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KEY WORDS: Antiembolic stockings, device-related pressure injury, pressure ulcer, massage, moisturise, intensive care unit.

THE EFFECT OF MASSAGE ON THE PREVENTION OF COMPRESSION STOCKING-ASSOCIATED PRESSURE INJURY IN INTENSIVE CARE PATIENTS

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ABSTRACT

AIM: Effect of massage on prevention of antiembolic stockings- associated pressure injury (AES-API).

MATERIALS AND METHODS: It is a quasi-experimental design design. The massage group (n=30) received skin massage and skin protective care with a moisturizer at least 3 times or at every change of position (every 2 hours a day) in a day during the period they wore AES. The nonmassage group(n=39), no massage was performed.

RESULTS: There was no significant difference between the sociodemographic and clinical characteristics of the massage group and nonmassage groups during ICU admission. The duration of AES use in the massage group was longer than that of the nonmassage group during the treatment and care period (p>0.05). However, AES-API only observed in the nonmassage group (n=5; 12.8%).

CONCLUSION: The short superficial skin massage may beneficial for its prevention for AES-API.

INTRODUCTION

Antiembolic socks (AES) can result in some complications if not monitored closely or not used properly. Medical device associated pressure injury (MDAPI) is one of these complications.[1,2] If the stockings are not well placed, they can exert more pressure than the capillary closure pressure when they crease in certain areas of the leg, resulting in injury. Compression discomfort is experienced usually around the ankle or foot. For this reason, it is recommended to closely monitor the skin under the stockings throughout the use of stockings.[3-6]

In some studies, the rate of antiembolic stockings- associated pressure injury (AES-API) inside medical devices was reported between 2.2-14%.[2,7] AES-API was identified as a major problem for ICU patients in a study in Turkey.[8]

In particular, it is advocated that supporting perfused tissues by massaging will support the regeneration, flexibility and durability of the skin. Although AES does not generally disturb the superficial perfusion, it is recommended to remove these pressure stockings for a short time, observe the skin and apply maintenance for long-term use.[9,10] However, sometimes these stocking breaks may not be sufficient to prevent wounds caused by these types of stockings. This suggests that skin perfusion should be supported during these breaks. In this context, the aim of this study is to determine the effect of mild skin massage with moisturizers on the reduction of AES-API in ICU patients

Research Hypotheses

H1: A skin massage of 30 seconds with moisturizers performed to the extremity where the AES is worn reduces the risk of MDAPI.

H0: A skin massage of 30 seconds with moisturizers performed to the extremity where the AES is worn is not associated with the risk of MDAPI.

MATERIALS AND METHODS

Design: This study is a quasi-experimental study. The study was conducted between June 2019 - September 2019 in the Adult Intensive Care Unit of a private university hospital. The study was performed within a period of 4 months by contacting 30 participants in the experimental group and 39 participants in the control group. Among the patients enrolled in the ICU unit, patients who met the sampling criteria were assigned to trial (n = 39) and control groups (n = 39) in turn. Among the patients selected as the experimental group, 9 patients were lost within the first 3 weeks (2 cardiac arrest cases, 2 transferred to another institution, 5 early discharged). The d value, which is the effect size index (in the light of the reported academic studies)[8-11] was calculated as d = 0.61 (0.5-0.8 medium-level effect size), $\alpha = 0.05$ (margin of error), $1-\beta = 0.80$ (power). In order to determine the sample size, the calculation (d-value) method developed by Cohen was used to calculate the effect size.[12]

The study's dependent variable was AES-API. Independent variables were massaging with protective and moisturizing creams, age, gender, body mass index (BMI), patient habits, hemodynamic indicators: hemoglobin (Hb) and plasma albumin levels, blood pressure, past medical history/ peripheral chronic diseases, APACHE (Acute Physiology and Chronic Health Evaluation) score, duration of AES use, mechanical ventilation status, use of vasopressors, use of sedatives, and routes of feeding (enteral, parenteral).

