The Effect of Joints Range of Motion Exercises on Delirium Prevention in Patients Admitted to Intensive Care Units

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ABSTRACT

Introduction: The most common neurological diagnosis in patients hospitalized in ICU is Delirium. Delirium is an acute consciousness disorder that is accompanied by inattention, thinking disorder, and perception disorders that fluctuate over a short period of time. This syndrome is associated with various complications in the hospital and outside the hospital. The purpose of this investigation was identifying the effect of joints range of motion (ROM) exercises on blocking and decreasing the period of delirium in ICU patients. Materials and Methods: 168 patients admitted in ICU wards of Imam Khomeini and Golestan Hospitals of Ahvaz were the subjects of the present study. The patients were examined by the ICDSC Delirium checklist daily, and the joints ROM exercises were performed from the time of admission to the day of discharge, two times a day in the morning and night. Results: There was a significant difference in the levels of delirium between the control and intervention groups after the intervention, using logistic regression model (P =0.006). There was a significant difference between the two groups in terms of duration of delirium using Mann-Whitney test (p = 0.003). Conclusion: The results of this study indicated that the ROM exercises of the joints reduced the levels and duration of the delirium. The results of this study can be used to determine the ROM exercises of the joints in the planning of patient care in patients admitted to intensive care units of hospitals by clinical nurses and physiotherapists as well as occupation therapists.

Key Words: Joints Range Of Motion Exercises, Intensive Care Unit, Delirium.

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INTRODUCTION

The most common neurological diagnosis among patients admitted to the ICU is delirium. Delirium is an acute consciousness disorder that is accompanied by inattention, thinking disorder, and perceptual impairment that changes over a short duration of time. Delirium is rarely diagnosed in the intensive care unit, and it is reported that the incidence of 20-80% is due to the severity of the disease and the need for mechanical ventilation [1]. Recently, national safety reports have focused on the prevention of delirium as a care quality indicator [2].

Delirium is associated with a variety of side effects. Intra-

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hospital complications include fall with damage, bed sore, incontinence, catheter dislocation and drug mistakes [3]. Studies conducted using magnetic imaging showed that there is a positive association between the duration of the delirium in the ICU and the brain atrophy and disturbance in the white part of the brain [4]. In patients with mechanical ventilation, the existence of delirium has been related to a 2.5-fold increase in short-term mortality and a 3.2-fold increase in six-month mortality [5]. Each additional day with delirium increases the risk of death by up to 10% [1]. The danger of delirium has been considered to be equal to MI and sepsis [6].

Hospitalization in ICU is stressful for the patient and his/her family due to the unfamiliar equipment and procedures. This confusion and unfamiliarity can cause disrupting mental relaxation and even physiological and psychological disturbances in patients [7]. In particular, three risk factors of sedatives, inactivity, and sleep disturbance in intensive care units have been commonly found through frequent clinical procedures, and are therefore considered as important goals for the prevention of delirium [8].

Prevention by drugs has been considered only for patients at a high risk of delirium and it is not generally recommended. The only drug approved by the FDA to treat delirium is dexmedetomidine, which is only for short-term use [9]. There is little evidence to support the effectiveness of haloperidol in the treatment of delirium [10]. Considering the drugs' side effects and failure to achieve the expected outcomes in treating delirium with current medications, evidence suggested an increase in non-pharmacological plans [11].

Findings showed that long time rest on the bed is an effective factor in the development of delirium. Therefore, mobility can be effective as a preventive action in shortening the delirium duration [12]. In a person who can't receive messages correctly due to the diminished senses, the input of senses can't be interpreted, and also she or he can't search for the environment due to the reduced mobility, and sensor crashes happen. Subsequently, this reduction of sensors is expressed as delirium. To improve the mobility and identify the environment, the protocol involves increasing standing and helping patients sit on the chair several times. Each kind of exercise would provide an opportunity for the patient to communicate verbally with staff, and this physiological aspect of mobility may be useful in maintaining cognitive function during a critical and prolonged illness [13]. Regular exercise therapy, supervised by a physiotherapist, may improve daily rhythms and patient orientation [12]. It has been declared that the onset of occupational therapy and physiotherapy in the early days of the critical illness would prevent the immobility caused by the sedations and reduce the delirium prevalence [14].

