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The effect of controlled sedation based on Richmond scale on the duration of mechanical ventilation in patients admitted to ICU

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***Abstract*---**Background & objective: Patients treated with mechanical ventilation may need sedatives and analgesics due to discomfort, pain, lack of coordination with the device, immunity maintenance, and oxygenation elevation. The use of sedation scoring protocols and systems reduces the duration of mechanical ventilation and hospitalization. Therefore, this study aimed to investigate the effect of controlled sedation based on the Richmond model on the duration of

mechanical ventilation in patients admitted to the ICU. Methodology: This experimental study was performed on 60 patients admitted to ICU, who had been selected by simple random sampling and divided in two intervention and control groups. The data collection tools included the Richmond Agitation Sedation Scale (RASS), and Berne separation program checklist. In the intervention group, intervention was performed according to the standard Richmond protocol, but the control group received only the routine care. After the intervention, data were collected at 24 hours, 48 hours and 72 hours after the intervention by SPSS-21 statistical software, and then were analyzed by descriptive statistics (mean, standard deviation) and inferential statistics (paired t-test, independent t-test and repeated measure). Results: Repeated analysis of variance showed a significant difference ($P < 0.01$) between the intervention and control groups in terms of the score of separation from mechanical ventilation. This difference was greater in the intervention group. The score of separation from the device in the intervention group was higher than the control group. The independent t-test did not show a significant difference between the two groups in terms of the score of separation from the device at the first day ($P = 0.54$) and second day ($P = 0.4$), but at the third day, it showed a significant difference between the two groups ($P < 0.01$). Conclusion: Considering the effectiveness of Richmond sedation model in reducing the duration of mechanical ventilation in ICU patients, this protocol is expected to be used by medical team to wean patient of mechanical ventilation, as it can play an important role in reducing drug use, hospital stay, hospital complication and hospitalization costs.

***Keywords*---**Richmond model, duration mechanical ventilation, patients, ICU admission.

Introduction

Most patients with life-threatening conditions are admitted to intensive care unit (ICU) [1]. According to United States statistics, 55,000 patients are admitted to the intensive care unit daily for a variety of reasons [2], with more than 90% of them requiring mechanical ventilation [3]. Mechanical ventilation is a supportive treatment in patients with decreased level of consciousness, which helps to maintain patients' oxygenation [4, 5]. Despite the many benefits of mechanical ventilation, its long-term use causes respiratory problems, pneumonia, gastrointestinal complications, heart disorders, musculoskeletal problems and bed sores [6, 7]. Patients undergoing mechanical ventilation may also require sedation and analgesics due to discomfort, pain, lack of coordination with the device, immunity maintenance, and oxygenation [8].

Barotraumas is another complication caused by prolonged use of mechanical ventilation, which in addition to pulmonary infections is the most important cause of death in patients admitted to ICU [9]. It often causes agitation, anxiety, pain, discomfort and physiological / psychological complications [10, 11]. Studies

show that patients who are weaned of mechanical ventilation at later time have a higher mortality rate in addition to pulmonary and infectious complications [12, 13]. For a patient connected to mechanical ventilator for more than 3 days, the risk of pneumonia is doubled and risk of death is 12-fold [2]. Inadequate weaning management in patients admitted to ICU often exacerbates the complications of hospitalization [14]. In United States additional costs for each day stay in ICU is estimated at 30-40 thousand dollars for each patient and 1.5 million dollars annually [15]. Weaning from mechanical ventilation in a safe and timely manner leads to favorable outcomes for patients [12], because the use of standard instructions and sedation techniques reduces the use of painkillers and narcotics [16]. Sedation reduces mechanical complications, coma, respiratory arrest, bradycardia, slow bowel and stomach movements, and kidney failure [8]. Sedation also reduces anxiety, relieves pain, improves sleep and adaptation, and lowers neuromuscular stress [17]. Today, care and treatment guidelines emphasize on the use of sedation techniques in the management of ICU patients [18]. Roos (2020) argues that, the use of pain management and sedation techniques plays an important role in reducing the length of hospital stay in patients under mechanical ventilation [19].

Unfortunately, sedation guidelines or criteria are not used in Iran. Patients in the intensive care unit are weaned of the device based on the perception and judgment of physicians and nurses [8]. However, in the developing countries, many studies have been conducted on the benefits of separation protocols for weaning patient of mechanical ventilation [12]. The Richmond model is an approved agitation sedation scale in the intensive care unit [20]. Many physicians and researchers have approved the use of this model for the care of patients admitted to ICU. The Richmond scale classifies patients according to their characteristics and conditions and shows the prognosis and risks [21]. The use of protocols and sedation scoring systems reduces the duration of mechanical ventilation and the length of hospital stay [22].

