end of the position compared to the beginning of the position.

Introduction

Pressure ulcers are common in immobile hospitalised elderly, especially in intensive care patients, and where bone spurs are present [1]. According to NPUAP data, 1.3-3 million patients developed pressure ulcer in the United States in 2016. It was found in the studies conducted in Korea and Japan in 2010, and conducted in Iran in 2012 that the incidence of pressure ulcer in patients hospitalized in intensive care clinics was 5.9%, 11.2% and 13.4% respectively [2-4].

Pressure ulcer, which is an important health problem in elderly people who stay in nursing homes, are hospitalized or immobilized, Pressure ulcer is decreases the quality of life of patients, prolongs hospital stay, increases the risk of complications and increases the cost of care and mortality. Risk factors need to be identified and evaluated to reduce the frequency of pressure ulcer and to prevent its development. Risk factors of pressure ulcer are divided into two groups as extrinsic and intrinsic. Extrinsic factors include pressure, moisture, friction and tear. Intrinsic factors include immobilization, lack of activity, deterioration in sensory perception, nutrition, demographic characteristics, oxygenation, skin temperature and chronic diseases [5-7].

One of the important risk factors for pressure ulcer is pressure and pressure is mostly associated with reduced or loss of mobilization. According to the European Pressure Ulcer Advisory Panel (EPUAP) and NPUAP (2009), pressure inhibits circulation and causes tissue integrity to deteriorate. Under prolonged and constant pressure, the skin becomes thinner and the possibility of developing atrophy and pressure ulcer increases [8]. Landis (1930) found in his study that blood pressure was 32 mmHg in the precapillary arterioles, and 12 mmHg in the venule tip. When the interface pressure on the tissue exceeds 32 mmHg, blood flow to the capillary bed is blocked and it causes tissue ischemia. As a result of the studies, it was determined that

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the continuous and sufficient pressure that disrupts the blood flow causes hypoxia, localized ischemia, tissue acidosis and cellular necrosis. Determining the risk of wound development with pressure measurement is important for preventing pressure ulcer and initiating appropriate interventions [6]. The pressure in the precapillary arterioles can only be determined by invasive techniques. Since it isn't possible to evaluate the pressure formed in the soft tissues and the precapillary arterioles feeding those tissues, the measurement of the vertical force per unit area between the body and the support surface is taken into account in practice. The interface pressure is the force acting per unit area vertically between the body and the support surface. The interface pressure generated during the delivery of external pressure to subcutaneous tissues is predictive of tissue damage [9-13]. In their study, Suriadi et al. (2007) found that interface pressure was one of the risk factors affecting pressure ulcer development [14].

The fact that pressure causes tissue damage is related to application time, density of pressure and tissue tolerance. In a study, it was reported that necrosis and pressure ulcer occurred as a result of tissue ischemia lasting 1-2 hours in neurological patients [15]. Tissue tolerance is explained by the fact that tissues are affected at different rates by different pressures. The reason for the different tolerances of tissues against pressure is the different reflections of pressure on different tissue depths. When pressure was exerted on a bone spur, it was found that the soft tissue closest to the bone spur had the most damage. It was reported that the highest pressure was near the bone spur and it was 40-60 mmHg in sacrum, hips and heels in supine position, 70-80 mmHg in thoracanter in lateral position and 75-100 mmHg in ischiadic tubercles in sitting position [10,16]. In interface pressure measurements, it was found that the pressure affected a wider area in the deep tissues adjacent to the bone and was reflected to a narrower area on the surface.

The fact that tissues are affected by different pressures at different rates is explained by the tolerance of the tissues. The reason why tissues have different tolerances to pressure is the different reflection of pressure on different tissue depths. When pressure is applied to a bony prominence, the damage is greatest in the soft tissues closest to the bony prominence [10]. The fact that the pressure affecting the tissue disappears for a short time increases the tolerance of the tissues significantly [17]. NPUAP and EPUAP (2014) reported that reducing interface pressure is a valid clinical intervention to reduce pressure ulcer development [18]. Therefore, measurement of interface pressure is becoming widespread in research and clinical settings based on the assumption that there is a relationship between interface pressure and pressure ulcer development [19]. However, as a result of the literature review, it was found that there was limited research in which the interface pressure was evaluated in the elderly and the pressure ulcer development in the elderly patients in the intensive care unit was not examined sufficiently [12,13].

