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ORIGINAL ARTICLE

ASSESS THE IMPACT OF PASSIVE RANGE OF MOTIONS (PROMS) ON PHYSIOLOGICAL VARIABLES & BEHAVIORAL PAIN OF ICU PATIENTS

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ABSTRACT

Background: Patients admitted in the Intensive Care Unit (ICU) due to serious medical conditions spend majority of their time in bed and are frequently on a ventilator. The purpose of this study was to see how Passive Range of Motions (PROMs) affected physiological variables and behavioral pain in ICU patients.

Materials & Methods: Descriptive, cross-sectional, quantitative study conducted at Sir Ganga Ram Hospital from 15th Feb 2022 to 31th March 2022, in which 80 patients admitted in adult ICU were included in the study through convenient sampling. Self-administered proforma was used to collect the demographics of study participants as well as physiological variables. Behavioral Pain Scale (BPS) was used to assess the impact of pain before, during and after performing PROM. Physiological factors (BP, HR, RR, Oxygenation, and CVP) were measured at 10min, 20min, and 1 hour intervals.

Results: Patients having age range from 18 years to 57 years old recruited for the study whose mean age was ($\bar{X}$=41.38 ±7.0). Overall, no significant change was observed in the mean values of Physiological factors, but reduction in behavioral pain was noticed after one hour of intervention (PROM) in 63.75% patient.

Conclusion: Passive range of motions (PROM) can be effective and efficient way to lessen the behavioral pain of ICU patients.

KEY WORDS: Passive range of motion; Physiological variables; Behavioral Pain; Mechanically Ventilation; Intensive care units.

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INTRODUCTION

Patients admitted in the Intensive Care Unit (ICU) due to serious medical conditions spend majority of their time in bed and are frequently on a ventilator.[1] Hypotrophy, a condition that involves impaired strength and endurance in skeletal muscles and tendons, stiffness in the joints, decreased bone density, and degradation of cartilage, can occur in ICU patients.[2] There is no single way that can be utilized to get patients more active in the ICU. Mobilization, mobility, exercise, activity, and rehabilitation are the most widely used terminology, and there is typically an "early" prefix before the term, such as early mobilization. Early mobilization appears to be the most commonly used word, and it frequently incorporates both passive and active interventions.[3] In the ICU, two types of physiotherapy therapies are used: passive and active interventions. Positioning, passive-ROM, bending, CPM, electrical muscle stimulation, and splinting are examples of passive interventions. Active therapies include exercise therapy, training in activities of daily living such as balance and standing, and getting out of bed.[4]

Passive-ROM is a highly prevalent treatment for patients who are unable to move their arms and/or legs on their own owing to coma and/or sedation.[5] The "range of rotation or translation by which a joint is either actively or passively manipulated between two opposite positions in a specific direction" is defined as ROM.[6] A physiotherapist performs passive-ROM manually on ICU patients.[7] Passive-ROM is frequently used by physiotherapists in intensive care units, although it has a wide range of uses. It is usually done 5-7 days a week; with 1-4 sets per joint and

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2-30 repetitions of each action in each joint.[8] Bedside cycle ergometry is one approach of delivering extended periods of motion exercise to patients in intensive care units. There are bed cycles for both active and passive exercise. It is set for revolutions per minute (RPM) when used passively, and it has numerous gears to choose from, when used actively.[9] Beginning this intervention as soon as 72 hours after ICU admission has been shown to be safe and free of substantial hemodynamic or respiratory abnormalities. Passive intervention with a bedside cycle ergometer is regarded safe and feasible in critically sick ICU patients due to the fact that there are no clinically meaningful and nearly no significant changes in respiratory and circulatory variables such as respiratory rate (RR), heart rate (HR), and blood pressure (BP) throughout therapy sessions.[10] Another advantage of passive exercises is that they lessen pain behaviors, implying that mobilization may be a unique method to pain management in critically sick patients. In a study of physiologic responses to a passive exercise intervention in mechanically ventilated critically ill individuals, the behavioral Pain Scale score is reduced both during and after the session.[11] In view of the above literature findings, current study undertaken at Sir Ganga Ram hospital, Lahore to assess the impact of PROM on physiological variables and behavioral pain of MV patients.

