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Evaluation of Physical Restraint Practices and Their Neurovascular Effect on Intensive Care Unit Patients

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ABSTRACT

Introduction: The purpose of this study is to examine the characteristics of restraints applied in intensive care units and the neurovascular effects on patients to whom physical restraints are applied.

Material and Methods: The cross-sectional observational study was conducted between April 2018 and September 2018 in the internal and surgical intensive care units of a state hospital. The study included 120 patients to whom physical restraints were applied. The data were collected using a data collection form developed in accordance with the literature through a review of patient records in addition to observation and interview methods. The patients under restraint were observed and the nurses responsible for patient care were interviewed. Approval for the study was granted by the Local Ethics Committee, permission was obtained from the institution and informed consent from the relatives of the intensive care units patients in the study. Data obtained in the study were analysed statistically using SPSS vn 22.0 software and descriptive statistics, the Cochran Q test, Chi-square test, Friedman test and the Kruskal Wallis test.

Results: A statistically significant increase was observed in oedema and colour change in the region below the physical restraint in a 5-day observation period and pulse strength was determined to have decreased ($p<0.05$). No significant change was determined in the temperature and capillary filling time of the restrained area in the 5-day observation period ($p>0.05$). No significant difference was determined between the restraining materials used in respect of oedema and pulse strength. A statistically significant difference was determined between the restraining materials used in respect of colour change, capillary filling time and temperature parameters on the second and third days of the restricted area ($p<0.05$).

Conclusion: The results of the study showed that in physical restraint, which is mostly preferred in intensive care units, an increase in the period of physical restraint increases the possibility of neurovascular complications and the use of special restraint equipment could reduce the potential development of neurovascular complications.

Key words: Intensive care unit, physical restraint, patient, nursing care.

Introduction

Intensive care units (ICUs) are one of the special departments where high-quality care services that patients need are provided. Therefore, the management of the care provided and the treatment process are highly important for excellent patient care (1). Restraint practices are one of the commonly used methods to ensure the safety of patients in health care institutions, especially ICUs, and are also considered as a controversial issue (2-4).

Restraint practice is discussed in 2 general classification categories: physical restraint (PR) and chemical restraint (CR) (5,6). Physical restraint is defined as any action or procedure that is used to prevent damage or injury to the patient himself/herself or to others and that restricts free body movements by a method that the person cannot easily control or remove by attaching a part of the body (5, 7, 8). CR, which is also regarded as a usual form of treatment especially for patients connected to mechanical ventilators, involves the use of a drug that provides sedation to control anxiety, pain, and patient's behaviors and to facilitate medical interventions (1, 5, 9).

The use of restraints is a method that should be applied in cases in which patient behaviors are unfavorable and alternative methods fail to protect the patient and others in ICUs where patient safety should be considered as an indisputable requirement (3, 10). It is reported that physical restraint is commonly used in different ICUs

with a prevalence ranging from 0-90% across the world, despite the lack of evidence to support that it is an effective and reliable method for patients and the potential risks associated with the use of restraint (4,11-17). The prevalence of CR use aimed at stabilizing the physiological condition and patient comfort in patients connected to mechanical ventilators in adult ICUs is reported to vary between 20-30% (12, 18).

Despite ongoing attempts to reduce the frequency of use, restraints are applied more frequently in ICUs for reasons such as the critical state of patients in ICUs and the use of aggressive treatment methods such as mechanical ventilation, and the common use of invasive devices including arterial lines, endotracheal tubes, and intravenous catheters (2, 16, 17, 19, 20). Nevertheless, it is known that various degrees of unrest, confusion, and delirium develop in a significant proportion of patients in ICUs (16, 21). Such patients' agitated and uncontrolled behaviors that may result in the displacement of the endotracheal tube or other medical devices may lead to the failure to implement the planned treatment of the patient, damage to himself/herself and those around, serious injuries, patient falls and even death (1, 3, 16).

The use of restraint can be perceived as an application that allows for treatment applications and contributes to patient safety, however, it is a complex procedure involving physical, psychological, ethical, and moral issues in which the balance between harm and benefit to the patient should be well evaluated (3, 8, 20, 22). The literature provides a lot of evidence about the harmful physical and psychological effects of the use of restraint. It has been reported that CR which is not applied in accordance with a protocol may lead to increased agitation in patients and that the deep sedation it may cause may also lead to serious complications such as respiratory depression and death (11, 12).