Yeganeh (2018) believes that use of Richmond model has an important role in reducing agitation, use of sedatives and length of hospitalization in ICU [23]. Taran (2019) argues that the use of Richmond model reduces the need for mechanical ventilation 2. Therefore, the use of Richmond model has an important role in reducing the discomfort caused by mechanical ventilation [10]. Since nurses are in the first line of treatment in the ICU compare to physicians, they play an important role in accelerating the process of weaning from mechanical ventilator [24]. Studies show that nurses can effectively and safely use the separation protocol and wean patients of mechanical ventilator in a safe way [3]. Therefore, the researcher in this study decided to investigate the effect of controlled sedation based on the Richmond model on the duration of mechanical ventilation in ICU patients.

Methodology

This experimental study was conducted in 2021 on 52 patients (allocated in two intervention and control groups) admitted to the ICUs of Hakim Jorjani Hospital. The inclusion criteria for entering this study were; having no severe injuries, having the ability to move at least one limb, having the score of 5-8 based on

Glasgow coma scale despite the endotracheal tube, and being under CPAP ventilation with SPONT mode. All participants in this study were between 18 and 60 years old. The study was started 48 hours after the patient's admission to ICU. Exclusion criteria were; having a history of alcohol or drug use, having a diagnosis of quadriplegia or spinal cord injury, and/or liver / kidney disease, and requiring continuous sedatives or high muscle relaxants during hospitalization. The sample size of this study was calculated to be 52 patients (n=26 in each group) based on Yeganeh article (2018), with an effect size of 1.04 and confidence interval of 95% at a significance level of 0.05 [23].

The Richmond Agitation Sedation Scale (RASS) was used to determine the level of agitation and the need for sedatives. This tool was designed in 2002 by Sessler et al (2002), with its validity and reliability being confirmed [20]. In Iran, this tool was translated by Tadrissi in 2009 and its validity and reliability were evaluated. The reliability of this questionnaire was confirmed with a correlation coefficient of 95% [25]. The second tool used in this study was the Bern Separation Program Checklist, which is a standard checklist developed by Burns et al. (1990) [26]. This tool has 26 items with 12 items being related to general assessment and 14 items being related to the assessment of patient's respiratory function. The questions are answered by yes and no. The total score of patient's readiness for separation is 26. When the patient obtains a score of above 17, he/she is ready to be separated from mechanical ventilation [27, 28]. Burn et al (1990) believed that, this checklist is able to predict the successful separation of patient from mechanical ventilation by 85% for 72 hours [24, 26].

In this study, after approving the project in the University's Student Research Committee and receiving the code of ethics: IR.IAU.CHALUS.REC.2020.019 from the Islamic Azad University of Chalous Branch, the researcher first explained the purpose of this research to the hospital officials and ICU manager. Then, while explaining the study objectives to the relatives of patients admitted to ICU and obtaining written consent from them, he randomly divided the study samples into two intervention and control groups. Since after the intervention and acquiring skills by nurses, there was a possibility of bias in collecting information, first the data of samples in the control group and then the data of intervention group were collected. The researcher collected and recorded information in both groups 10 minutes after nursing care. In the control group, a 2-hour workshop on Richmond scale was first held for students and nurses, and then, the study method was explained.

At the first 12 hours of admission to ICU, patients' arterial blood pressure, agitation, pain, and medication and dosage were assessed by Richmond tool in both the intervention and control groups. In the intervention group, in case of agitation (ie: Richmond score of greater than 1) and before using sedative, patients were first assessed by the main researcher in terms of possible clinical problems, including the need for suctioning the endotracheal tube, insertion of urinary catheter in terms of urinary retention and correct positioning in bed. If the score of Richmond scale was more than 2, a full vial of Opotel ampoule (IV paracetamol) was injected to relieve pain according to the doctor's instructions. In the intervention group, patients' agitation levels were assessed hourly by

Richmond scale, and then the sedative was administered in case of agitation (score of 1 to 4) according to the doctor's order.

If the patient's agitation continued after administering the above-mentioned sedatives, other sedatives such as Propofol (50 micrograms per hour by weight) and fentanyl (50 micrograms per hour by weight) were prescribed by the anesthesiologist. In addition to the above measures, patient's arterial blood pressure was measured and recorded hourly by the monitoring device. In case of hypertension (BP of above 140 mm Hg), nitroglycerin was injected according to the doctor's instructions and in case of hypotension (BP of below 80 mm Hg), adrenaline was injected.

In the control group, the patient's agitation was evaluated based on the Richmond scale only once at the time of admission to ICU, and then according to the routine care and under the supervision of an anesthesiologist, the required drugs were administered to patient. No intervention was performed in the control group except for the routine care. Data were collected 3 times (the first, second and third days of hospitalization). It should be noted that in this study, 3 samples were excluded from the study (2 due to death and 1 due to being weaned of the device within 1 day). However, they were replaced by other samples. The recorded data entered into SPSS-21 software and then, were analyzed by descriptive statistics (tables, mean, and standard deviation) and inferential statistics (paired t-test, independent t-test and rapid-manager test) at the significant level of 0.05.