MATERIALS AND METHODS

This was descriptive, cross-sectional, quantitative study conducted at Sir Ganga Ram Hospital, Lahore for the period of 6 weeks 15th Feb, 2022 to 31st March, 2022. By using convenient sampling total 80 patients were selected for the research work. Self-administered proforma was used to collect the demographics of study participants as well as physiological variables. Behavioral Pain Scale (BPS) consisted of three sections: facial expressions, movements of upper limbs and compliance with mechanical ventilation were used to assess the impact of behavioral pain before, during and after performing PROM. The exercise lasted 20 minutes every day, five days a week, and consisted of 15 repetitions, 1-4 sets of each joint, whereas sedated patients received 7 sets of each joint of the same repetition in supine position. Physiological factors (BP, HR, RR, Oxygenation, and CVP) and behavioral discomfort were measured at 10min, 20min, and 1 hour intervals. The passive-exercise routine included flexion-extension motions for both the upper limbs (Wrist flexion, extension, and ulnar and radial deviation; elbow flexion, extension, supination, and pronation; and shoulder flexion, extension, abduction, and adduction) and lower limbs (Ankle plantar flexion and extension, dorsiflexion, inversion and eversion, knee flexion and extension, and hip flexion, extension, abduction, adduction, and internal and external rotation). After completing the range of motion exercise routine, the patient should rest for around one hour without engaging in any activity until the researchers receive the final reading.

Inclusion criteria was all male and female patients having age range 18 years to 57 years, admitted in adult ICU and anticipated need for mechanical ventilation for at least 48 hours. All the patients should have stable respiratory status as well as heart rate, blood pressure and oxygen saturation within unit-specified norms. Those patients who experience frequent desaturation, hypotension, new cardiac enzyme alterations, new anti-dysrhythmia therapy, or a recent breathing mode change until these issues were excluded. Also those suffering from elevated intracranial pressure, neuromuscular disease, cardiac arrest, missing limbs, or an irreversible ailment were not included. Approval was taken from concerned hospital authorities and Ethical Review Committee to conduct the research work as well as written informed consent also taken from all the study participants, attendants prior to research work. Demographic and physiological data during four phases were measured using mean, standard deviation and percentages. The chi-square test and p-value$<$0.05 were used to analyze the relationship between passive range of motions, physiological variables, and behavioral pain. The data was evaluated using the Statistical Package for Social Sciences (SPSS-21).

RESULTS

Total 80 patients admitted in adult ICU having age range from 18 years to 27 years old considered for the study and their mean age was recorded as $\bar{X}=41.38 \pm 7.0$). Complete demographics are shown in the Table 1.

Table 1: Socio-demographic data of patients (n=80)

Variables	Frequency	%age
Age		
18-27 years	5	6.25
28-37 years	20	25.00
38-47 years	34	42.50
48-57 years	21	26.25
Total	80	100.00
Mean Value: $\bar{X}$ = 41.38 Standard deviation ± 7.0		
Gender		
Male	60	75.00
Female	20	25.00
Total	80	100.00

Medical diagnosis		
Neurosurgical disorder	22	27.50
Respiratory disorders	45	56.25
Cardiovascular disease	13	16.25
Total	80	100.00
Mode of ventilation		
C.V. mode	33	41.25
S.I.M.V mode	47	58.75
Total	80	100.00
Vasopressors		
Yes	22	27.50
No	58	72.50
Total	80	100.00
Sedation		
Yes	71	88.75
No	9	11.25
Total	**80**	**100.00**

PROM was done in four stages on MV patients, with physiological variables measured before and after one hour of intervention. The mean values of SBP and DSP decreased after 10-20 minutes, but returned to baseline after one hour. HR and RR values increased after 20 minutes and were approximately one hour closer to baseline; oxygen saturation declined after 20 minutes and was approximately one hour closer to baseline; and CVP decreased after 10-20 minutes and increased after one hour as depicted in the Table 2.

According to patient facial expressions, 76.25% of participants were grimacing prior to intervention, but only 5% and 3.75% were grimacing after 20 minutes and one hour, respectively. In terms of upper limb movements, 71.25% of participants were fully bent with finger flexion earlier to starting PROM, while 75% of respondents had no movement after one hour of intervention. In terms of ventilator compliance, 50% of participants were fighting with the ventilator prior to PROM, whereas 35% were tolerating the ventilator after one hour of intervention as indicated in the Table 3. Chi-square test was performed to check the association of behavioral pain throughout four phases which showed that there was direct association of behavioral pain and passive range of motions as mentioned in the Table 4.

Table 2: Average values of physiological variables of patients on mechanical ventilation during each of the four stages of passive range-of-motion workouts (n=80)

Details	Baseline	10 mints	20 mints	1 hour
Systolic blood pressure	122.65±2.0	119.45±3.3	116.81±2.9	122.72±4.0
Diastolic blood pressure	84.71±1.1	81.80±4.1	79.60±2.8	84.08±5.0
Heart rate	86.03±3.0	89.58±5.4	93.92±4.5	85.93±6.5
Respiratory rate	18.92±1.0	20.25±2.4	21.28±1.9	18.82±3.3
Oxygen saturation	94.42±1.1	93.65±1.4	93.03±2.2	94.10±3.2
CVP	11.28±2.2	11.19±1.9	11.25±2.4	12.15±1.8

Table 3: The pattern of Behavioral Pain over the four stages of passive range-of-motion activities in patients who were mechanically ventilated (n=80)