It is stated that many adverse outcomes such as decreased mobility, increased risk of nerve injury and pressure sore, hypertension, tachycardia, circulatory disorder, increased thrombosis risk, aspiration or urinary/fecal incontinence, life-threatening injuries and death may occur in patients under physical restraint (1, 4, 11, 12, 14, 19, 21, 23). Furthermore, it has been emphasized in many studies that PR may also cause damage to the skin and neurovascular complications in the area it is applied (17, 24-28). The studies evaluating the effects of restraint practices, which are also considered as the practices that put the rights of patients at risk by violating their autonomy and freedom, on patients indicate that patients have strong emotional reactions to restraint, feel angry, resentful and sad and experience anxiety and fear (29).

There is a limited number of studies carried out to determine the prevalence and characteristics of restraint use in ICU patients in Turkey. However, it is possible to say that restraint use in ICUs is a frequently used practice, especially when the results of the studies conducted with nurses are examined (28, 30-34). The aim of this study was to examine the characteristics of restraint practices applied in ICUs and the neurovascular effects of PR applications, which are known to be used frequently, on patients. The results of this study are considered to be guiding for healthcare professionals working in ICUs in planning and managing the care of patients under restraint.

Material and Methods

Type of Research

This cross-sectional and observational study was conducted in the internal and surgical ICUs of a hospital in Afyonkarahisar province.

Population and Sample of the Study

A total of 617 patients admitted to the internal and surgical ICUs of the relevant hospital within the period of time during which the study was conducted constituted the population of this study, which was carried out between June and September 2018. The sample consisted of a total of 120 ICU patients meeting the inclusion criteria of the study from among 330 patients to whom restraint practices were applied (those who stayed in the ICU for longer than 24 hours, those to whom restraint practices were applied, those who were regularly followed for five days from the first day during which the restraint practice was initiated, and those from whose relatives permission could be obtained for the observation and collection of patient data). 287 patients to whom restraint practices could not be applied during the study period, 102 patients who stayed in the ICU for less than 24 hours, 57 patients who could not be followed for 5 days without interruption, and 52 patients from whose relatives permission could not be obtained were excluded from the study.

Data Collection Tools

The Patient Information Form prepared in accordance with the literature review (9, 11, 12, 17, 26, 28-30, 32, 33, 35) and expert opinions, and the Daily Observation Form of the Patient to whom Restraint Practice was Applied were used to obtain the data.

The content validity of the data collection forms prepared was evaluated by 2 specialist nurses and 3 academic experts with working experience in the ICU. After the expert opinions, no change was suggested in the data collection forms, a preliminary study was conducted with seven ICU patients, and the data collection forms were finalized. In this study, restraint practice standards defined by the Ministry of Health Quality and Accreditation Department within the scope of Health Quality Standards in 2015, and the existing care procedure of patients under restraint in the institution where the study was carried out were also taken as a guide in the preparation of questions included in the data collection forms investigating the evaluation of the conformity of the existing restraint practices in ICUs to the standards set. The standards on restraint practices in our country and the written procedure in the institution require the application of restraints under the responsibility of the physician and the written order of the physician, the notification of the frequency of control of the region in writing in terms of the effects of the area where restraint would be applied and the effects of restraints in the physician's order given for restraint, 24-hour review of the need for restraint.

The patient information form included 26 questions regarding the demographic (age, gender) and medical characteristics (diagnosis, Glasgow coma score (GCS) value, acute physiology and chronic health assessment score-APACHE-II, length of stay in ICU) of the patients included in the study, and characteristics of restraint practices (type of restraint, restraining material, start

time, physician's order for restraint, cause of restraint, alternative interventions, etc.). The Daily Observation Form of the Patient to whom Restraint Practice was Applied includes questions aimed at evaluating the data on edema, temperature, pulse strength, color change and capillary filling time of the restrained area on a daily basis for the evaluation of neurovascular effects of physical restraint practice on the patient.

Collection of Research Data

The data were collected by examining the patient records, observing the patient and interviewing with the nurses responsible for patient care using the observation and interview method and by visiting the ICU on a daily basis by the researcher. The data on the demographic and medical characteristics of the patients to whom restraints were applied were obtained within the first 24 hours of inclusion of patients in the study. The data on the characteristics of restraint practices in ICUs were obtained within the first 24 hours during which restraint to patients was initiated, and the data on the neurovascular effects of PR on patients were obtained by observing and evaluating the restrained patients in terms of neurovascular findings at the same time for five days at 24-hour intervals. The edema in the restrained area was evaluated according to available/none available and gode depth in a 5-day observation period. In the evaluation of gode, the depth of pitting and regression time of pitting formed by applying pressure of 4-5 seconds to an edematous area with a finger were taken as criteria. In this rating, it was determined that the gode depth was <2 mm: rapid improvement 1st degree (+), 2-4 mm: improvement in 10-15 seconds 2nd degree (++), 4-6 mm: improvement in 1 minute, 3rd degree (+++), 6-8 mm: improvement time above 2 minutes 4th degree (++++) edema. Evaluation of the pulse strength in the restrained area: palpation of peripheral pulses was performed and scored by grading between 0-4 according to the degree of fullness of the pulse.