Materials and Methods

The study was conducted analytically to determine the frequency of pressure ulcer development and predictive value of interface pressure in pressure ulcer development in elderly patients hospitalized in internal medicine intensive care units.

The population of the study consisted of patients aged 65 and over who were hospitalized in the clinics mentioned above for four months. In an earlier study conducted in Turkey on this topic, the prevalence of pressure ulcer seen in the elderly was found to be 10.52% [20]. 95% confidence interval and 10.52% prevalence were calculated by using unknown sample calculation method. The number of samples was calculated as 139 and 140 patients were reached. Patients were included in the sample using the nonprobability random sampling method.

The study was conducted in an internal medicine intensive care clinic, chest diseases intensive care clinic, coronary intensive care clinic and anesthesia intensive care clinic of a university hospital. The patients who were aged 65 and over who are hospitalized in the designated clinics and dates of the hospital, unable to be mobilized, bedridden, positioned every two hours, are evaluated within the first 24 hours of admission to the clinic, and high risk (range of 10-12 points) and very high risk (in the range of 6-9 points) according to the Braden Risk Assessment Scale, patients who did not develop pressure ulcers and who were hospitalized for at least 72 hours were included in the study. The patients who couldn't physically participate in the practices, couldn't be evaluated every other day, had neurological disorders and received antineoplastic treatment weren't included in the study.

The data of the study were collected by the researcher an internal medicine intensive care clinic, chest diseases intensive care clinic, coronary intensive care clinic and anesthesia intensive care clinic between April and August 2018. A questionnaire form was applied to these patients. Interface pressure was measured with Palm Q-Portable Interface Pressure Sensor 4 cm below the sacrum while the patients were in supine position (at the beginning of the position: at the 1st minute of the position and at the last minute of the 2nd hour). Patients were evaluated every two days during their stay in the clinic. In this process, interface pressure was evaluated at least twice (three days) and eight times at the most (15 days). The patients who developed pressure ulcer were evaluated according to the staging system developed by EPUAP and NPUAP and added to the data of that patient and the evaluation of that patient was finished.

The data of the study were collected by using the "Questionnaire Form, "Braden Risk Assessment Scale" and "Palm Q-Portable Interface Pressure Sensor" prepared by the researchers in the light of literature.

With the "Questionnaire Form" prepared in the light of literature, the socio-demographic characteristics of the participants (height and weight measurement values (taken from the patient anamnesis forms) and the specific conditions (comorbidities, features of bed, nutritional status and blood values) affecting the pressure ulcer development were examined. "Body Mass Index" groupings were made according to World Health Organization standards. The questions about the factors affecting the pressure ulcer development were presented to the opinion of 3 experts in the field of nursing and arrangements were made in accor-

dance with the recommendations.

The Braden Risk Assessment Scale has six subcategories: sensory perception, moisture, activity, movement, nutrition, friction and tearing. The total score on the Braden scale ranges from 6 to 23. A lower total score indicates a high risk of pressure ulcer development. Those who score between 12 and 10 are defined as high risk and those who score between 9 and 6 are defined as very high risk [21]. Reliability-Validity of Braden Risk Assessment Scale was conducted in Turkey by Pınar and Oğuz in 1988 and was found as high.

The Palm Q-Portable Interface Pressure Sensor is a scanning device that measures interface pressure. This device was developed by Cape Co., Ltd. in Yokosuka, Japan. This device measures in about 10 seconds. The pressure range of this device is determined as 0 - 200 ± 3 mmHg, respectively.

Before starting the study, necessary approval from the Ethics Committee, institutional permission from the hospital where the research was conducted, and verbal consent from the participants / family members were obtained.