Details		Baseline f (%age)	10 mints f (%age)	20 mints f (%age)	1 hr f (%age)
Facial expression	Relaxed	0 (0%)	0 (0%)	41 (51.25%)	47 (58.75%)
	Partially tightened	10 (12.50%)	18 (22.50%)	31 (38.75%)	21 (26.25%)
	Fully tighten	9 (11.25%)	25 (31.25%)	4 (5%)	9 (11.25%)
	Grimacing	61 (76.25%)	37 (46.25%)	4 (5%)	3 (3.75%)
Movement of upper limbs	No movement	4 (5%)	4 (5%)	52 (65%)	60 (75%)
	Partially bent	4 (5%)	4 (5%)	8 (10%)	4 (5%)
	Fully bent with finger flexion	57 (71.25%)	68 (85%)	20 (25%)	16 (20%)
	Permanently retracted	16 (20%)	4 (5%)	0 (0%)	0 (0%)
Compliance with ventilation	Tolerating movement	28 (35%)	48 (60%)	64 (80%)	72 (90%)
	Coughing but tolerating	12 (15%)	12 (15%)	16 (20%)	8 (10%)
	Fighting ventilator	40 (50%)	20 (25%)	0 (0%)	0 (0%)

Table 4: Association of behavioral pain throughout four stages of passive range of motions among mechanically ventilated patients (n=80)

Behavioral pain throughout four phases	Responses	Level of pain			X^2 & p-value
		No pain	Moderate	Severe	
Baseline	Yes f (%)	2 (2.5%)	12 (15%)	51 (63.75%)	1.00 & 0.00*
	No f (%)	1 (1.25%)	12 (15%)	2 (2.5%)	
10 mints	Yes f (%)	1 (1.25%)	12 (15%)	21 (26.25%)	1.00 & 0.00*
	No f (%)	1 (1.25%)	40 (50%)	5 (6.25%)	
20 mints	Yes f (%)	7 (8.75%)	22 (27.5%)	10 (12.5%)	1.00 & 0.01*
	No f (%)	10 (12.5%)	30 (37.5%)	1 (1.25%)	
1 hour	Yes f (%)	12 (15%)	55 (68.75%)	1 (1.25%)	1.00 & 0.00*
	No f (%)	12 (15%)	0 (0%)	0 (0%)	

**Significant p<0.05*

DISCUSSION

The mean values of changes in physiological parameters of ventilated patients during passive exercises revealed a significant decrease in oxygen saturation, systolic and diastolic blood pressure, the mean values after 10 and 20 minutes of intervention compared to baseline, while after 1 hour of exercises the mean values were nearly equal to baseline. Although there was a significant shift in blood pressure means scores, these changes were within physiological variation normal levels. This finding is congruent with the findings of a research conducted by Burtin et al., who discovered no changes in HR, SBP, diastolic blood pressure, or respiratory rate following PROM exercises.[12] Zafiropoulos et al. did another study in which they employed a mobilization technique on patients who underwent upper abdominal surgery and discovered significant increases in systolic, diastolic, and MBP when sitting on the edge of the bed. When the patients sat up in bed for 20 minutes, their heart rate and blood pressure returned to normal.[13] Genc et al. found in a research that "the hemodynamic and respiratory effects of passive limb exercise for mechanically ventilated patients receiving low-dose vasopressor/ inotropic support" improved CVP considerably following passive leg workouts.[14]

In terms of behavioral pain throughout the phases of PROM, the current study found that the majority of critically ill patients showed grimacing facial expressions before intervention and relaxed face expressions after 1hr of intervention indicating that passive exercise reduces the experience of tension and pain. This finding is similar to the findings of Rahu et al., who found that grimace facial behaviors were the most commonly seen pain behavioral reactions during endotracheal suctioning.[15] Majority of the patients evaluated were fully bent with finger flexion prior to intervention and did not move their upper limbs after 1 hour. This finding is consistent with Bailey's research, which concluded that physical activity is also thought to reduce pain, anxiety, promote sleep, and improve mood, all of which are beneficial in reducing the effects of illness on muscle.[16] Current result showed that half of patients were fight ventilator before intervention while majority of then had tolerating movement after 1hr of intervention. This finding was in contrast with Payen et al. who found that an intubated patient's response to a nociceptive stimulus is associated with a change in compliance with ventilator (cough, fight) prompted us to include this item on the BPS during mobilization.[17]

CONCLUSION

There was no significant difference observed in physiological variables before and after PROM, but there seems to be direct association of passive range of motions in reducing behavioral pain of mechanically ventilated patients during and after the intervention, emphasizing that physiotherapists should play an effective and efficient role to improving the quality of life (QoL) of MV patients.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	NT, AB, AS
Acquisition, Analysis or Interpretation of Data:	NT, AB, AS
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All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.