In this rating, the pulse was defined as 0 points when high pressure was applied but the pulse could not be taken, very light pulse 1 point (+) when there was no pulse, could be palpated but could not be counted, weak pulse 2 points (++) if it was weak and filamentous, normal pulse 3 points (+++) if the pulse was heard easily, and leaping, visible pulse 4 points (++++) if the pulse was strong and did not disappear when the applied pressure was changed. Evaluation of the capillary filling time was performed according to the criterion that the time elapsed for the whitened area after pressure applied to the nail bed distal to the restricted limb to turn pink again was above or below the 2-second period of time, the color evaluation was performed according to the color of the skin in the restrained area and its surrounding, and the temperature evaluation was performed according to the classification of the limb as warm/cold by palpation examination to evaluate the arterial circulation in the restrained area and its surrounding.

Ethical Permission

The ethics committee approval dated and numbered 2018/19 was received from the Clinical Research Ethics Committee of Afyon Kocatepe University, and permission was obtained from the institution where the study would be carried out. Furthermore, verbal and written informed consent was obtained from the relatives of the intensive care patients included in the study and they were informed about the aim of the study.

Statistical Analysis

The data were analyzed using SPSS version 22.0 (Armonk, NY: IBMCorp). The data of continuous variables were defined by mean and standard deviation, and the data of categorical variables were defined using frequency and percentage. Cochran's Q test was used for the dependent group comparisons of categorical variables, and the chi-square test was used for independent group comparisons. The comparisons of more than 2 dependent groups of continuous variables without normal distribution were analyzed by the Friedman test, and the independent group comparisons were analyzed by the Kruskal-Wallis test. In the tests performed, the alpha level was accepted as $p<0.05$ for statistical significance.

Results

Characteristics of Patients Under Restraint

It was determined that 58.3% of the patients were male, the average age was 72.2±13.9 years and the mean length of stay in ICU was 5.3±8.4 days. 30.8% of the patients had a respiratory diagnosis while more than a quarter of them (27.5%) had a neurological diagnosis. While it was determined that 38.3% of the patients were hospitalized in the anesthesia ICU, more than half of them (55.8%) were connected to ventilatory support and the vast majority of the patients under ventilatory support (88.1%) were under mechanical ventilator support, it was found out that the number of equipment connected to the patients mostly varied between 2-4 (78.3%) (Table 1).

Characteristics of Restraint Practices

The results on the characteristics of restraint practices in ICUs are presented in Table 2. It was determined that PR was applied to only 70% of the patients, nearly a quarter of them (22.5%) were found to be under both PR and CR. While it was determined that there was no written physician's order in 36.7% of the patients under PR (n=111),

it was observed that the criteria specified in the written physician's order (the type of restraint, restrained area, number of restrained areas, frequency of control of the restrained area for complications) did not comply with the restraint procedure applied to the patient in more than half of the restrained patients (58.3%). It was determined that the patients (n=75) mostly began to be restrained during the time periods including weekend and night shifts and that the restraint was mostly applied by intensive care nurses (76.7%). It was determined that physical restraint was applied in the form of the bilateral wrist (59.8%) in the majority of patients and that most of the patients (48.6%) were restrained with special restraint equipment which is defined as a patient safety belt.

It was determined that physically restrained patients were mostly restrained for reasons such as "to prevent the patient from harming himself/herself and his/her environment" (22.1%) and "to allow

Table 1. Demographic and medical characteristics of restrained patients (n= 120)

Characteristics	Min	Max	Mean ± SD
Average age (years)	18	96	72.2 ± 13.9
Mean length of stay in the intensive care unit (days)	2	48	5.3 ± 8.4
Mean GCS score in the first 24 hours	3	15	9.2 ± 3.5
Mean APACHE-II score in the first 24 hours	11	97	42.0 ± 10.3
Gender	n		%
Female	50		41.7
Male	70		58.3
Primary diagnosis			
Respiratory	37		30.8
Neurological	33		27.5
Neurosurgical	17		14.2
Cardiac	10		8.3
Surgical	7		5.8
Metabolic/Endocrine	4		3.3
Renal	4		3.3
Oncological	3		2.5
Infection	2		1.7
Psychiatric	2		1.7
Orthopedic	1		0.8
Intensive care unit stayed			
Anesthesia intensive care	46		38.3
Neurology intensive care	32		26.7
Chest Diseases Intensive Care	24		20.0
Surgical intensive care	18		15.0
Respiratory support			
Yes	67		55.8
No	53		44.2
Respiratory support type *			
Invasive mechanical ventilation	59		88.1
Noninvasive mechanical ventilation	8		11.9
Number of medical equipment available in the patient			
1	-		-
2-4	94		78.3
5 and above	26		21.7
Type of Medical Equipment **			
Foley catheter	119		26.6
Peripheral venous catheter	90		20.1
Nasogastric tube	71		15.9
Central venous catheter	65		14.5
Oxygen cannula-mask	45		10.1
Artery catheter	37		8.3
Drain	9		2.0
CPAP-BPAP	8		1.8
Chest tube	3		0.7