Statistical analysis of the data was conducted under the supervision of a statistical expert with the statistical package program "Statistical Package for the Social Sciences (SPSS) 22.0" (PASW Inc., Chicago. IL.USA). Descriptive statistics, -square test, COX Regression (in numerical data), Kaplan Meier-Survival Time (categorical data) test were used in the analysis of the data. Results were evaluated at 95% confidence interval and p <0.05 significance level. In reporting this research, the authors adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

Results

The mean age of the patients is 71.60 ± 6.90 years and the mean BMI is 24.64 ± 3.13 kg / cm^2. 5% of the patients are cachectic and 5.7% are obese, 39.3% are overweight and half of the patients are normal weight. Of the patients included in the study, 52.1% are women and 82.1% are non-smokers. Airbeds are used in 57.1% of the patients (Table 1).

Pressure ulcer developed in 22.1% of the patients during

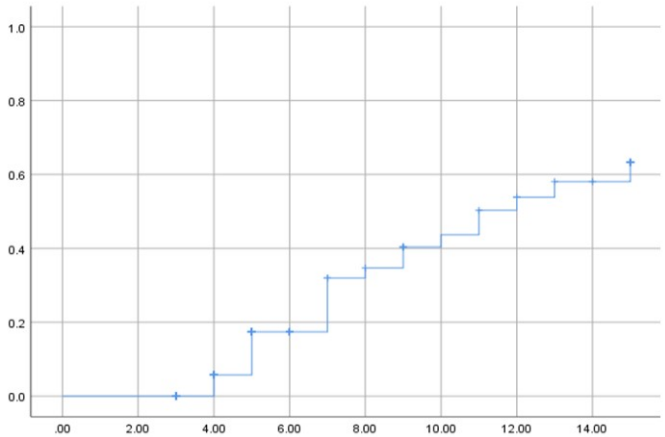

Figure 1. Distribution of pressure ulcer developments times according to survival analysis.

Table 1. Descriptive characteristics of elderly patients hospitalized in internal medicine intensive care units.

Socio-Demographic Characteristics			
		Mean	Standard Deviation
Age		71.60	± 6.90
Body Mass Indeks		24.64	± 3.13
		n	%
Gender	Woman	73	52.1
	Man	67	47.9
Properties Affecting Pressure Ulcer Development			
		n	%
Body Mass Indeks	Cachexia (< 18.49)	7	5
	Normal (18.5-24.9)	70	50
	Overweight (25.0-29.9)	55	39.3
	Obese (30.0 <)	8	5.7
Smoking	Smoker	25	17.9
	Non-Smoker	115	82.1
Nutrition	Regime-1	39	27.9
	Enteral nutrition / TPN / Enteral nutrition+TPN	101	72.1
Bed	Standard hospital bed	60	42.9
	Airbed	80	57.1

period in which they were controlled. Ulcer has developed at the earliest on the 3rd day and at the latest on the 15thday (Figure 1).

The meantime for ulcer development was found to be 6.90 ± 2.9 days (Table 2).

Pressure ulcer developed in 36% of smokers and in 19.1% of non-smokers. The meantime for pressure ulcer development (7.62±1.0) in smokers was found to be significantly shorter than in non-smokers (11.55±0.6) (p = 0.002). All cachectic patients developed pressure ulcer, followed by obese, normal and overweight patients (25%, 21.4%, 12.7%). A significant difference was found between pressure ulcer development and BMI groups (p=0.00). When body mass index and time for pressure ulcer development were evaluated, it was determined that pressure ulcer developed in cachectic patients (4.87±0.4 days) in a shorter period and that it developed at the latest in overweight patients (12.61±0.7 days), and a statistically significant difference was found between them (p=0.00) (Table 2).

In patients who developed pressure ulcer, the interface pressure at the beginning of the supine position on the first day of hospitalization was 40.92±6.87 mmHg. After two hours in the same position, the interface pressure value was measured as 44.41±7.09 mmHg. On the third day, the interface pressure at the time of the supine position was 42.39±7.41 mmHg. After two hours in the same position, the interface pressure value was measured as 45.97±7.50 mmHg. At the final evaluation of all patients, the interface pressure at the time of the supine position was 47.75±6.79 mmHg. After two hours in the same position, the inter-

Table 2. Pressure ulcer development and interface pressure values in elderly patients.