The results of the study done by Tatematsu et al, showed that ROM exercises of the joints, resistance exercise and daily walking reduced the amount of antipsychotics in patients with delirium [12]. Also Karadas & Ozdemir (2016) in their study examined the effect of ROM exercises on the incidence of delirium. The findings of their study showed that the amount of delirium in the intervention group that performed the ROM exercises was 8.5%, and less than the control group with 21.3%, but the difference between the two groups was not statistically significant [15].

Since nurses have frequent contacts with patients, they can play a key role in prevention, early diagnosis and treatment of delirium in patients [16]. Nurses are often the main providers of mobility for patients with severe illnesses. Mobility must be a nursing care priority for patients who are severely ill [17].

Despite the fact that in recent years, the survivors of intensive care units have been increasing, unfortunately, patients and their families face many physical and mental problems after discharge, some of which are caused by prolonged inactivity in these units. One of these problems is delirium, which largely remains hidden for the treatment staff, receives no treatment, and has many short-term and long-term complications. Also, there have been no drugs for complete and uncomplicated treatment of this syndrome. Therefore, the researcher aimed to investigate the effect of joint ROM exercises on the prevention of delirium in patients admitted to ICU.

MATERIALS AND METHODS

This study was a randomized controlled clinical trial design with two groups of intervention and control in which the effects of ROM exercises on the prevention of delirium in patients admitted to intensive care units were investigated. This study was conducted from January to May in 2018 on 168 patients aged 18 years and older in Imam Khomeini and Golestan hospitals of Ahvaz with random method and randomized permutable blocks with block size of 6. This research was approved by the Ethics Committee of the Research and Technology deputy of Ahvaz Jundishapur University of Medical Sciences (code of ethics 1396709 IR.AJUMS.REC.) and registered with IRCT20180114038362N1 at the Iranian Center of Clinical Trials.

The samples were selected based on the inclusion criteria and randomly divided into intervention and control groups. The sample size was calculated 77 persons for the control group and 77 persons for the intervention group using the following formula:

Including 5% reduction, 84 persons were considered for the control group, and 84 in intervention group (168 in total). The inclusion criteria were: patients aged 18 years and older, minimum 24 hours stay in the ICU, no visual impairment, no amputation of lower limbs, no history of cognitive impairment such as dementia and psychosis, no drug poisoning, no increase in intracranial pressure, based on doctor's diagnosis, no myocardial ischemia and arrhythmias, not having hyperthermia, not being admitted in the ICU post-cardiac arrest, absence of conditions limiting mobility (femoral artery catheter, unstable fractures), not getting 4 or 5 scores in RASS criteria. Exclusion criteria were: the onset of active gastrointestinal hemorrhage during study, unstability of vital signs (cyctolic blood pressure equal to or greater than 200 mmHg, average arterial pressure equal to or less than 65 mmHg, number of pulses equal to or less than 40 and greater than or equal to 130 within a minute), arterial hemoglobin saturation equal to or less than 88%, respiratory rate equal to or less than 5 or equal to or more than 40 times per minute, heart rhythm disorders during the study.

After obtaining the code of ethics from the Research Deputy of Faculty of Nursing and Midwifery and Imam Khomeini and Golestan hospitals followed by necessary coordination with Imam Khomeini and Golestan hospitals presidents, the researcher went to ICUs of these hospitals. Patient introduction to this research was done through anesthesiologist. Also, in order to observe ethical points of view, the purpose of the research, the method of conducting research and its safety, and the optional continuity of cooperation were explained to the patients and their families, and their informed written consent was obtained, the patients and their families were given an adequate explanation that doing the exercises would not have any negative effects on patient. The consent form for lethargic or confused patients was filled in by their legal guardian, and if the patient became alert, the explanations were told once again to him/her. After assigning the samples to the intervention and control groups, the patients of control group underwent the routine treatment and care and hospital rehabilitation programs. In the control group, after assessing the patients with RASS (Richmond Agitation-Sedation Scale) and APACHE II (Acute Physiology and Chronic Health Evaluation) at the time of admission, they were checked with ICDSC (Intensive Care Delirium Screening Checklist) daily, and the delirium score was recorded until discharge. Joints ROM exercises were performed only for patients under the mechanical ventilation and after 3-4 days after the admission to the ICU with the physician order. The patients of the intervention group were evaluated daily by the ICDSC delirium checklist, and the delirium score was recorded and also went under the training exercises defined in this study, in addition to the above-mentioned routine program and after evaluating RASS and APACHE II during the admission. All patients of the intervention group received ROM exercises until the discharge 2 times a day in the morning and at night, and each round movement was done 10 times and 30 seconds each time in the full range of large joints of the upper and lower extremities and completely controlled. These exercises began for the patient, when the patient's vital signs were stable and the anesthetist specialist authorized the ROM exercises in a formal and legal manner in the patient's file (typically the time for beginning the exercises and the ROM movements for patients were in the time when the patients' physiological conditions were not risky). These exercises were performed on the joints of wrists, elbows and shoulders in the upper extremities, and the ankles, knees and thighs joints in the lower extremities. The patients who were able to perform the exercises in an active ROM way, were previously trained and performed under the supervision of the researcher; and for the patients who didn't have the ability to perform the exercises, these exercises were carried out by the researcher in the form of passive ROM and in an assisted-active way for the patients who had little ability to cooperate. The exercises were performed in case of the patients' tolerance, and stopped in case of intolerance, and were postponed until the next day. Delirium daily check was done until discharge.

