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Original Research Article

Nature-Based Sounds Role in Physiological Stress Responses in Patients under Mechanical Ventilation Support

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ABSTRACT

Background: Mechanical ventilation is a lifesaving modality but is often associated with high anxiety and agitation which may lead to high cost treatment and complications.
Objectives: To estimate the effect of the nature-based sounds (NBS) on physiological stress responses (heart rate, respiratory rate, blood pressure) in patients under mechanical ventilation support. Design: randomized controlled trial.
Methods: The data was collected from October 2016 to August 2017. One twenty subjects were randomly assigned to either the experimental or control group. Subjects in the experimental group listened to nature based sounds played via media player through head phones and subjects in the control group were also provided headphones but no sounds were played. Physiological stress responses such as heart rate, respiratory rate, systolic and diastolic blood pressure were assessed through bed side cardiac monitor at baseline, 15th, 30th, 45th, 60th min and 30 min after the intervention (NBS).
Results: There was a significant reduction in physiological stress responses in the intervention group.
Conclusion: Nature based sounds (NBS) may have a calming effect on physiological stress responses and hence further stabilising the patient overall.

Keywords: Mechanical ventilation, Nature-based sounds (NBS), stress, physiological stress responses

INTRODUCTION

Patients under mechanical ventilation support undergo multiple stressors related to physiological condition, ongoing clinical interventions, and the intensive care environment itself. [1] Stress of any kind may lead to stimulation of the sympathetic nervous system, causing an increase in respiratory rate, heart rate and blood pressure. Music has been always relaxing in stress. [2] Nature based sounds is also a form of soothing music and hence a reduction in these physiological parameters can be expected with these sounds too. Nature based sounds denote to the sounds which are already existing in the nature. They could result from natural phenomena such as wind, rain, ocean, river, birds, and animals' sounds. Natural environments have been found to be restorative effects on health by inducing positive emotional states and sustained attention. [3] Patients on mechanical ventilator frequently exhibit anxiety as evidenced by increased physiological parameters and produce assessment and management challenges for clinicians and nurses. Though drugs may be necessarily administered to make them calm and prevent any injury. However, parallel, intermittent and adjunctive use of non-

pharmacological interventions with sedatives may magnify the effects of and reduce the dosages of drugs in order to get equal effect. Therefore, Sedation need not to be given in all cases in order to manage the patient's distress related to mechanical ventilation.

Objectives

The study was undertaken to identify the effect of the NBS on physiological stress responses in patients under mechanical ventilation support and to determine the association between effects of NBS with selected variables of patients. We hypothesized that nature based sounds will have a positive effect in reducing the physiological stress responses (HR, RR, BP) of patients on mechanical ventilator support at α level of 0.05.

MATERIALS AND METHODS

The study was a prospective randomized controlled trial done in respiratory ICU of a tertiary hospital. As per the pilot study done in 10 patients, mean heart rate (102.8±14.83) in experimental group and 104.6±18.5 in control group, assuming 5% level of significance and 80% power, estimated sample size was 120 (60 in each group of experimental and control). Patients were allocated to the NBS and without NBS group along with routine care using a computer-generated randomization list. The allocation was sealed in thick, opaque envelopes before data collection. After participants completed the baseline data evaluation, the sealed envelopes were opened sequentially. The sealed envelopes prepared and opened by nurse on duty and she placed the headphones on selected patients. The researcher was blinded to random assignment throughout the study period.

Inclusion criteria

The patients aged between 18 and 65 years under mechanical ventilation support on pressure support ventilation mode and SIMV for 48 hours in an ICU, having Glasgow Coma score of 9 or above. Patients who were able to hear and see, non-drug-addicted, not taking any neuromuscular blocker agent and antihypertensive drug, having no facial signs of being scared, not currently using NBS intervention and without any psychiatric or neurological illnesses.

Exclusion criteria

Subjects extubated from mechanical ventilation, having a skull injury that restricted the use of headphones, physical restrained, who need emergency dose- stat sedative and who withdraw from study.

Intervention (nature-based sounds)

The preliminary authors were contacted for providing different sounds and CD was further prepared by combining different sounds. The CD was given to different experts for the quality, pitch, frequency and rhythm of the sounds. The sounds included birds 'chirping, soothing rain sounds, river streams, waterfall sounds and sea waves sound. The subjects in the experimental group wore the foam-lined headphones. The volume of the media player was adjusted according to the subjects' comfort by responding to their facial expression and holding up fingers responsive to confirmation by nurse on duty. The subjects in control group also wore the same headphones and remained quiet for the same time duration. Pre and post-test HR, RR and BP were measured using the calibrated cardiac monitor placed on the bed side. The institute ethics committee of the AIIMS hospital granted the approval of the study (Ref. No. IESC/T-393/28.11.14). All participants were explained about the voluntary participation and withdrawal from the study at any given point of time and their written informed consent was taken prior to participating in the study. NBS was played between 5 to 6 pm to accommodate nursing activities and the unit's routine. The approximate time taken for each subject was 2 hours for one setting of NBS and other group too. Consort diagram is given in figure 1.