In the ICU unit where the study was conducted, all patients were sleeping in single-person departments. Study settings and subjects. In the Private University Hospital Adult Intensive Care Unit where the study was conducted, the pressure injuries of the patients within the first two hours following patient's hospitalization are evaluated using the Braden pressure injury risk scale. A pressure injury specialist nurse visits the hospital ICU twice a week and evaluates the patients for pressure injuries. The specialist nurse guides the nurses in terms of the problems associated with pressure injury. A total of 30 nurses are employed in the intensive care unit. The nurses have university degree at minimum. The number of patients per nurse is 1 Grade I patient and 1 number Grade III patients, or 2 Grade II patients, or 3 Grade I patient.

Inclusion Criteria:

The patients, conscious or unconscious, who were 18 years of age and older wore AES upon the decision of the physician, were planned to wear the same type of AES (the choice of the physician for AES was below-knee stockings), had no disease to prevent wearing AES, had no pressure injuries in the lower extremities at the time of admission to the ICU, had no problems with massaging, had not been diagnosed with cerebral death, had no problems with changing positions, were, were included in the sampling of the study.

Exclusion Criteria:

The patients who were hospitalized in the ICU for less than 24 hours, and who were determined to be allergic to the protective creams and moisturizing body lotions used in massaging and skin care, were excluded.

All patients wore the socks recommended by the doctor. Massage was planned for immobile patients and high-risk patients at every position change; the patients were massaged every 2 hours. For the patients, who had to stay in bed and did not have problems with mobilization, massage was given per each shift (once every 8 hours). Patients in this study were given 30 seconds of efflorage massage. Massage was applied to the areas under the AES. Feet were elevated 15-30 degrees, and then AES was removed. Moisturizing lotion (*Bepanthol Body Lotion)* for spread on the extremity before the massage. Hand fingers and palms were used for massage. The massage was started with light pressure and sliding movements from the patient's lower extremity fingers and was applied from the periphery to the center. The procedure was repeated 5-6 times in one session. Since the skin in the heel area is thick, massage was applied at medium pressure in this area. A stopwatch was used during the massage. Meanwhile, the medial malleolus in the foot was blocked from massage. However, the moisturizing lotion and barrier cream (*Cavilon Barrier Cream)* was applied to these areas. Finally, a barrier cream was applied to the heels where the pressure was stronger and under the rubber edge of the AES. Next, the AES was dressed again starting from the tip of the toes, and the foot was lowered to its normal position. At the end of the massage, protective cream was applied to the fingers of the patient which remained out of the stockings. This massage care was continued until the physician recommended the patient to stop wearing the AES, or the patient was discharged from the ICU. The control group patients were not massaged.

According to literature, especially in immobile individuals, AES should be re-dressed within 30 minutes after removal. This period is important to protect the venous pressure in the legs from the effect of femoral blood flow velocity.[11,13]

In this study, mobility status of the patients, Braden risk score, and literature recommendations on this subject were taken into consideration for the frequency and duration of removing the stockings.[14-16] Massage duration and re-wearing of stockings did not exceed 8.6 minutes on each leg.

NPUAP Classification System 2016 was used for determining "pressure injuries".[16] The risk levels of each patient were evaluated with Braden Pressure Injury Risk Scale (PIRS), and patients' skin qualities were evaluated using the Skin Monitoring Form on the same day and at the same time. Braden scale were recorded and analyzed on the IBM SPSS (Statistical Package for Social Sciences). Assessment for pressure injury and all color changes on the skin are established with the ICU physician.

Ethics: During the study, the Human Rights Helsinki Declaration was adhered to. Ethics committee approval was obtained from the Clinical Research Ethics Committee of the University, where the study was conducted (2019.101.IRB. 013), and institutional permit was obtained from the hospital (EMA/hd/236/2019) in writing. Informed consents were obtained from the conscious volunteers themselves and the legal guardians of the unconscious volunteers. Also, participants knew that data could be published in national or international journals for scientific purposes. participants knew that data could be published in national or international journals for scientific purposes.