		Developed		Undeveloped		p value
		n	%	n	%	
Pressure Ulcer		31	22.1	109	77.9	0.000
Smoking	Smoker	9	36.0	16	64.0	0.066
	Non-Smoker	22	19.1	93	80.9	
Body Mass Indeks	Cachexia (< 18.49)	7	100	0	0	0.000
	Normal (18.5-24.9)	15	21.4	55	78.6	
	Overweight (25.0-29.9)	7	12.7	48	87.3	
	Obese (30.0 <)	2	25.0	6	75.0	
Nutrition	Regime-1	0	0	39	100	0.000
	Enteral nutrition / TPN / Enteral nutrition+TPN	31	30.7	70	69.3	
		Mean	Standard Deviation	Mean	Standard Deviation	
1.day – pre-position measurement		40.92	±6.87	37.10	±5.12	0.000
1.day – post-position measurement		44.41	±7.09	40.50	±5.18	
3.day – pre-position measurement		42.39	±7.41	37.52	±5.12	
3.day – post-position measurement		45.97	±7.50	41.12	±5.21	
Final assessment pre-position measurement		47.75	±6.79	37.61	±5.06	
Final assessment post-position measurement		51.25	±6.71	41.19	±5.15	
				Mean	Standard Deviation	
Pressure ulcer development times (day)				6.90	± 2.9	
Smoking	Smoker			7.62	± 1.0	0.002
	Non-Smoker			11.55	± 0.6	
Body Mass Indeks	Cachexia (< 18.49)			4.87	±0.4	0.000
	Normal (18.5-24.9)			10.68	±0.8	
	Overweight (25.0-29.9)			12.61	±0.7	
	Obese (30.0 <)			5.0	±0.0	

Table 3. Relationship between pressure ulcer and interface pressure values in elderly patients.

	B	Standard Deviation	Exp(B)	%95 C.I.	p value
Interface Pressure					
1.day – pre-position measurement	0.12	± 0.02	1.135	(1.07-1.20)	0.000
1.day – post-position measurement	0.12	± 0.02	1.134	(1.07-1.19)	0.000
3.day – pre-position measurement	0.13	± 0.02	1.147	(1.08-1.21)	0.000
3.day – post-position measurement	0.13	± 0.02	1.145	(1.08-1.20)	0.000
Final assessment pre-position measurement	0.15	± 0.02	1.169	(1.11-1.22)	0.000
Final assessment post-position measurement	0.15	± 0.02	1.166	(1.11-1.22)	0.000

face pressure value was measured as 51.25±6.71 mmHg (Table 2).

In the last evaluations made on the first, third and different days, it was determined that one unit increase in the interface pressure value at the beginning of the position increased the pressure ulcer development by one fold (p=0.00). In the last evaluations made on the first, third and different days, it was determined that a one-unit increase in the interface pressure value after two hours of position increased pressure ulcer development in the similar way (p=0.00).

In all measurements, the relationship between interface pressure and pressure ulcer development was evaluated by COX-Regression Analysis and a statistically significant difference was found between them (p=0.00).

It is clear that on the first day, a one-unit increase in the interface pressure value at the beginning and at the end of the supine position increased the pressure ulcer development by one fold (95% G.A: 1.07-1.20; 95% G.A: 1.07-1.19, respectively). It is evident that on the third day, a one-unit increase in the interface pressure value at the beginning and at the end of the supine position increased the pressure ulcer development by one fold (95% G.A: 1.08-1.21; 95% G.A: 1.08-1.20, respectively). In the last evaluation, it is seen that one unit increase in the interface pressure value at the beginning and end of the supine position increased the pressure ulcer development by one fold (95% G.A: 1.11-1.22; 95% G.A: 1.11-1.22, respectively) (Table 3).