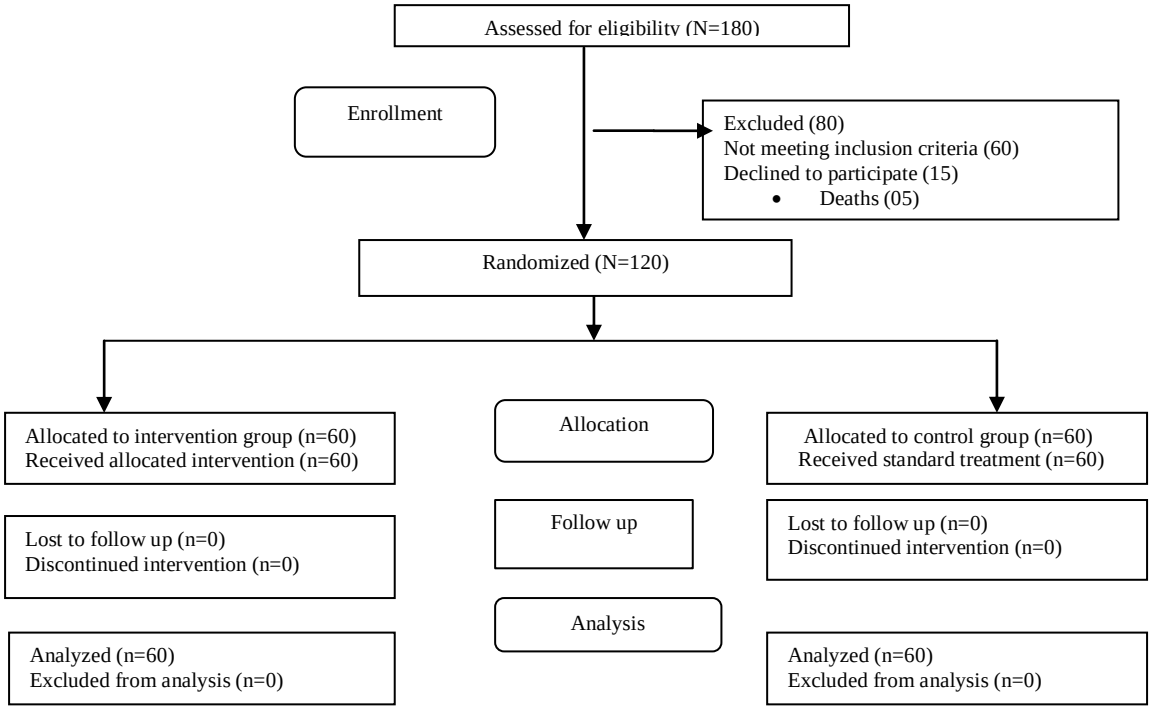

Figure: 1: CONSORT diagram

RESULTS

SPSS version 16.0 was used to analyze the data. The data collected was coded, entered into a Microsoft excel sheet and all entries were checked for any errors. Chi-square tests were used to detect any significant difference between the groups' demographic and clinical data. An independent t-test was used to detect any significant differences between the groups' mean values of physiological parameters.

- Both the groups were found homogeneous in terms of sample demographic and clinical characteristics, has been shown in Table 1.
- There were statistically significant differences in the mean heart rate, respiratory rate, systolic blood pressure and diastolic blood pressure. of both the group at 15th, 30th, 45th minutes and 60th minutes and even 30 minutes after removal of NBS indicating that subjects in the experimental group had lower heart rate than the control group. (table 2, table 3, table 4 and table 6)
- There was no significant association of HR, RR and BP with selected demographic and clinical variables such as age, gender and smoking status, length of ICU stay, ventilator mode and GCS score.

