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The Effect of Implementing Nursing Care Based on Gordon's Model on the Clinical Outcomes of Patients Undergoing Coronary Artery Bypass Surgery: A Quasi-experimental Study

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Abstract

Background: Open-heart surgery is associated with life-threatening complications, and providing nonstandard nursing care without any plan for patients undergoing this type of surgery in the intensive care unit (ICU) can deteriorate their conditions.
Objectives: This study investigated the effect of providing nursing care based on Gordon's functional health patterns model on the clinical outcomes of patients undergoing coronary artery bypass surgery in the cardiac surgery ICU.
Methods: This was a quasi-experimental study involving 58 patients undergoing coronary artery bypass surgery admitted to the cardiac surgery ICU of Ahvaz Golestan Hospital in 2021. The patients were selected using convenience sampling and based on the inclusion criteria, and they were divided into intervention and control groups. First, the information related to the outcomes of the patients in the control group was collected using a checklist. Then, all the ICU nurses working at the study site were trained in Gordon's model and how to perform nursing care based on this model. They provided the necessary nursing care based on this model for the patients in the intervention group under the supervision of the researcher. The data of the patients in the intervention group were collected after completion of the intervention using the same checklist used for the control group. Finally, the data were analyzed using SPSS version 25.
Results: There was a statistically significant difference between the intervention and control groups in the length of stay at the ICU (P = 0.007), length of ventilation (P = 0.001), and successful weaning from the ventilator (P = 0.026). However, there was no significant difference between the 2 groups in terms of patient mortality (P = 0.16) or re-admission to the ICU (P = 0.16).
Conclusions: According to the results, Gordon's functional health patterns model of the nursing process can be easily used to improve the care and treatment outcomes of patients admitted to the cardiac surgery ICU.

Keywords: Coronary Artery Bypass Surgery, Nursing Care, Treatment Outcome, Intensive Care Units

1. Background

The overwhelming majority of deaths from noncommunicable diseases in the world are due to cardiovascular diseases, and based on the available forecasts, the rate of these deaths will rise from 17 million to 25 million from 2008 to 2030 (1). Cardiovascular diseases are the most common reason for death in most countries, and Iran is no exception. Based on the data of the global burden of disease (GBD) studies, cardiovascular diseases alone account for 20 - 22% of the burden of diseases in Iran, which is one of the serious concerns of the health system in this country (2). In fact, cardiovascular diseases are common and growing causes of death in Iran. According to a previous study, the rate of deaths from cardiovascular disease has alarmingly increased from 10.2% in 1990 to 39.9% in 2019 (3).

One of the most common causes of cardiovascular diseases, such as angina pectoris and heart attack, is coronary artery blockage (1). With advances such as thrombolytic therapy, balloon angioplasty, and

arterectomy, medical practices in the management of cardiac patients have improved and made considerable progress. However, coronary artery bypass graft (CABG) surgery is still the primary treatment of choice for these patients in many cases (4). Coronary artery bypass improves not only the cardiovascular condition but also the quality of life after surgery in these patients (1). It can be said that coronary artery bypass surgery is one of the most valuable treatment methods that, if performed on time, can play a major role in reducing the mortality rate and complications caused by these diseases (3). However, due to its difficult mechanisms, which possibly involve stopping the heart function and establishing extracorporeal blood circulation, this surgery can inevitably have acute and chronic consequences (5).

After CABG, patients are transferred to the intensive care unit (ICU) and stay there for at least 24 to 48 hours for recovery and advanced monitoring. Many complications caused by surgery can occur in this unit because, after the operation, the patient spends vital hours there (5). While some complications, such as postoperative bleeding and delirium, are transient, others, such as strokes, are more permanent and seriously affect the patient's condition. Infection, neurological problems, kidney failure, gastrointestinal problems, etc., may prolong ICU stay lasting for more than 48 hours or increase the length of intubation and the rate of re-admission (6). Therefore, special medical and nursing attention and care are necessary to prevent these complications and improve patient outcomes. Meanwhile, the type and manner of providing nursing care play critical roles due to the more hours spent at the patient's bedside (5, 6).

The ultimate goal in chronic diseases is the proper control of the disease and prevention of complications caused by it, which can be promoted by providing quality nursing care. In fact, nurses are the main pillars in the process of improving the quality of care, so their performance has a fruitful contribution to advancing organizational goals and improving patient outcomes. In ICUs, nurses are effective and important members of the health team who can have a direct impact on the health status of patients, and this is possible if they have the necessary clinical skills and insights into nursing care (7).