Discussion

It was found in our study that 22.1% of elderly patients hospitalized in intensive care clinics developed pressure ulcer. When the results of the studies conducted in different countries are examined, it is apparent that the frequency of pressure ulcer is similar to our results. Gedamu et al. (2014) found that 22.7% of hospitalized patients aged 54 years and over developed pressure ulcer [22]. Rasero et al.

(2015) also found that pressure ulcer developed in 22.52% of elderly patients hospitalized in intensive care units [23]. Gherghina et al. (2014) found that 21.6% of elderly patients developed pressure ulcer [24]. In a study conducted in Italy, it was found that the incidence of pressure ulcer was 22.7%, the mean age of those without pressure ulcer was 83.7-7.8 years, and the mean age of those with pressure ulcer was 85.6-6.9 years [25]. In the scope of our study, it can be said that the frequency of pressure ulcer is higher in elderly patients in intensive care unit.

In some of the studies examined, the frequency of pressure ulcer is different from our results. The factors such as nutrition and comorbidities may be the reason why our study results differ from the results of the study mentioned above. Some diseases increase the pressure ulcer development (metabolic disorders, circulatory disorders... etc.). In a study conducted with 2099 patients in the intensive care unit in Macedonia, the frequency of pressure ulcer was found to be 12.19% [26]. Neloska et al. (2016) reported that 61.7% of the patients had good nutritional status [26]. In our study, 72.1% of the patients were given enteral feeding and only 27.9% received regimen-1. In a retrospective study examining the frequency of pressure ulcer development, malnutrition was reported to be a risk factor for pressure ulcer development [27]. Borsting et al. (2017) found the frequency of pressure ulcer to be 14.9% in their study and stated that the frequency of pressure ulcer was higher in diabetic patients compared to other patients [28]. While 9.5% of the patients who participated in the study by Borsting et al. (2017) had diabetes, 22% of the patients who participated in our study had diabetes. Therefore, it is thought that the incidence of pressure ulcer is higher in the patients in our study [28].

In our study, it was found that the mean age of the patients who developed pressure ulcer was higher than the mean age of those who did not develop pressure ulcer (mean age of those who developed pressure ulcer was 72.41±1.01 years; mean age of those who did not develop pressure ulcer was 71.37±0.69 years). It is known that the risk for developing pressure ulcer increases as age increases [5,14]. In the studies carried out, it was seen that the mean age was lower in those who developed pressure ulcer than those who did not [26,29]. Lahmann (2006) determined that the mean age of patients without pressure ulcer was 62.5 years and the mean age of those who developed pressure ulcer was 73.4 years [30]. According to the study of Neloska et al. (2016), the mean age of those who did not develop pressure ulcer was 76.32±11.1 years, and the mean age of those who developed pressure ulcer was 76.38±11.1 years [26].

Jiang et al. (2014) found that 30.28% of the patients in the 70-79 age range, 23.11% of the patients in the 80-89 age range, 5.18% of the patients in the age group of 89 and over developed pressure ulcer [29]. Contrary to the information that the risk foor pressure ulcer development increases with age, the study of Jiang et al. shows that the frequency of pressure ulcer development decreases in older ages [29]. This may be due to methodological differences. In our study, patients with high and very high risk for developing pressure ulcers in the intensive care unit were included; however, in the study of Jiang et al. (2014), all patients hospitalized in clinics such as daily care units and emergency maternity wards were included [29]. Another reason for this difference can be explained by the fact that age is not an effective factor in pressure ulcer development alone, and that factors such as diseases, medications, nutritional status and moisture of the skin are also effective in ulcer development [6,15].

In our study, no pressure ulcer developed in any of the patients fed with Regim-1, however 30.7% of the patients given "Enteral feeding", "Total Parenteral Nutrition (TPN) feeding" or "Enteral and TPN feeding" developed pressure ulcer. Saghaleini et al. (2018) stated that nutritional deficiency was a key risk factor for ulcer development, collagen synthesis and tension strength were reduced in case of malnutrition, and sudden weight loss was the major risk factor for pressure ulcer development [31]. According to the results of our study, it can be said that TPN feeding is a risk factor for pressure ulcer development, some basic nutrients cannot be provided in patients given TPN feeding and therefore, the risk for pressure ulcer development increases. In our study, the development of pressure ulcer in all cachectic patients supports this prediction.