RESULTS

There was no statistically significant difference among the characteristics of the experimental and control groups. The youngest age was 25, the oldest age was 84 (respectly, mean age: 53.67±16.42, 58.87±14.88, p=0.173). In the experimental group, 33% of the volunteers was at the age of 65 and above, and in the control group, 38.4% at the age of 65 and above (p>0.05). The ratio of F/M was 56.7/43.3% in the experimental group, and 56.4/43.6% in the control group (p>0.05).

Table 1 presents some clinical characteristics of the patients in the experimental and control groups. On the day they were admitted to the ICU unit, the Braden pressure wound risks of both the experimental group (15.27 ± 1.72) and the control group (14.26 ± 2.88) volunteers were low (p = 0.09). The patients in the experimental group used AES longer than the control group patients did (p> 0.05). However, AES-API was only observed in the control group (n=5; 12.8%).

Table 2 presents results of the skin examination for pressure injury in the experimental and control groups. The color (73.3%, 71.8%), temperature (90.0%, 89.7%), humidity (63.3%, 64.1%), turgor (93.3%, 82.1%) values of the patients in the experimental and control groups were normal, and there was no difference between the groups (p>0.05). There was edema in the lower extremity of two patients in both groups. There was no impairment in skin integrity in the experimental group; however, skin integrity was impaired in 5 patients (12.8%) in the control group. Of these patients, two were suspected for deep tissue pressure injury (SDTI) (ankle, patella) and the other three had grade 1 pressure injuries (right and / or left ankle, under the elastic stocking band).

DISCUSSION

Since the sample of this study represents a small and specific group, it is difficult to discuss the results in a comprehensive scale within the literature. Risk factors on this subject are unclear, as the number of studies on AES-API in the literature is limited.[4] Barakat-Johnson et al.[17] demonstrated that 14.0% of MDAPIs (ICU 11.8%, non-ICU patients 18.8%) was AES-API. Hobson et al.[7] reported that. 12.0% of all pressure injuries was AES-API. According to Apold et al.[1] 12.0% (n=5) of all pressure injuries were AES-API. Gefen et al.[18] reported that 5% of ICU patients and 13% of patients outside the ICU had AES-API. In our study, while the AES-API was not present in the experimental group, it was present by 12.5% (n=5) (6.25% in total) in the control group, which was similar to the findings in literature.

Risk factors for AES-API are generally defined in conjunction with MDAPI.[2,17] Nevertheless, some studies reported that AES-API was more common in male patients (more at risk in the male according to etiology), individuals above 59 years of age, caucasian race, individuals with diabetes and oncological health problems, individuals receiving mechanical ventilation support, inmobilizer, smokers, individuals receiving vasopressor therapy (particularly, >48 hours), individuals receiving sedative treatment, and in individuals with high BMI (>28 or, particularly, 30k/m2).[2,7,18] Duration of AES use and AES re-location are included in these factors.[5,19]

In the present study, the low levels of Hb and albumin in most of the patients in both experimental and control group indicated that the patients' oxygen and nutrient carrying capacity might have declined. In addition, smoking, lower extremity edema, use of vasopressor for more than 48 hours and, steroid and sedative therapy may be indicators that perfusion support on the surface of the skin had reduced. However, we believe that these are not sufficient to explain the AES-API that is observed in the control group.