Table 1: Distribution of Demographic and clinical variables of subjects in experimental and control groups **N=120**

		Experimental group f (%) n=60	Control group f (%) n=60	p value
Gender:	Males	35 (58)	37 (62)	0.70 χ^2
	Females	25 (42)	23 (38)	
Age (years):	Means	47.07±10.66	46.90±10.95	0.93^t
	(range)	(25-65)	(18-62)	
Residence:	Urban	41 (68)	43 (72)	0.69 χ^2
	Rural	19 (32)	17 (28)	
Education:	Illiterate	18 (30)	24 (40)	0.42 χ^2
	Primary	4 (7)	8 (13)	
	Senior secondary	9 (15)	6 (10)	
	Undergraduate	8 (13)	7 (12)	
	Postgraduate	21 (35)	15 (25)	

Table 1 to be continued…			
Medical diagnosis: Pleural effusion	8 (13)	9 (15)	0.69 χ^2
Respiratory arrest	7(12)	6 (10)	
Interstitial lung disease (ILD)	6 (10)	10 (17)	
Chronic obstructive pulmonary disease (COPD)	21 (35)	15 (25)	
Others	18(30)	20 (33)	
Mode of ventilation			
volume controlled ventilation (VCV)	24 (40)	23 (38)	0.92 χ^2
Synchronized intermittent mandatory ventilation (SIMV)	11 (18)	14 (23)	
Pressure support ventilation (PSV)	17 (28)	16 (27)	
Assisted controlled ventilation (A/C)	8 (13)	7 (12)	
Length of stay in ICU (days)			
0-4	16 (27)	25 (42)	0.18 χ^2
5-8	34 (57)	25 (42)	
>8	10 (16)	10 (16)	
No of days on mechanical ventilation			
0-4	21 (35)	27 (45)	0.42 χ^2
5-8	31 (52)	28 (47)	
Above 8	8 (13)	5 (8)	
GCS score: 9	32 (53)	36 (60)	
10	28 (47)	24 (40)	0.46 χ^2

chi-square (χ^2), independent 't' test * p value<0.05

Table 2: comparison of heart rate of subjects in experimental and control group. N=120

Time	group	Mean±SD	Mean difference	t value	p value
Baseline	Experimental (n=60) Control (n=60)	104.58±6.68 102.25±7.06	2.33	1.860	0.06
15 min	Experimental (n=60) Control (n=60)	99.77±5.81 102.37±6.33	2.60	2.343	0.02*
30 minutes	Experimental (n=60) Control (n=60)	97.85±6.52 104.12±7.26	6.27	4.975	<0.001*
45 minutes	Experimental (n=60) Control (n=60)	97.57±5.18 104.07±6.21	6.50	6.229	<0.001*
60 minutes	Experimental (n=60) Control (n=60)	96.47±6.58 104.37±7.02	7.90	6.36	<0.001*
30 min after NBS	Experimental (n=60) Control (n=60)	94.47±9.73 100.52±9.09	6.05	3.519	0.001*

P<0.05 level of significance *Significant

Table 3: comparison of respiratory rate of subjects in experimental and control group N=120

Time	group	Mean±SD	Mean difference	t value	p value
Baseline	Experimental (n=60) Control (n=60)	31.28±2.86 32.28±3.69	0.77	1.271	0.20
15 min	Experimental (n=60) Control (n=60)	30.97±2.68 33.17±3.61	2.15	3.702	<0.001*
30 minutes	Experimental (n=60) Control (n=60)	30.32±3.08 33.80±2.27	3.48	7.057	<0.001*
45 minutes	Experimental (n=60) Control (n=60)	29.87±2.99 34.23±2.59	4.37	8.549	<0.001*
60 minutes	Experimental (n=60) Control (n=60)	29.45±2.68 34.27±2.28	4.82	10.61	<0.001*
30 min after NBS	Experimental (n=60) Control (n=60)	28.80±2.87 31.83±2.30	3.03	6.389	0.001*

Table 4: comparison of systolic blood pressure of experimental and control group N=120

Time	Group	Mean±SD	Mean diff.	t value	p value
Baseline	Experimental (n=60) Control (n=60)	129.02±7.32 127.20±7.99	1.82	1.299	0.19
15 minutes	Experimental (n=60) Control (n=60)	124.95±8.08 126.43±9.45	1.48	0.92	0.35
30 minutes	Experimental (n=60) Control (n=60)	123.98±7.66 127.58±8.56	3.60	2.42	0.01*
45 minutes	Experimental (n=60) Control (n=60)	122.77±7.70 127.90±8.54	5.13	3.45	0.001*
60 minutes	Experimental (n=60) Control (n=60)	122.50±7.38 128.22±8.45	5.72	3.94	<0.001*
30 min after NBS	Experimental (n=60) Control (n=60)	121.07±7.93 124.02±9.72	2.95	1.82	0.03*

P<0.05 level of significance * Significant

Table 5: comparison of diastolic blood pressure of experimental and control group diastolic blood pressure scores. N=120