Two tools were used in this study: (A) Richmond Agitation-Sedation Scale (RASS): The Richmond tool was designed by Sessler et al in 2002 and its reliability has been approved [18]. This tool was reviewed by Seyed Davood Tadrisi and colleagues in Iran. The reliability of this scale was evaluated and agreed as 0.95 between the evaluators using intra-cluster correlation coefficient [19]. The tool consisted of 10 levels for determining agitation-sedation, with four levels for agitation, 1 level for calm and alert and five levels for sedation levels. These options were rated from +4 to -5. The patient who got the score of -4 or -5 was not evaluable in terms of delirium, and was excluded from this research.

(B) The delirium screening tool of the Intensive Care (ICDSC): The ICDSC questionnaire was first designed by Bergeron et al in 2001 as a tool for screening delirium based on DSM-IV-TR criteria and delirium clinical symptoms [20]. This tool was evaluated by Mahdieh Torshizi and colleagues [21]. In the criterion validity, the Persian cutting point of the tool was equivalent to the score of 5, and at this point of cut, the sensitivity of cut was 80% and its characteristic was 93%. This tool investigated the symptoms of the disease in eight fields of change in consciousness level, attention deficit disorder, hallucination or delusions, restlessness or slow psychomotor, disproportionate mood or word, sleep and

awaking rhythm disorder and fluctuation in symptoms. Score of 4 and above represented delirium. Patients with scores between 1 and 3 were considered as delirium sub-syndromes.

The collected data was entered into the SPSS software version 21 after the quantitative review. For describing the demographic data, the mean and standard deviation were used as well as the relative frequency and percentages. For comparison, the level of significance was considered to be 0.05%.

FINDINGS

Of the 168 patients admitted to the ICU during the data collection period, 2 in the intervention group and 5 in the control group were excluded (Figure 1). To compare the age of the two groups, the independent t-test was used (Table 1). The two groups did not have any significant difference in terms of the demographic characteristics (P-value> 0.05) (Tables 1 and 2). Fisher's exact test was used to compare gender and marital status between two groups, and chi-square test was used to compare the educational status. For comparison between two groups in terms of mechanical ventilation, nutrition, physical restrain, antibiotic and transfer to the ward Fisher exact test, in terms of duration of intubation, Mann-Whitney test, and in terms of comorbidities and the cause of hospitalization Chi-square test was used (Tables 2 and 3). There was no significant difference between two groups regarding the clinical characteristics (P-value> 0.05) (Tables 3 and 5). According to the results presented in tables 2 and 3, the variables of gender and physical restrain were not homogeneous in the two groups. In order to compare the delirium levels between two groups of intervention and control at the end of the study and take into account the distorting effect of gender and physical restrain, the logistic regression model was used. In this model, the delirium levels (delirium / sub delirium) were considered as response variable, and gender (male / female), physical restrain (have / doesn't have), and the group (intervention / control) were considered as independent variables. Regarding the values presented in the above table, the likelihood of sub-delirium involvement in the control group was 4.54 times greater than in the intervention group (p-value = 0.006), with moderating the bias effect of gender and physical restrain (Table 4). According to Table 3, before the intervention, the majority of patients in the two groups of intervention and control at the beginning of entering the ward didn't have delirium based on the ICDSC delirium checklist, and there was no significant statistical difference (p-value = 0.444). Mann-Whitney and APACHE II tests were used for making the comparison between the two groups for the duration of stay, and the independent t-test was also used to compare the delirium and GCS1 start time (Table 6). Table 7 shows the duration of delirium in two groups. A statistically significant difference was observed between the control and intervention groups using Mann-Whitney test and p-value = 0.003.