Although there is no significant difference between the patient characteristics of the groups (Table 1) in this study, the presence of AES-API in the control group draws attention to the variables related to stockings rather than clinical characteristics. Although the Braden risk score of the control group demonstrated relationship with some variables (smoking, feeding method, stocking duration) (Table 2), it cannot be said with certainty that they played a role in the AES-API in the control group. Because all patients had low risk of pressure-related injury. Also, there is no clear risk factor for AES-API demonstrated in the literature. It is reported that AES-API shares the risks of traditional pressure wound in terms of pressure wound associated with medical

devices.[14,15,17] In studies with high level of evidence, age, mobility level, vasopressor treatment, low Hb and albumin values and pressure-related injuries in peripheral vascular diseases in the patient's health history have been shown as important risk factors for pressure-related injuries in intensive care patients. The relationship between feeding/feeding method and pressure-related injuries was reported to be low or uncertain. Smoking, blood pressure (systolic blood pressure <90 mm Hg and/or diastolic blood pressure <60 mm Hg), diabetes and a history of cardiovascular disease were defined as independent risk factors.[20-23]

The reason why AES-API was not observed in the experimental group in this study may be that massage with a moisturizing lotion gives the skin elasticity, warms the skin and increases the perfusion properties of the skin. In addition, since the dead cells on the skin surface are shed by way of massage, skin strength can be better preserved with the barrier cream applied to the skin at the end of the massage. Thus, tissue resistance can be reinforced against the pressure created by the stockings and the friction caused by the stocking dressing and removal. When the AES-API cases in the control group were examined, their appearance under the stocking band and mostly around the ankle (linear pressure ulcer/Grade-I and II on the anterior aspect of both ankles) suggested insufficient perfusion and cutting on skin. In addition, we believe that the injuries in these regions are not directly related to the characteristics, with which the Braden scale demonstrated a relation. Those injuries rather suggested that they were more related to the position of the stockings and the pressure which they exerted. Accordingly, the H1 hypothesis of the present study can be accepted.

Socks breaks and skin care very important in stocking use. AESs are medical devices with large skin contact areas. They create long-term continuous low pressure compared to various medical devices. Accordingly, this creates a significant static friction force effect, causing skin integrity impairment, rash, blisters and cuts.[4,17,24] Recent developments in pressure-related injury researches suggest that cutting/stifling forces lead to a reduction in local blood flow and increase the risk of pressure injury.[17,25] Despite the fact that AESs were dressed in line with pressure grade measurements (generally taken at the time of admission to hospital or before the surgical operation), it should be noted that immobility or excessive volume load during and after the surgical operation may cause edema in lower extremities, and edema may develop in ICU patients. Therefore, it is recommended to repeat these stocking measurements. it is reported that AES may cause more local pressure and injury otherwise.[7,23]

As a result, correct application of AES as a medical tool, examining the skin under pressure and supporting the skin with massage by nurses can provide a less interrupted treatment for patients.

Future studies on this topic will provide stronger evidence for this aspect of care.

Table 1. Clinical characteristics of the experimental and control groups (N= 69)

Factors	Experimental (n=30)		Control (n=39)		Test	
	n	%	n	%	t/X^2	p
Smoking or, smoking + alcohol*	11	36.7	27	69.2	6.011	**0.014*** **
Body Mass Index					0.160	0.923
Normal	16	53.3	19	48.7		
Overweight	8	26.7	11	28.2		
Obese	6	20.0	9	23.1		
Diet					0.069	0.793
Oral + Enteral	24	80.0	29	74.4		
Parenteral + IV fluid	6	20.0	10	25.6		
Albumin below 3.4gr/dl	12	57.1	21	75.0	1.023	0.312
Hemoglobin (Female, male, below 12.13 gr/dl)**	28	6.7	35	10.3	-	0.690
Under mechanical ventilation	2	6.7	5	12.8	-	0.690
Under sedative therapy	1	3.3	3	7.7	-	0.627
Under vasopressor therapy	3	10.0	4	10.3		1.000
Under steroid therapy	2	15.4	8	42.1	-	0.141
Blood Pressure-Systolic Mean(SD),min-max	118,40±16,57	84-150	118,21±16,64	90-167	0,048	0,913
Blood Pressure-Diastolic Mean(SD),min-max	68,97±13,53	41-98	66,18±11,80	40-90	0,913	0,365
APACHE Score (n = 5)	18.50±7.78		14.00±2.65		-	-
Duration of AES mean (SD), min-max	2.23±2.68	1-14	1.70 ±1.53	1-8	-1.036	0.304
Braden PIRS at the time of ICU admission	15.27± 1.72		14.26 ±2.88		1.700	0.09
Braden PIRS during hospitalization in ICU	16.57 ± 1.97	9-19	14.99 ± 3.32	8-19.5	2.449	**0.017*** **