According to the BMI groups, the pressure ulcer development and the time of pressure ulcer development evaluated by survival analysis were found to be parallel to each other. The pressure ulcer was found to be the highest and earliest in cachectic patients, followed by obese, normal and overweight patients, respectively. According to our findings, it can be stated that cachexia and obesity are important factors in the development of pressure ulcer. Neloska et al. (2016) found that pressure ulcer developed in 35.15% of patients with a body mass index above 20kg/m^2[26]. Hyun et al (2014) found that the rate of pressure ulcer was higher in cachectic and obese elderly patients compared to other groups. In thin individuals, ulcer development is facilitated by loss of adipose tissue due to changes in negative nitrogen balance. Obesity, on the other hand, causes the deterioration of adipose tissue and the tissues in the lower layer become more susceptible to ischemic damage [32].

While 17.8% of women participated in our study developed pressure ulcer, 26.9% of men developed pressure ulcer. Our study findings support the results of studies indicating that male gender is a risk factor for pressure ulcer. Borghardt et al. (2015) reported that 59% of male patients developed pressure ulcer [33]. Gedamu et al. (2014) found that 50.7% of male patients developed pressure ulcer [22]. In their study, Rasero et al. (2015) found that men were more risky in terms of pressure ulcer development than women were [23].

In our study, it was found that 36% of the patients who smoked had pressure ulcer. In a study by Borghardt et al. (2015), pressure ulcer developed in 18% of smokers [33]. Nassaji et al. (2013) found in their study that there was a statistically significant relationship between smoking and pressure ulcer ($p<0.001$) [34]. Smoking is an important risk factor in the development of pressure ulcer. Due to the physiological effects of smoking (disruption of tissue oxygenation, endothelial damage, etc.), it can be said that pressure ulcer is more common in patients.

The mean time for the development of ulcer was found to

be 6.90 ± 2.9 days and the ulcer developed at the earliest on the 3rd day and at the latest on the 15th day. In a study by Gherghina et al. (2014), pressure ulcers developed on average 5 days in elderly patients [24]. Ülker Efteli and Yapucu Güneş (2013) reported in their study that pressure ulcer developed in 1% of patients in 10 days, 50% in 1-5 days, 5% in 6-10 days, and 15% in 11-15 days [35].
In our study, when the relationship between the mean value of interface pressure and pressure ulcer development was evaluated, it was found that the mean value of interface pressure at the beginning of position in all measurements was between 40 and 47 mmHg in those who developed pressure ulcer. At the end of the position, it was determined that the interface pressure value was between 44 and 51 mmHg in those who developed pressure ulcer. In the literature, it is stated that the interface pressure between 40 and 60 mmHg affects pressure ulcer development [16]. Supriadi et al. (2014) found in their study that the peak value of interface pressure was 66.2±42.0 mmHg in those who developed pressure ulcer and 42.7±14.8 mmHg in those who did not develop pressure ulcer and found a statistical significance (p=0.00) [12]. We can say that our findings support the results of the study conducted by Supriadi et al. indicating the interface pressure value is a factor affecting pressure ulcer development.

Conclusion

As a result of our study results, it is clear that the pressure ulcer developed frequently in the patients being cachectic and given TPN feeding and the interface pressure was higher than 32 mmHg. The higher the interface pressure, the higher the risk for developing pressure ulcer. Therefore, it is recommended that interface pressure measurements and pressure reducing measures be taken in TPN-fed and cachectic patients.

Limitations

During the study period, all patients could not be evaluated equally. Patients were not selected by randomization to the study.

Competing interests

The authors declare that they have no competing interest.

Financial disclosure

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Ethics approval

The study was approved by the local ethical committee (Decision date:27.10.2017, Decision number:2017/45, Aydın Adnan Menderes University Faculty of Health Sciences, Non-Invasive Clinical Research Ethics Committee).

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