Results

Comparing the demographic characteristics of the study samples, there was no significant difference in terms of age between the intervention and control groups according to the independent t-test (P = 0.66). There was also no significant difference between the two groups in terms of gender according to the Chi-square test (0.17 = P). Repeated analysis of variance showed a significant difference between the intervention and control groups in terms of the score of separation from the device (P <0.01). This difference was greater in the intervention group. Also, the score of separation from the device in the intervention group was higher than the control group.

Independent t-test did not show a significant difference between the two groups in terms of the score of separation from the device on the first day (P = 0.51) and second day (P = 0.4), but independent t-test showed a significant difference between the two groups on the third day (P <0.01). This difference was greater in the intervention group.

Table 1: Comparison of mechanical ventilation use in the intervention and control groups

Time / Group	First time	Second time	Third time	P-Value
Intervention	14.88 (2.23)	16.46 (3.19)	21.38 (3.15)	P<0.01
Control	13.48 (2.76)	15.57 (2.67)	16.88 (5.45)	P<0.01

P-Value	P=0.51	P=0.4	P<0.01	

Discussion

The results of this study showed that the use of Richmond model is effective in reducing the duration of mechanical ventilation in patients admitted to ICU. In this study, patients receiving nursing care based on the Richmond model were better prepared to be separated from the mechanical ventilator.

Salmani (2013) in a study showed that the use of sedation protocols was effective in reducing the duration of mechanical ventilation in ICU patients (p = 0.03), so that the length of hospitalization and the need for mechanical ventilation in the group that received care based on standard protocol was significantly less [12]. Abddar (2013) argued that the use of Richmond model reduces the dose of painkillers in patients under mechanical ventilator [29]. Yeganeh (2018) stated that Richmond model reduces agitation and lowers blood pressure in patients connected to mechanical ventilator ([23]). Yosefi (2015) showed that the use of Richmond model reduces the duration of mechanical ventilation in ICU patients ([10]), and Williams (2008) revealed that use of Richmond protocol relieves pain in ICU patients ([30]). Cinotti (2020) also showed that the use of standard sedation protocols relieves pain and reduces the length of hospital stay in ICU patients ([31]). Therefore, it can be said that the use of pain relief and sedation protocols play an important role in reducing the length of hospital stay in patients admitted to ICU ([32]), because the use of such models plays an important role in the management of patients connected to mechanical ventilator ([19]). The use of standard protocols in the care of patients admitted to ICU leads to the proper distribution of drug, effective metabolism of the drug and the establishment of an appropriate serum level of the drug in the patient's body ([33]). Therefore, they have an important role in reducing the drug dose, anxiety and hospital complications in ICU patients ([34]). According to studies, it can be said that the use of Richmond sedation protocol has an important role in faster separation of patients from mechanical ventilation ([21]). Bugedo (2013) in a study showed that the use of protocols and scoring systems for sedation of hospitalized patients has an important role in reducing the duration of mechanical ventilation and ICU stay ([22]). The use of Richmond model reduces agitation and discomfort in patients connected to mechanical ventilation ([10]). Taran (2019) argued that the use of Richmond sedation protocol reduces patients' need for mechanical ventilation ([2]). The use of standard sedation protocols leads to positive outcomes, such as pain relief, reduced anxiety, improved sleep and reduced stress in patients admitted to ICU ([17, 35]).

According to the results of studies, the use of standard guidelines based on sedation criteria has an important role in increasing the quality of nursing care and patient satisfaction, and reducing hospital stay, hospitalization costs and hospital complications ([8, 36, 37]). It seems that the use of Richmond sedation scale reduces the duration of mechanical ventilation, as well as physiological changes in patients under mechanical ventilation ([23]). In 2002, the Intensive Care Association recommended the use of standard sedation protocols in patients under mechanical ventilation ([23]), because in situation where we are faced with the shortage of nursing staff and increasing hospitalization costs, shorter length of hospital stay in ICU has a great advantage for health care systems. Therefore,

the use of standard separation techniques plays an important role in the quality of nursing care, and reducing complications and treatment costs ([2, 3]).

Due to the advantages of separation protocols, further studies should be conducted on different protocols for separating patients from mechanical ventilation. Therefore, the researcher suggests different protocols to be implemented on the duration of hospital stay, hospital complications, the use of painkillers and the duration of mechanical ventilation.

Conclusion

Considering the effectiveness of Richmond relaxation model in reducing the duration of mechanical ventilation in ICU patients, we can expect nurses to use this standard method in order to increase the quality of nursing care and deliver a safe, low risk and low cost care for patients admitted to ICU.

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Conflict of interest

No conflicts of interest/competing interests were declared by the authors.

Authors' contribution

MG: Supervised the research
HH: Wrote the article.
MM: Assessment of research report process
MR: Literature search
ZS: Data collection, data analyze
ZT: Conceived and designed the analysis

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