DISCUSSION AND CONCLUSION

Some studies have suggested that age is one of the main factors affecting the incidence and severity of delirium [22, 23]. These studies have shown that the effect of aging on brain actions and reducing the consciousness and attention to the environment around the person causes short-term confusion and changes the knowledge [24]. Therefore, in order to have the least effect on the results of the study, the age of the research subjects in both intervention and control groups was analyzed by independent T-test, and the results were not statistically significant. A significant proportion of research units didn't have any comorbidity except the cause of admission. Afterwards, patients with heart, endocrine and respiratory diseases were ranked in the following order; respectively. For some studies, comorbidities have been one of the factors affecting development of delirium [22, 23]. Central nervous system diseases such as epilepsy, cardiovascular diseases such as heart failure and kidney diseases also can cause this disorder, as well as most medications, especially overdoses [24]. In this study, Mann-Whitney test showed that the duration of stay in ICU was 5.14 and 5.59 hours in the control and intervention groups, and it was not statistically significant in the research units. The patient's longer stay in the ward can make patients more exposed to cognition disruptive factors, such as environmental and physiological factors, and may affect the outcome of the study [25].

It has been believed that the mechanical ventilation is an important cause of delirium due to the administration of sedative drugs, which is often inevitably accompanied with it [23]. Girard (2018) believed that too much administration of sedative drugs exacerbates cognitive impairment, and on the other hand, endotracheal tube as a disturbing physical device increases the patient's agitation and irritability [26]. In this study, 21.4% of each intervention and control group were under mechanical ventilation. The presence of endotracheal tube led to the patient's inability to communicate, increasing the patient's anxiety and apprehension. On the other hand, the endotracheal tube, as an artificial airway, harmed the airway and took the patient respiratory freedom to a great extent [27, 28]. Considering the difference in the duration of endotracheal tube in the airway of study units, and the probability of affecting the results, the units of study in both intervention and control groups were investigated for

the duration of intubation with Mann-Whitney test, and no significant difference was observed.

In the present study, joints ROM exercises reduced the delirium levels and duration of delirium. Other studies have suggested that the early motility is effective in reducing the delirium development [29, 30]. In this context, Truong et al (2015) defined the early mobility as patient activity in the first 48 hours after the admission to ICU. These movements included a spectrum which involved passive ROM exercises to walking in ward [31]. The improvement of the cognitive abilities of patients has been one of the reasons that can be considered for this decrease in delirium induced by ROM exercises [32]. The results of this study was consistent with the findings of Schweickert et al (2009). In this study, the patients who started early mobility experienced shorter periods of delirium, which significantly differed from the control group [33]. Other studies also confirmed the findings of the current study. For example, Needham et al (2010) in a study conducted on patients with acute respiratory failure found that physical training improves delirium status in patients. Patients with early physical activity had a significant difference in reduction of delirium in comparison to those who did not take this treatment [34]. Further studies have suggested that ROM exercises were effective on reducing delirium. Nydahl et al suggested that there was a significant consensus on the effect of mobility on the reduction of delirium in patients admitted to ICU [35]. In the study of Balas et al, the incidence of delirium was reduced by almost half as a result of the patients' mobility [36].

Different results have been obtained in other studies. The study of Karadas & Ozdemir (2016) also examined the effects of ROM exercises on the incidence of delirium. The findings of this study showed that the amount of delirium in the intervention group that performed the ROM was 8.5% which was less than the control group with 21.3%, but the difference between the two groups was not statistically significant. The results of this study were not consistent with the results of the current study [15]. This difference in the findings could be due to the shape and type of the exercise. In some studies, including the present study, the interventions only focused on ROM exercises. While a wide range of activities, such as sitting on bed, sitting down and standing up in a row, a preliminary walk and full walking in the patient's tolerance range, might have a greater impact on reducing the delirium. On the other hand, the characteristics of research units could lead to the differences in the significance of findings in various studies.