* Respiratory support type did not change in a 5-day observation period.
** One patient had more than one medical equipment.
mean: mean, SD: standard deviation
APACHE-II: Acute physiology and chronic health assessment
GCS: Glasgow Coma Score
CPAP: Continuous Positive Airway Pressure
BPAP: Bi-level positive airway pressure

healthcare personnel to perform medical treatment" (20.5%), and that no alternative method was applied before restraint in nearly half of the patients (48.2%). While it was determined that the majority of patients under restraint (79.2%) were checked at two-hour intervals, in the patient follow-up records made by the nurse, it was observed that the pulse strength and temperature of the restrained area were never evaluated, and that a scale evaluating the sedation requirement of the patient was not used in patients to whom CR was applied (Table 2).

Table 2. Characteristics of restraint practices in intensive care units (n= 120)

Type of restraint	n	%
Only physical restraint	84	70.0
Only chemical restraint	9	7.5
Both physical and chemical restraints	27	22.5
Written physician's order for physical restraint (n= 111)		
Yes	67	55.8
No	44	36.7
Written physician's order for chemical restraint (n= 36)		
Yes	35	97.2
No	1	2.8
Chemical restraint application protocol		
Intermittent sedation during the day	33	91.7
Continuous infusion	3	8.3
Compliance of restraint order and restraint procedure applied to the patient		
Yes	50	41.7
No	70	58.3
Start time of restraint practice		
Weekday day shift	45	37.5
Weekday night shift	38	31.7
Weekend day shift	29	24.2
Weekend night shift	8	6.7
Person who applied the restraint		
Nurse	92	76.7
Auxiliary Staff	18	15.0
Nurse and auxiliary staff	10	8.3
Type of physical restraint *		
Bilateral wrist	79	59.8
Unilateral wrist	22	16.7
Bilateral wrists and ankles	19	14.4
Unilateral wrists and ankles	7	5.3
Unilateral ankle	3	2.3
Bilateral wrist, ankle and chest	2	1.6
Type of material used in physical restraint (n= 111)		
Gauze	11	9.9
Green fabric bond	46	41.4
Patient safety belt	54	48.6
Reason for applying restraint **		
To prevent the patient from harming himself/herself and his/her environment	73	22.1
To allow healthcare personnel to perform medical treatment	68	20.5

Table 2 cont. Characteristics of restraint practices in intensive care units (n= 120)

Type of restraint	n	%
To prevent patient from removing the tubes connected to him/her	64	19.3
To prevent patient from falling out of bed	63	19.0
To be able to control the patient's behaviors	59	17.9
To maintain the anatomical position of the patient	4	1.2
Application of alternative interventions before restraint		
Yes	62	51.7
No	58	48.3
Alternative intervention applied before restraint ***		
Communicating with the patient	97	74.1
Lifting bed sides	14	10.7
Providing psychological support	13	9.9
Getting help from the relatives of patients	4	3.1
Using pharmacological methods	3	2.3
Frequency of evaluation of the patient after restraint		
Hourly	25	20.8
Every 2 hours	95	79.2
Evaluation parameters of the patient after restraint ****		
Vital signs of the patient	120	32.8
Restrained patient's general mood	84	22.8
Skin integrity	82	22.2
Color of the restrained area	82	22.2
Pulse strength of the restrained area	-	-
Temperature of the restrained area	-	-
Sedation level	-	-
Change in the patient's mood after restraint		
Yes	63	52.5
No	57	47.5
Change in the patient's mood		
Calming - introversion	38	60.3
Agitation	21	33.3
Crying-moaning	4	6.4

* There are patients restrained by more than one method.
** More than one reason was indicated.
*** There are patients to whom more than one alternative interventions were applied.
****More than one parameters were evaluated in one patient.
The results related to the characteristics of restraint practices in Table 2 are based on the observation in the first 24 hours during which restraint was initiated.