Time	group	Mean±SD	Mean difference	t value	p value
Baseline	Experimental (n=60) Control (n=60)	83.27±5.65 81.83±6.26	1.43	1.31	0.19
15 min	Experimental (n=60) Control (n=60)	82.07±85.46 82.13±5.90	0.06	0.06	0.94
30 minutes	Experimental (n=60) Control (n=60)	81.88±5.92 82.85±5.92	0.97	0.894	0.373
45 minutes	Experimental (n=60) Control (n=60)	122.77±7.70 127.90±8.54	5.13	3.45	0.001*
60 minutes	Experimental (n=60) Control (n=60)	122.50±7.38 128.22±8.45	5.72	3.94	<0.001*
30 minutes after NBS	Experimental (n=60) Control (n=60)	121.07±7.93 124.02±9.72	2.95	1.82	0.03*

Table 6: Association of physiological stress response with selected demographic variables N=120

		Experimental group (n=60)			Control group (n=60)		
Research variables	Demographics	χ^2	Df	p value	χ^2	df	p value
Heart rate	Age	2.21	3	0.54	1.88	3	0.59
	Gender	3.70	1	0.06	3.00	1	0.10
	Length of ICU stay	0.85	2	0.65	1.25	2	0.53
	Ventilator mode	2.53	3	0.46	7.12	3	0.06
	GCS	2.31	1	0.19	*8.69*	*3*	*0.03**
Respiration rate	Age	2.97	3	0.39	1.52	3	0.67
	Gender	0.72	1	0.39	2.74	1	0.11
	Length of ICU stay	3.72	2	0.15	4.25	2	0.11
	Ventilator mode	0.82	3	0.84	4.15	3	0.24
	GCS	2.11	1	0.18	1.93	3	0.58
Systolic BP	Age	5.48	3	0.14	3.30	3	0.34
	Gender	0.49	1	0.60	0.63	1	0.59
	Length of ICU stay	0.85	2	0.65	0.80	2	0.96
	Ventilator mode	1.78	3	0.61	0.18	3	0.98
	GCS	0.001	1	1.00	5.90	3	0.11
Diastolic BP	Age	7.63	3	0.05	1.74	3	0.62
	Gender	0.008	1	1.00	3.72	1	0.06
	Length of ICU stay	2.98	2	0.22	3.63	2	0.16
	Ventilator mode	1.01	3	0.79	3.62	3	0.30
	GCS	0.20	1	0.79	2.35	3	0.50

DISCUSSION

The present study aimed to investigate the effects of nature-based sounds on physiological stress responses in patients on mechanical ventilator support in respiratory ICU. We hypothesized that the subjects who listened to nature-based sounds would show significant reduction in physiological stress responses such as HR, RR, SBP and DBP than the subjects not exposed to nature-based sounds. The research hypothesis got accepted by showing a significant reduction in physiological stress responses. Natured based sounds as an inexpensive and non-invasive, non-pharmacological intervention has been used in various studies in recent years. The study findings indicated that at six different time points nature-based sounds significantly reduced HR, RR, SBP and DBP when compared to non-nature-based sounds arm. The present findings are in agreement with Rejeh N et al [4] in which statistically significant differences ($p < 0.05$) were found in systolic and diastolic blood pressure, mean arterial pressure, heart rate, and oxygen saturation over time in both the groups. Similar findings were reported with significant reduction in heart and respiratory rate, systolic and diastolic blood pressure with music therapy [5-8] however, other studies [9,10] showed inconsistent findings, they didn't report any significant changes in physiological parameters

Limitations

The present study had few limitations. Firstly, there were five different types of nature-based sounds and the subjects might

not have their favorite sounds as per their choice which might have reduced the effect of the intervention. The sounds could have been given by asking individual subjects' preference. However, since the results showed positive effects; we may conclude that that the limited choices over sounds selection did not considerably affect our results. Secondly, since the patients were chosen from one respiratory ICU of the hospital, their demographic and clinical characteristics might be similar to some extent but the findings can't be generalized to broader population.

Implications

The findings of this study imply that nature-based sounds can significantly improve physiological stress responses in patients on mechanical ventilator support in ICU. Nursing managers and hospital authorities need to provide adequate training, equipment, and facilities to nurses to facilitate their use of such strategies.

Recommendation

Further studies might be undertaken to ascertain whether the effect of particular sound they liked were more affirmative than the sounds they didn't like if used in separate ways such as individually, combination of two sounds and all the sounds in one group. Further studies comparing the effects of music interventions with different frequencies (e.g., once or twice per day) are warranted. The present intervention could be compared with other non-pharmacological intervention for assessing the immediate and long-term benefits.

CONCLUSION

The findings of the present study and those of previous research indicate that nurses in the clinical setting may use nature-based sounds as a healing ambience to help reduce ICU patients' physiological stress responses and to promote health and well-being of the patients. However, as the duration of the effect of intervention is indistinct, nurses need to monitor patients' physiological stress after providing the nature-based sounds' intervention. In addition, nurses must be sensitive enough to understand that individual patients may have different responses to nature-based sounds so that they may consider providing the nature-based sounds according to their preferences.

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