For the confirmation of the results of the present study, a meta-analysis, which focused on the interventions affecting delirium control and its duration, showed a wide range of minor effects to a significant improvement in the incidence of delirium in various studies. But finally, the significant effect of early physical activity on the reduction of delirium development or the reduction of its duration was confirmed [37].

Another factor contributing to the difference found between the present study and the study of Karadas and Ozmadir can be due to the difference in the scale of delirium diagnosis in two studies [15]. In [15], the CAM-ICU scale was used, and in the present study, the ICDSC scale was used. Different evaluation of delirium symptoms by these two scales was one of the factors affecting the differences in the results' significance. Finally, it can be said that instead of recommending a specific type of mobility, such as ROM exercises, a range of special exercises for each patient from passive ROM to the active movements according to the patient's tolerance can be more effective in reducing the incidence of delirium and shortening its duration. Also, due to the multifactorial nature of delirium, attention to controlling other factors, including infection control, patient hydration, and the application of interdisciplinary team methods, can enhance the impact of ROM exercises on delirium's control.

The results of this study showed significant effects of ROM training on the reduction of levels and delirium duration. Considering the consequences of the delirium and the ease of performing ROM which is not time consuming, it can be said that its implementation can be beneficial to reduce delirium in the ICU.

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Conflict of interest

There were no conflicts of interest between the authors of this article.

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Table 1- Comparison of mean age of intervention and control groups

Variable	Intervention group		Control group		p-value
Age	Mean	SD	Mean	SD	0.623
	45.16	16.83	46.53	19.11	

Table 2- Comparison of qualitative demographic characteristics in two groups of intervention and control

Variable	Control group N (%)	Intervention group N (%)	p-value
Gender Male Female	 56 (66.7%) 28 (33.3%)	 29 (34.5%) 55 (65.5%)	<0.0001
Education Illiterate Elementary and junior high school High school and university	 15 (19.7%) 13 (15.4%) 33 (43.4%)	 28 (33.3%) 33 (29.3%) 23 (27.4%)	0.057
Marital status Married Single	 69 (82.1%) 15 (17.9%)	 74 (88.1%) 10 (11.9%)	0.278

Table 3- Comparison of qualitative clinical features in two groups of intervention and control

Variable	Control group N (%)	Intervention group N (%)	p-value
Delirium level before intervention No delirium (0) Sub syndrome (1-3) Delirium	 38 (45.2%) 28 (33.3%) 12 (14.3%)	 39 (46.4%) 33 (39.3%) 18 (21.4%)	0.444
Mechanical ventilation Have Doesn't have	 18 (21.4%) 66 (78.6%)	 18 (21.4%) 66 (78.6%)	0.464<0.99
Nutrition PO NPO	 30 (35.7%) 53 (63.1%)	 35 (41.7%) 49 (58.3%)	0.005
Physical restrain Have Doesn't have	 22 (26.2%) 62 (73.8%)	 8 (9.5%) 76 (90.5%)	0.194
Intubation duration Less than 24 hours 24-48 hours 48 hours and more	 10 (47.6%) 6 (28.6%) 5 (23.8%)	 14 (73.7%) 4 (21.1%) 1 (5.3%)	0.395
Comorbidities No comorbidity Heart diseases Respiratory diseases Endocrine diseases Neurological diseases Cancer Gasterointestinal diseases Gynecological diseases	 44 (52.4%) 11 (13.1%) 6 (7.1%) 8 (9.5%) 4 (4.8%) 6 (7.1%) 0 (0.0%) 5 (6.0%)	 51 (60.7%) 11 (13.1%) 5 (6.0%) 5 (6.0%) 2 (2.4%) 2 (2.4%) 4 (4.8%) 3 (3.6%)	0.119%
Cause of hospitalization General Surgery Neurosurgery Care in ICU Cancer Respiratory diseases Gynecological diseases	 31 (36.9%) 23 (27.4%) 3 (3.6%) 3 (3.6%) 16 (19.0%) 8 (9.5%)	 17 (20.2%) 30 (35.7%) 4 (4.8%) 2 (2.4%) 14 (16.7%) 17 (20.2%)	0.415
Antibiotic Takes Doesn't take	 67 (79.8%) 17 (20.2%)	 72 (85.5%) 12 (14.3%)	0.406
Final situation Transfer to ward Death	 80 (95.5%) 4 (4.8%)	 82 (97.6%) 2 (2.4%)	