Neurovascular Effects of Physical Restraint

The results related to change in the neurovascular characteristics of the physically restrained area from day one to day five are presented in Table 3. According to the results, it was determined that edema and color change in the region under physical restraint statistically significantly increased in a 5-day observation period and that pulse strength decreased ($p<0.05$). No significant change was determined in the characteristics such as temperature and capillary filling time of the restrained area in a 5-day observation period ($p>0.05$).

While there was no statistically significant difference between the detection materials in terms of edema and pulse strength characteristics, it was determined that restraining materials differed significantly in terms of the parameters of color change, capillary refilling time, and the temperature of the restrained area on the second and third days, that the ratio of patients with color change in the area decreased in a 5-day observation period among the restrained patients using a patient safety belt, that this ratio increased in patients restrained using a green fabric bond, and that the ratios of patients with and without color change observation were similar during the observation period in the patients restrained with gauze. While it was determined that the ratio of patients whose capillary refilling time was more than two seconds increased in a 5-day observation period in patients restrained by a green fabric bond, there was a decrease in patients restrained by a patient safety belt ($p<0.05$, Table 4).

Discussion

Patients in ICUs constitute the patient group in which patient care is of great importance since they have life-threatening serious diseases and complex and critical situations (1). It was reported that patient-related factors such as age, delirium, mechanical ventilation, and the use of an invasive device increased the need for the use of restraints in these patients (4, 11, 14, 16, 17). Therefore, restraint practices should be regarded as an application that is directly associated with the responsibility of health professionals in ICUs to create a therapeutic environment.

In this study evaluating the characteristics of the use of restraints in ICUs and their neurovascular effects on patients, it was determined that PR was the most commonly used type of restraint. In the study carried out by Gu et al. (16), it was reported that 61% of ICU patients were restrained and more than one PRs were applied in 24.1% of patients during their stay in ICU. Similarly, it is possible to find many studies reporting that the PR method is still a commonly used intervention in ICUs although its safety and efficiency for patients are doubtful (1, 12, 14, 17, 21). Similar results were also found in some studies conducted in our country (27, 28, 30-32). However, it is observed that CR is applied to approximately one-quarter of restrained patients in ICUs. It is known that sedation-forming pharmacological agents are administered to relieve agitation, pain, and anxiety associated with mechanical ventilation in a significant proportion of patients under mechanical ventilation treatment (9, 35, 36). On the other hand, it is known that failure to apply CR in accordance with a certain protocol may cause the patient to wean from the mechanical ventilator later than expected.

Furthermore, excessive sedation was associated with a decrease in blood pressure and a reduction in cardiac output and gastrointestinal motility (11). Therefore, it is stated that the choice between PR and CR should be made depending on the disease, treatment administered, and available resources (16).

In our study, it was determined that both PR and CR were applied together in some of the patients to whom restraint was applied. It was reported that chemical restraint was also used as an alternative or additional method in physically restrained patients (11). Nevertheless, PR is used either alone or in combination with sedative agents to avoid the removal of mechanical devices, which

Table 3. Comparison of neurovascular characteristics of the area to which physical restraint was applied according to observation days

Characteristics	Day 1		Day 2		Day 3		Day 4		Day 5		
	Available		Available		Available		Available		Available		
	n	%	n	%	n	%	n	%	n	%	
	28	25.2	34	30.6	40	36.0	49	44.1	50	45.0	
Degree of edema	n	%	n	%	n	%	n	%	n	%	p= 0.000*
Gode depth <2 mm (+)	23	79.3	25	73.5	29	78.3	41	83.6	42	84.0	
Gode depth 2-4 mm (++)	6	20.7	9	26.5	8	21.7	8	16.4	6	12.0	
Gode depth 4-6 mm (+++)	-	-	-	-	-	-	-	-	2	4.0	
Gode depth 6-8 mm (++++)	-	-	-	-	-	-	-	-	-	-	
	Available		Available		Available		Available		Available		
Color change	n	%	n	%	n	%	n	%	n	%	
	34	30.6	34	30.6	38	34.2	40	36.0	44	39.6	p= 0.036*
Color of the restrained area	n	%	n	%	n	%	n	%	n	%	
Shaded, pale	17	52.9	20	58.9	21	52.7	24	60.0	26	59.1	
Redness	14	41.2	12	35.2	15	39.4	14	35.0	16	36.3	
Bruising	2	5.9	2	5.9	2	7.9	2	5.0	2	4.6	
Capillary refilling time	n	%	n	%	n	%	n	%	n	%	
Below 2 seconds	84	75.7	84	75.7	85	76.6	85	76.6	84	75.7	p= 0.910*
Above 2 seconds	27	24.3	27	24.3	26	23.4	26	23.4	27	24.3	
Temperature of the restrained area	n	%	n	%	n	%	n	%	n	%	
Warm	90	81.1	92	82.9	92	82.9	89	80.2	90	81.1	p= 0.764*
Cold	21	18.9	19	17.1	19	17.1	22	19.8	21	18.9	
Mean pulse strength score of the restrained area ***	Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SD		Mean ± SS		
	2.89 ± 0.45		2.86 ± 0.52		2.82 ± 0.57		2.73 ± 0.67		2.76 ± 0.65		p= 0.048**
Characteristics of pulse strength	n	%	n	%	n	%	n	%	n	%	
0 point No pulse	-	-	-	-	-	-	-	-	-	-	
1 point (+)very slight pulse (can be palpated but cannot be counted)	6	5.4	8	7.2	9	8.1	16	14.4	13	11.7	
2 points (++)weak pulse (weak and filamentous)	-	-	-	-	-	-	1	0.9	1	0.9	
3 points (+++)normal pulse (pulse is easily heard)	105	94.6	103	92.8	102	91.9	94	84.7	97	87.4	
4 points (++++)leaping and sonorous pulse	-	-	-	-	-	-	-	-	-	-	