According to the literature, one of the reasons that can reduce the quality of nursing care and cause complications for the patient is the lack of a comprehensive and systematic approach to taking care of all the systems of the patient's body, with an emphasis on the ill-functioning systems. This is more evident in departments such as cardiac surgery ICU, where the patient has complex conditions, and the workload of nurses is high. The use of health care patterns and models can help create a systematic perspective in patient care (7, 8). A case in point is providing care based on Gordon's functional health patterns model (9).

A systematic and standardized data collection approach could be created based on Gordon's functional health model. This model enables the nurse to determine aspects of health and functions in terms of different patterns. These include perceiving and managing health, nutritional metabolism, elimination, activity-exercise, sleep-rest, cognitive-perceptual, self-perception/self-concept, coping-stress tolerance, value-belief, sexuality-reproduction, and role-relationship (10).

Gordon's model can be used to evaluate and provide care to a wide variety of patients. One group of patients that can significantly benefit from this model is cardiac surgery patients admitted to the ICU. Mukadder Mollaoğlu et al. in 2017 reported that the use of Gordon's model in the care of a heart surgery patient improved the performance of nurses and promoted the achievement of care goals. Due to the nature of their study, which was a case study, the authors recommended that this model be used on a larger statistical population (11). Turen and Enc's study also revealed that nursing care based on Gordon's care model improves patients' clinical outcomes (12). Also, Mahle et al.'s study investigated the effect of a cooperative learning model on reducing the time of intubation and extubation after cardiac surgery in children. They reported that the use of this model significantly reduces the time of mechanical ventilation and accelerates early extubation without increasing the possibility of reintubation (13). Meanwhile, the use of such care patterns has not been established in cardiac surgery ICUs.

2. Objectives

Given the limitations of previous studies on this topic and considering the importance of accurate and comprehensive nursing care in the heart surgery department, this study investigated the effect of nursing care implementation based on Gordon's functional health model on the clinical outcomes of patients undergoing CABG and admitted to a cardiac surgery ICU.

3. Methods

3.1. Study Design

This was a quasi-experimental study involving intervention and control groups. It was conducted in the cardiac surgery ICU of Golestan Hospital of Ahvaz in 2021.

3.2. Study Population

In this study, the research population included patients who were admitted to the cardiac surgery ICU of Golestan Hospital in Ahvaz after undergoing CABG. Patients were selected based on the inclusion criteria and convenience sampling. Since all the nurses working in the cardiac surgery ICU were on duty on rotating shifts, they were all trained in Gordon's functional model. Therefore, the information of patients in the control group was collected first to prevent information bias, and after training the nurses and implementing the intervention, the information of patients receiving the intervention was collected. The inclusion criteria were providing informed consent before the operation, age of 40 - 65 years, no history of cognitive or psychological problems, and no history of heart surgery.

The initial sample size for each group was n = 26. However, assuming an attrition rate of 10%, the ultimate sample size was n = 29 in each group (58 patients in total) according to similar studies (14).

3.3. Data Collection

Upon completion of sampling and data collection in the control group, all the nurses of the cardiac surgery ICU were first trained on how to evaluate the patient and perform nursing care based on Gordon's model. After making sure that the nurses have sufficient skills and knowledge to apply this model in patient care, we started sampling patients in the intervention group. Note that patients in the control group received only routine care, which involved no systemic or comprehensive method for diagnosing and treating all their problems. Instead, based on their experience, the nurses simply paid more attention to the prominent and common problems associated with surgery.

Gordon's model of evaluation and performance was taught by the lead researcher in 9 two-hour sessions lasting for 2 weeks. Training sessions were held for 16 nurses in 4 groups of 4 during 8 separate training sessions and 1 additional session for troubleshooting, questions, and answers (Table 1).

This involved lectures, question and answer sessions, practical evaluation and care based on this model, and providing the necessary feedback to all ICU nurses on different shifts. During the sampling period in the intervention group, the researcher randomly evaluated the correct use of Gordon's model by nurses in different shifts. Sampling in the intervention group began after the completion of the training sessions. As soon as the patients were transferred from the operating room to the ICU, the ICU nurses began to evaluate them and provide the necessary care based on Gordon's model. This process continued throughout the patient's stay at the ICU during different shifts under the lead researcher's supervision.

3.4. Data Collection Tools

In this research, a 2-section form was used to collect demographic information and clinical outcomes. The first section of this form dealt with the demographic information of the patients, including age, sex, education level, marital status, family history of heart disease, and duration of heart disease. This section was completed before the patient entered the operating room. The second section dealt with the clinical outcomes of the patients, including length of stay at the ICU, length of mechanical ventilation, successful weaning from the ventilator, the mortality rate of the patients, and readmission to the ICU. As far as the outcomes of the length of ICU stay and the length of ventilator connection were concerned, the groups were compared in terms of length, and the mean lengths were compared using the independent t-test in the 2 groups. Regarding the other three outcomes, i.e., successful weaning from the ventilator, readmission to the ICU, and mortality, the results were recorded as yes/no for each patient, and finally, the percentages of yes and no answers for each outcome were compared in the groups using the chi-square test and Fisher's exact test.

