Original Article

The effect of sensory stimulation provided by family on arterial blood oxygen saturation in critical care patients

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Abstract

Background: Stressors in the intensive care unit (ICU) impair patients' comfort, excite the stress response, and increase oxygen consumption in their body. Non-medical interventions are recommended by several studies as a treatment to improve comfort in the ICU patients. Sensory stimulation is one of the most important interventions. Since arterial blood oxygen saturation is an important index of patients' clinical and respiratory condition, this study aimed to investigate the effect of sensory stimulation provided by family on arterial blood oxygen saturation in critical care patients.

Materials and Methods: This study is a clinical trial conducted on 64 patients hospitalized in the ICU wards of Al-Zahra and Kashani hospitals in Isfahan, Iran in 2012 and 2013. The patients were selected by simple sampling method and were randomly assigned to two groups (study and control). Patients' arterial blood oxygen saturations were measured 10 min before, immediately after, 10 min and 30 min after sensory stimulation in the study group, and simultaneously in the control group without any intervention.

Results: Repeated measures analysis of variance (ANOVA) showed a significant difference in the mean of arterial blood oxygen saturation levels 10 min before, immediately after, 10 min and 30 min after sensory stimulation in the study group ($P < 0.001$), but in the control group, the difference was not significant ($P = 0.8$). Pair wise comparison of the mean arterial blood oxygen saturation levels at different time points by Fisher's Least Significant Difference (LSD) showed that there was a significant difference in the intervention group ($P < 0.022$). But in the control group, there was no significant difference between pairs of time points ($P > 0.18$).

Conclusions: Application of sensory stimulations as a nursing and non-medical intervention by the family members improves comfort and increases the level of blood oxygen saturation in critical care patients.

Key words: Family visitors, sensory stimulation, talk, oxygen saturation, touch

Introduction

Intensive Care Unit (ICU) is a ward that caters to patients with acute and life-threatening diseases.[1] The patients hospitalized in this ward experience numerous stressors due to environmental factors and specific treatment conditions or surgery. Physiological reactions excite the stress response and lead to an increase in BP, pulse, and respiratory rate, and consequently, the cardiac muscle needs more oxygen.[2,3]

One of the most important stressors is sensory deficit, which is caused by either deprivation or overload of sensory stimulation.[4,5] Apart from the irregular responses that the disease causes in a patient's body, with ICU being an unfamiliar place concerning appearance, noise, and smells, the patient's sensory stimulations have no specific meaning and content and their normal patterns are deleted. Sensory deficit acts as major stressor and influences the physiological balance of the body.[6,7]

Research showed an increased level of stress in 85% of patients hospitalized in the ICU.[8] For most of the patients in this ward, medical interventions are usually used to relieve patients' anxiety and provide them with comfort.[9]

These interventions have numerous complications of which the most important are a reduction in consciousness and a defect in patients' cognitive function. Non-medical interventions are suggested as the patients' conscious status and their active participation in care are very important in the ICU. These interventions not only bring about a feeling of comfort and never decrease patients' consciousness, but also lead to their active participation in care.[10] One of the most important interventions is sensory stimulation. Due to this, the patients' stimulations are organized and the patients are provided with meaningful and clear contents

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concerning the severity, time, and frequency.[11] Sensory stimulations can be applied to all five senses, but those of tactile and olfactory senses are more convenient, functional, and applicable.[12,13] Most of the studies have reported being in an unfamiliar environment and being far away from the family members as the most important causes for patients' anxiety.[12,14-18]

Happ *et al.* stated that the patients discharged from ICU claimed that presence of their family members beside them made them stress free in the ICU.[19] Eriksson and Bergbom stated that presence of a beloved person means a real touch for the patients and gives them the power and hope to face a serious disease.[20] Therefore, it can be concluded that presence of family members, in addition to helping the family, copes with the crisis by changing the patients' sensory stimulations to a meaningful content and promoting patients' peace and comfort through making a supporting and familiar environment.[17,18] Unfortunately, 44% of ICU wards prohibit the entry and presence of patients' families and argue that by this, patients' physiological stress is increased.[22]

Those ICU wards in which the family members are permitted to enter have no specific program to apply sensory stimulations. So, the family members enter the ward with no special training and they are often worried as to how t o provide their patients with peace and comfort.[23] As the care of all patients is to be administered by nurses, they are responsible for applying sensory stimulations and can involve family members in helping their patients. They should detect appropriate sensory stimulations with the help of the family members and provide the patients with an environment rich in meaningful stimulations.[13,21,24] As nurses are accountable for what they do, they have the right to know the effects of nursing interventions on the patients. In the ICU, arterial O2 saturation, as an important index of patients' clinical and respiratory condition, should be considered as the patients' basic data about oxygenation and acid alkaline balance, after arterial blood gas.[21,25] Abbasi *et al.* investigated the effect of family members' touch and talk on patients' level of consciousness in the ICU and reported that this intervention promoted patients' consciousness level.[12] Salavati *et al.* also investigated the effect of family members' touch and talk on conscious patients in the coronary care unit (CCU) and reported that family visits increased patients' O2 saturation percentage.[26] But no study has been conducted on the simultaneous effect of sensory stimulation and family members' participation on the arterial O2 saturation of patients with low consciousness in the ICU. Most of the researchers used only one type of sensory stimulation administered by a nurse and reported controversial results.