*Cochran's Q test
**Friedman Test, p<0.05
*** The degree of fullness of the pulse was taken as a criterion.
mean: mean, SD: standard deviation

are necessary for optimal patient care and life support in patients under artificial respiratory support, by the patient himself/herself due to his/her agitated and uncontrolled behaviors (19).

Nowadays, it is stated that the current trend for the use of a lighter and intermittent sedation strategy in ICU patients has increased the need for the use of PR in awake patients (37,38). In our study, the fact that more than half of the patients were under mechanical ventilation support, the majority of them had 2 or more medical equipment, and the implementation of the intermittent sedation strategy in the majority of patients to whom CR was applied may explain the use of PR in the majority of patients in this study and the use of PR in patients to whom CR restraint was applied.

In our study, a significant portion of the restrained patients were composed of patients with respiratory and neurological diagnoses.

These results are consistent with the study results of Al-Khaled et al. (23). The use of restraint in critical ICU patients with such a diagnosis can be attributed to patients' need for supportive respiratory equipment due to their medical condition, and the

Table 4. Comparison of neurovascular results according to the type of material used in physical restraint

	Gauze (n= 11)				Green fabric bond (n= 46)				Patient safety belt (n= 54)					
Neurovascular characteristics														
Edema	Available				Available				Available				X2	p
	n	%			n	%			n	%				
Day 1	2	18.1			11	23.9			15	27.7			0.518	0.772
Day 2	2	18.1			16	34.7			16	29.6			1.201	0.549
Day 3	4	36.3			18	39.1			18	33.3			0.363	0.834
Day 4	5	45.4			25	54.3			19	35.1			3.708	0.157
Day 5	5	45.4			26	56.5			19	35.1			4.569	0.102
Color change	n	%	n	%	n	%	n	%	n	%	n	%		
Day 1	6	54.5	5	45.5	18	39.1	28	60.9	10	18.5	44	81.5	8.253	0.016*
Day 2	5	45.5	6	54.5	20	43.4	26	56.6	9	16.6	45	83.4	9.667	0.008*
Day 3	5	45.5	6	54.5	24	52.1	22	47.9	9	16.6	45	83.4	14.593	0.001*
Day 4	4	36.3	7	63.7	29	63.0	17	37.0	7	12.9	47	87.1	27.029	0.000*
Day 5	5	45.5	6	54.5	31	67.3	15	32.7	8	14.8	46	85.2	28.871	0.000*
Pulse strength ****	Mean ± SD				Mean ± SD				Mean ± SD					
Day 1	2.89 ± 0.45				2.87 ± 0.49				2.89 ± 0.46				0.744	0.388**
Day 2	2.86 ± 0.52				2.78 ± 0.62				2.89 ± 0.46				1.288	0.256**
Day 3	2.82 ± 0.57				2.65 ± 0.76				2.93 ± 0.38				2.186	0.139**
Day 4	2.82 ± 0.60				2.74 ± 0.68				2.74 ± 0.65				0.191	0.662**
Day 5	2.64 ± 0.80				2.61 ± 0.80				2.87 ± 0.47				0.661	0.416**
Capillary refilling time	Below 2 sec		Above 2 sec		Below 2 sec		Above 2 sec		Below 2 sec		Above 2 sec			
	n	%	n	%	n	%	n	%	n	%	n	%		
Day 1	11	100.0	-	-	30	65.2	16	34.8	43	79.6	11	20.4	6.728	0.035*
Day 2	11	100.0	-	-	29	63.0	17	37.0	44	81.4	10	18.6	8.512	0.014*
Day 3	11	100.0	-	-	28	60.3	18	39.2	46	90.1	8	9.9	11.923	0.003*
Day 4	11	100.0	-	-	27	58.6	19	41.4	47	87.0	7	13.0	14.858	0.001*
Day 5	11	100.0	-	-	27	58.6	19	41.4	46	85.1	8	14.9	13.393	0.001*
Temperature of the restrained area****	Warm				Warm				Warm					
	n	%			n	%			n	%				
Day 1	10	90.9			33	71.7			47	87.0			4.558	0.102
Day 2	10	90.9			33	71.7			49	90.7			6.876	0.032*
Day 3	9	81.8			33	71.7			50	92.5			7.624	0.022*
Day 4	9	81.8			32	69.5			48	88.8			5.857	0.053
Day 5	9	81.8			33	71.7			48	88.8			4.767	0.092