The intervention was carried out based on Gordon's functional health assessment model, which includes 11 health patterns in nursing care. Nursing diagnoses related to these 11 patterns are extracted based on the North American Nursing Diagnosis Association (NANDA) nursing diagnoses. Each pattern of Gordon's functional health model describes a particular aspect of the patient's health, including (a) the pattern of perceiving and managing health, (b) nutritional metabolism, (c) elimination, (d) activity-exercise, (e) sleep-rest, (f) cognitive-perceptual, (g) self-perception/self-concept, (h) coping-stress tolerance, (i) value-belief pattern, (j) sexuality-reproduction, and (k) role-relationship (9, 10).

Of course, out of these 11 patterns, only those that were applicable to the ICU patients were examined. Patterns that required communication with the patients and their cooperation, as well as those that did not have much use in the care process of heart surgery patients (such as self-perception/self-concept, value-belief, and sexuality-reproductive), were removed. A comprehensive item called "monitoring vital signs and hemodynamics" was added to the evaluation form after consultation with and receiving approval from several intensive care specialists and heart surgeons. The content validity and reliability of Gordon's functional health assessment form

Table 1. Summary of Gordon's Model Training Sessions

Session	Groups of Nurses	Duration	Content Taught
First session	First group (n = 4)	2 h	Teaching how to implement items 1 to 4 of Gordon's model
Second session	Second group (n = 4)	2 h	Teaching how to implement items 1 to 4 of Gordon's model
Third session	Third group (n = 4)	2 h	Teaching how to implement items 1 to 4 of Gordon's model
Fourth session	Fourth group (n = 4)	2 h	Teaching how to implement items 1 to 4 of Gordon's model
Fifth session	First group (n = 4)	2 h	Teaching how to implement items 5 to 8 of Gordon's model
Sixth session	Second group (n = 4)	2 h	Teaching how to implement items 5 to 8 of Gordon's model
Seventh session	Third group (n = 4)	2 h	Teaching how to implement items 5 to 8 of Gordon's model
Eighth session	Fourth group (n = 4)	2 h	Teaching how to implement items 5 to 8 of Gordon's model
Final session	All nurses (n = 16)	4 h	Providing feedback, questions, and answers, and resolving the ambiguities of nurses

had been measured and confirmed in previous studies, and a Cronbach's alpha of 0.94 was reported (15, 16).

3.5. Statistical Analysis

Descriptive and analytical statistical methods were employed in SPSS v. 25 (IBM Corp., Armonk, NY, USA) to analyze the data. As far as quantitative variables were concerned, we used mean, standard deviation (SD), and minimum and maximum for reporting the data. Frequency (percentage) was used for reporting qualitative variables. The Shapiro-Wilk test was used to check the normal distribution of quantitative data.

An independent t-test was used to compare sample means, and the binary logistic regression model was used to estimate the odds ratio in dependent dichotomous variables. An independent samples *t*-test was used to compare the means of continuous variables in the 2 groups, and for the comparison of nonparametric variables, the chi-square test was used. $P < 0.05$ was considered statistically significant.

4. Results

Our final analysis was performed on 29 patients in each group (n = 58 in total). The mean age of the patients in the control group was 60.31 ± 7.55, and that in the intervention group was 58.55 ± 8.32 years. More than half of the patients in the control group (55.2%) and nearly two-thirds of the patients in the intervention group (62.1%) were male. In terms of marital status, the majority of the control group (96.6%) and the intervention group (93.1%) were married. The 2 groups were homogenous with respect to demographic variables. More details are given in Tables 2. and 3.

Examining the studied outcomes showed a significant difference between the 2 groups regarding the length of stay at the ICU (P = 0.007). Patients in the intervention group had a shorter mean length of stay at the cardiac surgery ICU compared with the control group. In addition, a significant difference was seen between the 2 groups with regard to the length of mechanical ventilation (P = 0.001), and the patients of the intervention group had a shorter length of ventilation compared with the control group. As for the rate of successful weaning from the ventilator, there was a significant difference between the intervention and groups (P = 0.026), with the rate of successful weaning in the former being higher than that in the latter. However, the results did not indicate any significant difference between the 2 groups with respect to ICU readmission and the mortality rate in this department (P = 0.16) (Table 4).