Lakie *et al.* investigated the effect of touch on arterial O2 saturation of the patients undergoing mechanical ventilation and reported that touch increased arterial O2 saturation.[25] Mohammadpour *et al.* reported that reflexive massage had no effect on arterial O2 saturation in cerbrovascular accident patients.[27] Maleki *et al.* investigated the effect of music on arterial O2 saturation in head injury patients and reported its positive effect.[28] Nilson also investigated the effect of music on patients with open heart surgery and reported no effect on their arterial O2 saturation.[29] Based on all the above-mentioned issues, the researchers conducted the present study to investigate the effect of sensory stimulation provided by family on arterial blood oxygen saturation in critical care patients.

Materials and Methods

This is a two-group clinical trial (IRCT2013110215241N1). The subjects comprised 64 patients hospitalized in the ICUs of Al-Zahra and Kashani hospitals affiliated to Isfahan University of Medical Sciences from December 2012 to June 2013. They satisfied the inclusion criteria and were selected through convenient sampling. The inclusion criteria were age 18-60 years; admission in the ICU ward for >24 h; 9 ≤ Glasgow Coma Scale (GCS) ≤12; having taken tranquilizers and narcotics (if needed) at least 6 h prior to the time of sampling; no addiction to smoking, alcohol, or drugs; no mental, hearing, or dermatological problems; availability of the patient's beloved person; no intake of medications like nitroglycerin, dopamine, or dobutamine at the time of the sampling; and hemodynamic stability on the day of research (pulse 60-100/min, mean BP > 65 mmHg, and O2 saturation >90%). Sampling continued simultaneously until 32 subjects were assigned to the study and control groups.

Ethical considerations

To conduct sampling, after obtaining approval from the Isfahan University ethics committee and a written permission from the university hospitals' authorities, the researcher referred to the research environment daily and selected the patients meeting the inclusion criteria. Then an informed written consent was obtained from the legal guardian of the patient if he/she was interested in participating in the study, and the subject was assigned to study or control group through random allocation.

Data were collected in a two-section questionnaire by questioning the patient's accompanying person, referring to the patient's file and the measurements of the physiological values. The first section was on subjects' demographic information and the second section contained an arterial O2 saturation record form. This questionnaire was designed by

the researcher based on a review of text books and similar articles and its content validity was established. Reliability of the arterial O2 saturation record form was confirmed by $r = 0.93$. To measure the arterial O2 saturation, a monitoring device (Pooyandegan Rah Saadat Co., Ltd, Tehran, Iran) was connected to the patient. Its validity was confirmed by its popular brand name and calibration at the time of study. After selection of the subjects and obtaining the written informed consents from their legal guardians, the researcher completed the demographic information questionnaire and then educated the patients' beloved person concerning the correct method of intervention (touching and talking to the patient). Next, patient's arterial O2 saturation was checked in the monitoring device and recorded as a dependent variable twice a day between 10-12 AM and 3-5 PM, 10 min before intervention.

In the study group, the environment was kept peaceful and quiet for 10 min. Then, after washing and disinfecting the hands by antibacterial gel and wearing a gown and sleepers, a family member sat by the patient, held the patient's hand smoothly, touched and called the patient by his/her name, and greeted and talked to him/her for 5 min about the trend of recovery and the ongoing interventions. After 5 min, there was 1 min of silence and no touch. The related family member again touched the patient's head and face smoothly and oriented him/her to the current time and talked about household events and family members for 5 min. After a minute of silence, finally, the relative held the patient's hands, touched him/her, wished him/her good health, and said good bye in the final 5 min. Except for emergency interventions leading to patient's exclusion from the study, no more extra intervention was conducted for the patients and peace and quietness prevailed around the patient. At the end of intervention, the family member left the ward and patient's arterial O2 saturation was checked on the monitoring device and recorded immediately after, 10 min after, and 30 min after intervention. In the control group, subjects' arterial O2 saturation was checked and recorded by the monitoring device with no intervention, at time points of 0, 27, 37, and 57 min.