*ki kare testi p<0.05 **Kruskal Wallis testi, p<0.05
***Nabız dolgunluk derecesi kriter alınmıştır. ****soğukla karşılaştırıldığında.
ort: ortalama, SS: standart sapma

need for close observation due to changing consciousness and abnormal behaviors associated with neurological diagnoses.

The use of restraint is considered a simple solution to the problem of treatment intervention and to ensure patient safety in patients who are critically ill and have uncontrolled behaviors (10). In this study, it was determined that the most important reasons for the use of restraint in ICU patients were the maintenance of the patient's treatment and the reasons for providing security.

Similarly to our results, in both the international (2, 9, 11, 16, 29, 39-41) and national (30, 32, 33, 42) literature, it was reported that restraint practices were used in ICU patients for reasons such as preventing medical devices from being displaced, keeping restless behaviors under control, protecting the patient from harming himself/herself and his/her environment, and being able to apply the recommended medical treatment. Nevertheless, the fact that unilateral or bilateral upper extremity restraints constituted the great majority of physically restrained areas of the patients both in our results and in different studies (11, 12, 16, 17, 28, 30, 41) supports these results.

According to our results, it was determined that the start time of restraint practices in ICU patients usually corresponded to time periods covering weekend and night shifts. In some studies, it was reported that the use of PR was considered to be a means

to compensate for the absence of manpower, which increased the potential for the use of restraint in ICUs (4, 23, 25, 43). ICU nurses, who are primarily responsible for the care of the patient, play a key role in following the need to initiate and terminate the patient's need for restraint and in the care of the patient to whom restraint is applied (2, 9, 16). In Turkey, an insufficient number of nurses and a lower patient-nurse ratio especially in ICUs may cause nurses to choose restraints as a preventive measure to ensure patients' safety by preventing them from observing patients' behaviors fully and continuously.

It is known that there are differences between various countries in the world in terms of the procedures of restraint practices. In some countries, various rules and guidelines were developed to reduce the improper use of restraints (44, 45). In Turkey, the standards related to restraint practices were determined in the Health Quality Standards published in 2015 by the Ministry of Health Department of Quality Accreditation. According to the regulation, restraint practices are interventions that are under the responsibility of physicians and should be applied with the written directive of the physician. Furthermore, the effects of restraint practices on patients should be checked and recorded at regular intervals (46). While our results indicated that there was no written physician's order in the vast majority of patients to whom CR was applied, they also revealed that the ratio of nurses who applied PR by the physician's order was lower, and moreover, the physician's order and the restraint procedure applied to the patient were not compatible in the majority of patients in terms of the characteristics such as the type of restraint, restrained area, number of restrained areas, frequency of control of the restrained area for complications. In Turkey, within the scope of legal regulations regulating the powers and responsibilities of nurses, all kinds of interventions requiring the administration of a drug to the patient require a written physician's request. The fact that the application of chemical restraint also includes the administration of a pharmacological agent with sedation effect to the patient may explain the higher rate of application of this intervention in accordance with the written physician's request in terms of both physician and nurse. However, PR is an intervention that should be applied with a physician directive and a written order. Nevertheless, studies conducted both in our country (32-34, 47) and in different countries (9, 16, 21, 23, 24, 40, 43) indicate that many nurses in critical care areas independently decide to apply PR. Furthermore, it was reported that nurses usually relied on their experience and intuitions while deciding on restraint and did not sufficiently benefit from clinical evidence (7, 22). This may lead to possible patient damages related to restraint. In our country, despite the current regulations regarding the use of restraints, the fact that nurses apply restraints without physician's order may be a consequence of insufficient coordination between professional members who are involved in the care and treatment of patients. The reasons such as the fact that nurses, who closely monitor the patient's behaviors, do not share the need for restraint decisions with physicians, and the fact that physicians do not pay enough attention to written requests may be effective in this case.