5. Discussion

This study investigated the effect of nursing care based on Gordon's functional health patterns model on the clinical outcomes of patients undergoing coronary artery bypass surgery and admitted to the cardiac surgery ICU. The results showed that the mean length of stay at the cardiac surgery ICU of the intervention group was significantly shorter compared with the control group. In a case report examining the effect of nursing care based on Gordon's functional model on heart surgery interventions, Mollaoğlu et al. concluded that the patient's biological and physiological problems were minimized following care based on this model, and this led to faster patient discharge (11). In a prospective clinical trial on symptomatic heart failure patients, Turen and Enc compared the effect of care based on Gordon's functional health model versus routine nursing care. Their findings showed a longer hospitalization for patients in the control group, with nearly one-third of

Table 2. Demographic Characteristics of the 2 Groups of Patients

Variables	Groups, No. (%)		P-Value [a]
	Control	Intervention	
Sex			0.592
Male	16 (55.2)	18 (62.1)	
Female	13 (44.8)	11 (37.9)	
Marital status			0.553
Single	1 (3.4)	2 (6.9)	
Married	28 (96.6)	27 (93.1)	
Employment status			0.632
Self-employed	5 (17.2)	8 (27.6)	
Retired	7 (24.1)	5 (17.2)	
Homemaker	11 (37.9)	10 (34.5)	
Unemployed	5 (17.2)	3(10.3)	
Employee	1 (3.4)	3 (10.3)	
Educational attainment			0.630
Illiterate	10 (34.5)	9 (31)	
Elementary	7 (24.1)	10 (34.5)	
Junior high school	6 (20.7)	6 (20.7)	
High school diploma	4 (13.8)	4 (13.8)	
Bachelor's degree	2 (6.9)	0 (0)	
Underlying disease			0.279
Yes	20 (69)	16 (55.2)	
No	9 (31)	13 (44.8)	
Family history			0.792
Yes	13 (44.8)	14 (48.3)	
No	16 (55.2)	15 (51.7)	

[a] Chi-square (χ^2) test

Table 3. Comparison of the Study Groups in Terms of the Mean Age and Body Mass Index

Variables	Groups, Mean ± SD		P-Value [a]
	Control	Intervention	
Age	60.31 ± 7.55	58.55 ± 8.32	0.403
Weight	69.51 ± 7.27	72.89 ± 8.40	0.407
Height	166.37 ± 8.04	168.51 ± 7.82	0.754
Body mass index	25.10 ± 2.00	25.80 ± 3.69	0.38

[a] Independent *t*-test

the patients being still hospitalized at the end of the 1-month study period (12). Contrary to these findings, Mahle et al.'s study, which investigated the effect of the collaborative learning model, found that this model has no effect on the postoperative length of stay in the pediatric ICU (13). It seems that this difference is due to the nature of Gordon's functional evaluation model, which emphasizes timely identification and diagnosis of patient problems and appropriate nursing action. Long-term postoperative stay at the ICU has always been an important issue in terms of the associated costs and hospital complications. Various reasons have been

Table 4. Comparison of the Clinical Outcome in the 2 Groups

Variables	Groups		P-Value
	Control	Intervention	
Length of hospitalization, mean ± SD	96.5 ± 85.2	27.3 ± 64.1	0.007 [a]
Length of ventilation, mean ± SD	86.14 ± 16.09	41.6 ± 82.1	0.001 [a]
Successful weaning, No. (%)			0.026 [b]
Yes	22 (9.75)	28 (6.96)	
No	7 (1.24)	1 (4.3)	
ICU readmission, No. (%)			0.160 [b]
Yes	4 (8.13)	1 (4.3)	
No	25 (2.86)	28 (6.96)	
Mortality rate, No. (%)			0.160 [b]
Yes	4 (8.13)	1 (4.3)	
NO	25 (2.86)	28 (6.96)	

Abbreviation: ICU, Intensive care unit.
[a] Independent *t*-test
[b] Chi-squared (χ^2) test

mentioned for this problem, including severe obstructive pulmonary diseases, recent pneumonia, kidney failure requiring dialysis and repeat surgery, body mass index, type of surgery, using a cardiopulmonary pump, using blood products, nonelective surgery, and multiple complications (17, 18). The wide variety of the reasons listed in the literature for long-term hospitalization is due to the nonsystematic and noncomprehensive care provided to these patients; it seems that Gordon's model, with its main focus on the nursing process, has been able to reduce the length of ICU stay by providing a systematic approach to care.