The families of control subjects were permitted to meet, touch, and talk to their patients after study. It should be noted that the intervention technique and the time points of arterial O2 saturation measurements were designed and finally modified based on related texts and nurses' experiences in the ICU and after checking with some of the teachers in Nursing and Midwifery School of Isfahan University of Medical Sciences as well as the nurses working in ICU. Data were analyzed by descriptive statistical tests including frequency distribution tables and distribution, mean and SD, and inferential statistical tests such as Chi-square, Mann–Whitney, independent *t*-test, repeated measure analysis of variance (ANOVA), and Least Significant Difference (LSD) *post hoc* test through SPSS version 16.[20]

Results

The findings showed no significant difference in demographic variables such as sex, patient's age, family member's age, hospitalization length, GCS, patient's education, family member's education, and patient's hospitalization service in the study and control groups [Table 1].

Most of the subjects were self-employed in the study and control groups (53.1%). About 50% and 56.2%

Table 1: Comparison of demographic variables of control and study groups

Group Variable	Study	Control	*P*
Sex			
Male	71.9%	75%	0.78
Female	28.1%	25%	
Patients' age			
Mean	38.7	41.3	0.46
Family member's age			
Mean	41.1	39.5	0.58
Level of consciousness			
Mean	10.7	10.6	0.74
Hospitalization length			
Days	10.6	9.97	0.8
Admitted in			
Internal ward	21.9%	21.9%	1
General surgery	28.1%	28.1%	
Neurosurgery ward	50%	50%	
Marital status			
Single	28.1%	21.9%	0.58
Married	68.8%	68.8%	
Divorced	3.1%	6.2%	
Widowed	0%	3.1%	
Family member's education			
Illiterate	3.1%	3.1%	0.77
Primary school	40.6%	37.5%	
High school	34.4	34.4	
University	21.9%	25%	
Patient's education			
Illiterate	3.1%	0%	0.97
Primary school	37.5%	40.6%	
High school	34.4%	37.5%	
University	25%	21.9%	

of the family members were homemakers in the study and control groups, respectively. Family members were the patients' spouses in about 50% in the study group and 53.1% in control group. About 59.4% of subjects in the study group and 65.6% in the control group were connected to ventilator. Chi-square test showed that the study and control groups were absolutely homogenous concerning demographic variables. Independent *t*-test showed no significant difference in subjects' O2 saturation 10 min before intervention in the study group and at 0 min in the control group, and both groups were absolutely homogenous ($P = 0.93$). In the study group, repeated measure ANOVA showed a significant difference in mean O2 saturation at four time points ($P < 0.001$), but these mean values showed no significant difference in the control group ($P = 0.8$) [Table 2]. Independent *t*-test showed a significant difference in the mean changes of O2 saturation immediately after intervention compared to 10 min before that ($P = 0.03$), 10 min after intervention compared to 10 min before that ($P = 0.002$), 30 min after intervention compared to 10 min before that ($P < 0.01$), 10 min after intervention compared to immediately after that ($P = 0.01$), 30 min after intervention compared to immediately after that ($P < 0.01$), and 30 min after intervention compared to 10 min after that ($P = 0.02$) in the study and control groups [Table 3]. As the time points of 0, 27, 37, and 57 min in the control group coincided with the time point s of 10 min before, immediately after, 10 min after, and 30 min after intervention in the study group, while reporting results and tables, the same time points were presented for the study group (0, 27, 37, and 57 min time points). LSD *post hoc* showed significant difference in paired times points in the study group ($P < 0.05$), while these paired times points showed no significant difference in the control group ($P > 0.05$) [Table 4].

Table 2: Comparison of mean changes of O2 saturation before, immediately after, and 10 and 30 min after intervention in the control and study groups

Group	Study		Control	
Time	Mean	SD	Mean	SD
10 min before intervention	94.7	3.8	94.7	3.6
Immediately after intervention	95.3	3.3	94.5	3.8
10 min after intervention	95.97	2.8	94.5	3.6
30 min after intervention	96.8	2.5	94.7	3.3
Repeated measure ANOVA				
F	9.69		0.34	
P	<0.001		0.8	

SD: Standard deviation, ANOVA: Analysis of Variance

Discussion

The results obtained in the study show that presentation of sensory stimulations by family members increased O2 saturation of the patients hospitalized in the ICU, due to which there was a significant difference between O2 saturation 10 min before intervention and immediately after that, and 10 and 30 min after intervention. As only one sensory stimulation was applied and the family was not involved in the intervention in most of the studies, comparison of the results of the present study with other quantitative studies is difficult. Lakie *et al.* reported that touch increased O2 saturation in agitated patients undergoing mechanical intervention in the ICU. In their study, the time point of immediately after massage was investigated, but not the time points longer than that.[25] Khost *et al.* and Imani *et al.* also reported that massage increased O2 saturation in women with CVA, as they found that it was increased 30 min after massage compared to 10 min after that and 10 min before massage, and 10 min after massage compared to 10 min before that. In their study, the time point of immediately after massage was not investigated.[3,30]