Therefore, nurses in critical care areas may ignore the physician's order by perceiving the restraint as an intervention for the benefit of the patient with respect to preventing the removal of equipment or ensuring the safety of the patient, considering issues such as patient safety and ethical issues in emergency situations. However, it should not be forgotten that non-compliance with existing regulations may lead to legal problems.

While it was observed that gauze and green fabric bond were used for PR in half of the patients in this study, it was determined that special restraint equipment was used in almost half of them. The selection of the appropriate material for physical restraint is important for the prevention of unwanted complications associated with restraint (5). Therefore, materials that provide patient safety and do not harm should be available in health institutions (43). In the studies, although there is no evidence indicating that gauze or bonding equipment produced from hospital fabric by adding cotton between layers are basic restraining materials, it was reported that they are the most commonly used restraining materials and that the institutions with special restraint equipment are inadequate (9, 17, 21). Similar results are also present in some studies carried out in our country (28, 30, 31).

It is known that the use of physical restraint brings along many risks of complications that may harm the patient, as well. Therefore, it is important to observe physically restrained patients carefully and closely in terms of complications and to record the patient's condition (5, 8, 26). In this study, it was determined that patients under PR were mostly followed at two-hour intervals, while the pulse strength and temperature of the restrained area were never controlled. This result indicates that ICU nurses need training on the evaluation criteria for neurovascular complications associated with PR. Demir (27) reported that the decrease in the frequency of care and observation in patients to whom PR was applied was associated with the development of complications. In the studies on the use of physical restraint, it was reported that the most frequently encountered and defined complications were the findings indicating neurovascular changes such as edema, redness and bruising in the restrained area (17, 24-29). In this study, significant results regarding the increase in edema and color change and the decrease in pulse strength as PR usage day increased in a 5-day observation period indicate that PR may contribute to the risk of developing neurovascular complications. Nevertheless, in this study, the fact that half of the patients were restrained with unsafe equipment such as gauze and green fabric bond may also be effective in these results.

When physically restrained patients resist to restraint, complications may develop in the restrained area. In the studies, it was reported that some complications such as edema, color change, and nerve injury could be associated with the use of inappropriate restraining materials (17, 24, 27, 29). In this study, the fact that results in favor of neurovascular complications were less frequently encountered in patients who were restrained using a special restraining material such as a patient safety belt, and less change in these parameters emphasize the necessity of choosing equipment that focuses on patient comfort and safety in patients to whom PR is applied and the importance of providing access to this equipment in health institutions.

Limitations and Strengths of the Study

The most important limitation of this study is that it was carried out in a single center and with a relatively low number of samples. The present situation of restraint practices in our country and their compliance with standards can be evaluated more effectively with multicentre studies with a larger sample size. However, the fact that neurovascular results in patients undergoing PR were limited to a 5-day observation period constitutes a limitation of this study. This limitation can be improved in a future observational study that plans to investigate the effect of PR and different restraining materials on neurovascular complications and involves the control group. In addition to these limitations, this study providing an insight into restraint practices, which continue to be an important patient safety problem for patients and healthcare professionals in the critical care area, with a different research design has also contributed to the literature in terms of revealing the possible effects of restraints on ICU patients, and some important results supporting the importance of cooperation of both physicians and nurses in restraint practices. This constitutes the strength of our study.

Conclusion

This study indicated that PR constitutes a significant part of restraint practices in ICUs, ICU nurses play an active role in restraint practices and have a decision-making position, and there is inadequate cooperation among healthcare team members with respect to deciding on the application of restraints and notifying them in writing despite the current legal regulations. However, it can be said that an increase in the period of PR, which is mostly preferred in ICUs, increased the possibility of neurovascular complications and that the use of special restraint equipment could reduce the potential development of neurovascular complications.

In line with these results, it is recommended to develop evidence-based guidelines that can be followed by both intensive care nurses and physicians in order to base the decision-making process on the use of restraint on clinical evidence rather than perceived benefits, to inspect the adequacy of existing legal regulations in practice, to support the staff involved in the restraint process with regular training programs, and to make improvements to ensure adequate resources such as safe restraint equipment and staff support.

AUTHOR CONTRIBUTIONS:

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Informed Consent: Written informed consent was obtained from relatives of patients or patients who participated in this study.

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