As far as the length of mechanical ventilation in the 2 groups was concerned, our results showed that the mean length of ventilation in patients at the cardiac surgery ICU in the intervention group was significantly shorter compared with the control group. In this regard, the results of Mahle et al.'s study on the effect of a cooperative learning model on reducing the time of intubation and early extubation after cardiac surgery in children showed that using this model significantly reduces the length of mechanical ventilation and accelerates the possibility of early extubation without increasing the rate of reintubation. However, this model did not affect the length of ICU stay (13). Chan et al. studied the effect of a multidisciplinary care model and concluded that this approach can significantly reduce the length of intubation without increasing the rate of death and re-intubation (19). Faghani et al. also reported that timely diagnosis of people at risk, as well as adjustment and implementation of detailed care plans, can lead to reduced length of intubation in heart surgery patients. This, in turn, prevented physical and mental complications of long-term mechanical ventilation and reduced treatment costs (20).

Our comparison of the 2 study groups in terms of the readmission rate of patients in the cardiac surgery ICU showed that although patients in the intervention group had fewer readmissions compared with the control group, the difference was not significant. The results of most studies conducted based on nursing models run counter to the findings of the present study. Turen and Enc, for example, reported that the use of Gordon's care model leads to a significant reduction in the readmission of patients with heart failure (12). In Pakrad et al.'s study, the readmission rate in the intervention group was nil after the 4-month follow-up, and this difference was statistically significant (21). Coskun and Duygulu also reported that using this model resulted in a significant reduction in the readmission rate of patients after discharge (22).

As far as the mortality rate of patients in cardiac surgery ICU was concerned, there was a smaller number of deaths in the intervention group compared with the control group, but the difference was not significant. In line with our results, Borregaard et al. showed that despite the reduced rate of readmission following the implementation of an individualized intensified follow-up plan after heart valve surgery, patients in the intervention group were not significantly different from their counterparts in the control group with respect to

the mortality rate (23). In contrast to the findings of the present study, Khan et al., who investigated the impact of an international collaborative quality improvement program on the outcomes of heart surgery due to congenital heart diseases, concluded that the length of ventilation, ICU stay, and hospital stay significantly decreased after the implementation of this program, which finally led to a significant decrease in the mortality rate (24). Various causes of postoperative death have been mentioned in the literature, some of which are related to the type of operation and medical and nursing interventions, while others are related to the individual's medical history. Regarding the findings of this study, which are related to mortality rate, note that in most of the studies conducted, unlike the current study, a 1-month period has been devoted to checking the mortality rate, which can explain the discrepancies in the results.

Finally, with regard to the rate of successful weaning from mechanical ventilation, the 2 groups were significantly different, with the rate of successful weaning in the intervention group being higher compared with the control group. According to Innok et al., using standard weaning protocols after elective heart surgeries, as opposed to using routine methods, can significantly increase the rate of successful weaning of the patient from the ventilator and significantly reduce the costs associated with cardiorespiratory care (25). Successful and early weaning, as mentioned earlier, can reduce the complications caused by mechanical ventilation and thus reduce costs and can be considered an important outcome in the evaluations related to the selection of the appropriate model and model of care.

5.1. Conclusions

Based on the findings of the current study, we can conclude that due to the nature of Gordon's model, which focuses on the nursing process and the familiarity of most nurses with this process, implementing this model in clinical settings is relatively easy and can lead to favorable results. These include an increased rate of successful weaning from ventilation, reduced length of ICU stay, and reduced length of intubation. Of course, more studies using different approaches should be conducted in this regard. In addition, systematic educational programs should be developed to familiarize nurses working in different departments with this care model.

5.2. Limitations

Due to the likelihood of information bias, it was not possible to randomize the sampling, which limited the generalizability of the results. However, an attempt was made to reduce this problem by matching some important demographic variables.

Also, monitoring of the patients was done only during their hospital stay, which could have affected the obtained data. Future studies are, therefore, advised to monitor the patients after discharge from the hospital and measure the outcomes of these patients at home.

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Footnotes

Authors' Contribution: Study conception, design, and critical revision of the manuscript: ID, MA, and NE. Data collection: ID and MA. Data analysis and interpretation: MA, NE, and MH. Drafting of the manuscript: ID, NE, and MA. All the authors contributed to the manuscript and approved the submitted version.

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Data Reproducibility: The dataset presented in the study is available on request from the corresponding author during submission or after publication.

Ethical Approval: This study, which involved human participants, was reviewed and approved by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (Ref. ID: IR.AJUMS.REC.1400.133).

Informed Consent: A written informed consent form was signed by the patient, who willingly agreed to take part in this study. The confidentiality and anonymity of patient information were ensured throughout the study process.

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