Table 4-Adjustment of the effect of confounding gender and physical restrain

Variable	Odds ratio	Confidence interval 95% For the odds ratio	p-value
Gender (Reference category: female) Male	5.89	1.85-18.79	0.003
Physical restrain(Reference category: doesn't have) Have	3.96	1.43-10.92	0.008
Group (Reference category: intervention) Control	4.54	1.53-13.43	0.006

Table 5- Comparison of quantitative clinical data in two groups of intervention and control

Variable	Control group Mean (SD)	Intervention group Mean (SD)	p-value
Duration of ICU stay	5.14 ± 3.18	5.59 ± 3.19	0.123
APACHI II	6.63 ± 4.14	7.11 ± 4.17	0.371
Time of delirium start	1.84 ± 0.60	1.50 ± 0.67	0.11
GCS1	12.59 ± 2.35	12.84 ± 2.20	0.52

Table 6- Distribution of delirium levels in intervention and control groups

Delirium	Intervention group	Control group	All patients
No delirium	79 (94.0%)	55 (67.9%)	134(81.21%)
Sub delirium	5 (6.0%)	26 (32.1%)	31 (18.79%)

Table 7- Comparison of Delirium Duration in two groups of intervention and control

Variable	Control group Mean (SD)	Intervention group Mean (SD)	p-value
Delirium duration	3.23 ± 1.48	1.75 ± 0.62	0.003

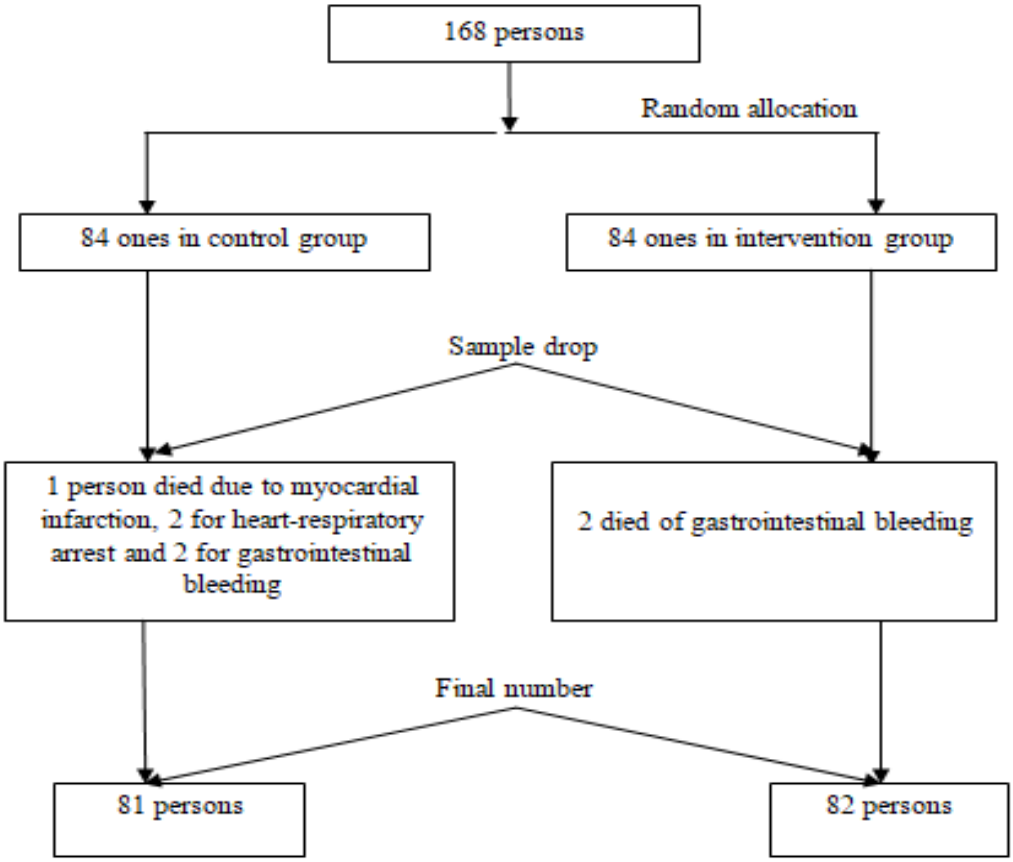

Fig. 1: The exclusion of patients from the groups