Those who were both smokers and alcohol users n= 7 (n= 6 control and n= 1 experimental group);

***Mean Haemoglobin value of the experimental and control groups, respectively, 10.80 ± 1.66, 10.62 ± 2.06 and the mean albumin value 3.33 ± 0.72, 3.14 ± 0.69*

****p<0.05; X^2, Chi-Square (Pearson Chi-Square, Continuity Correction, Fisher's Exact Test) test*

Abbreviations: ICU, Intensive care unit; APACHE, Acute Physiology and Chronic Health Evaluation; CS, Compression stocking; MBP-S, Mean -Systolic Blood Pressure; MBP-D, Mean Diastolic blood pressure; t, Independent sample t test, Braden PIRS, Braden Pressure Injury Risk Scale

Table 2: Skin qualities of both the experimental and control groups when AES-API occurs (N= 69)

Skin characteristics	Experimental (n=30)		Control (n=39)		Test	
	n	%	n	%	t/X^2	p
Color					0.032	0.984
Normal	22	73.3	28	71.8		
Pale or yellow	6	26.7	11	28.2		
Temperature					1.212	0.545
Normal	27	90.0	35	89.7		
Cold or hot	1	10.0	4	10.3		
Moisture					1.349	0.510
Normal or moist	18	63.3	25	64.1		

Dry	11	36.7	14	35.9		
Turgor					-	0.281
Normal	28	93.3	32	82.1		
Decreased	2	6.7	7	17.9		
Edema (lower extremity)					-	1.000
None	28	93.3	37	94.9		
Present	2	6.7	2	5.1		
Impairment of skin integrity					-	0.064
Present*	0	0.0	5	12.8		
None	30	100.0	34	87.2		
Grade of pressure injury (n = 5)						
SDTI	-	-	2	40.0		
Grade 1	-	-	3	60.0		
Number of injuries (n = 5)		-	-			
One	-	-	2	40.0		
Multiple	-	-	3	60.0		
Location of AES-API (n= 5)**						
Ankle	-		4	80.0	-	-
Under the rubber edge of the AES /patella	-		3	60.0	-	

**Characteristics of patients with AES-API: sedation (n = 3), vasopressor (n = 3), steroid (n = 4) and antibiotic (n = 3) treatment, enteral feeding (n = 3), parenteral feeding (n = 2), diabetes (n = 2) and hypertension and heart disease (n = 2), low plasma albumin (n = 4), most of them were between 45 and 64 years of age (n = 4, one of them was 74y), and BMI was normal (n = 4, one overweight), all of them had Hb values below normal, smokers (one of them was also an alcohol user) (n = 5), male (n = 5). Abbreviations: X^2, Chi-Square (Pearson Chi-Square, Continuity Correction, Fisher's Exact Test) test; SDTI, Suspected Deep Tissue Injury*

*** There were injuries in more than one place*

CONCLUSION

According to the findings of the presented study. AES can cause pressure-related injuries in ICU patients. In order to prevent or reduce AES-API, it may be beneficial to massage the patient with a moisturizer, depending on the patient's mobility and pressure injury risk. The further studies are needed to shed light on vasopressor combinations that are believed to play a role in the formation of AES-API and the effects of variables which reduce oxygen delivery to tissues (hypotension and/or decreased blood oxygen content, anemia). Findings represent individuals involved in this research.

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