Table 3: Comparison of mean changes of O2 saturation before, immediately after, and 10 and 30 min after intervention one by one variables in the control and study groups

Group	Study		Control		Independent *t*-test	
Time	Mean difference	SD	Mean difference	SD	*P*	*T*
Immediately after intervention compared to 10 min before	0.6	2.1	−0.2	1.7	0.03	2.25
10 min after intervention compared to 10 min before	1.3	2.9	0.1	1.96	0.002	1.78
30 min after intervention compared to 10 min before	2.03	3.6	0.03	1.5	<0.001	4.12
10 min after intervention compared to immediately after	0.7	1.6	0.03	1.2	0.01	2.49
30 min after intervention compared to immediately after	1.4	2.2	0.2	1.5	<0.001	3.66
30 min after intervention compared to 10 min after	0.8	1.2	0.2	1.6	<0.02	2.46

SD: Standard deviation

Table 4: Comparison of mean changes of O2 saturation by LSD test before, immediately after, and 10 and 30 min after intervention two by two variables in control and study groups

Time group	*P* value	
	Study	Control
Immediately after intervention compared to 10 min before	0.022	0.218
10 min after intervention compared to 10 min before	0.001	0.245
30 min after intervention compared to 10 min before	<0.001	0.193
10 min after intervention compared to immediately after	0.002	0.148
30 min after intervention compared to immediately after	<0.001	0.189
30 min after intervention compared to 10 min after	<0.001	0.196

Baghcheghi *et al.* reported that touch significantly increased O2 saturation at time points of 5 and 15 min after intervention, compared to 5 min before intervention, but the increase in O2 saturation at 10 min after compared to 5 min after intervention was not significant.[31] With regard to hearing stimulation, Zeydi used the favorite music of patients and reported an increase in O2 saturation of the patients hospitalized for open heart surgery.[32] Maleki used the sound of sea waves and bird songs and observed a gradual increase in O2 saturation at time points of immediately after and 30 and 60 min after intervention.[28] Salavati *et al*. reported that a family member's touch and talk increased the O2 saturation of coronary care patients at time points of immediately after and 10 and 30 min after intervention. They also reported a significant difference in O2 in paired time points, which is consistent with the present study.[26] Mohammadpour *et al.* reported no effect of reflexology massage on the O2 saturation of patients with stroke at time points of immediately after and 10 and 30 min after massage.[27] Nilsson did not use patients' favorite music in his study, but used a unique piece of music for all patients and reported no effect on O2 saturation of the patients in coronary surgery ward.[29] Cox and Hayes reported no effect of touch on O2 saturation of ICU patients.[33] The results of the above-mentioned studies are not consistent with the present study. The obtained controversial results can be due to differences in the type of the sensory stimulation, methods of applying them, or unfamiliarity of the stimulations for the patients, as well as differences in patients' cultures and tastes. In the studies on the auditory sense stimulations selected by patients, or in those with a familiar tactile stimulation, O2 saturation increase was significant. On the other hand, in some studies like that of Cox and Hayes, just the time point immediately after touch was investigated and no significant difference was observed. Perhaps in investigations involving longer time interval, an increase in O2 saturation would be observed. With regard to pair wise comparison of time points, in most of the mentioned researches, the difference was significant and O2 saturation gradually increased. In the study of Zeydi, O2 saturation was more 60 min after massage compared to 30 min after that, but in the present study, time points longer than 30 min were not investigated. Further research should be conducted to define the longevity of this effect at time points longer than 30 min. In the control group, no significant change was observed in subjects' O2 saturation at different time points, while in the study group, it gradually increased. It can be concluded that familiar sensory stimulations can increase O2 saturation in the ICU, and this increase can be due to meaningfulness of patients' sensory stimulations and reduction of O2 consumption, and consequently, lowered secretion of stress hormones and increased activity of parasympathetic system. Elevation of O2 saturation without an increase in patients' O2 intake is important as it can diminish the complications of oxygenation. Therefore, it is suggested to give adequate education to the nurses to include sensory stimulation with participation of the families as a major part of nursing care, although in the hospitals, there is no regular visit to the patients due to specific considerations.

Comparison of our findings with other studies in which sensory stimulations were not applied with participation of the family members revealed the difference between these two types of stimulations, which can be associated to increased efficacy of familiar stimulations.

Conclusion

Based on our results, it can be concluded that administration of sensory stimulations as a non-medical nursing intervention in the ICU, especially if conducted by the family members under the supervision of nurses, can change the unfamiliar stressful environment of the ward to a familiar convenient place for the patients and increase their O2 saturation. Participation of family members in the process of patient care, even for those hospitalized in the ICU, is helpful.

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