Original Article:
Open-heart Surgery Complications Following Programmed Education and Nurses' Clinical Competence

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Abstract: Heart surgery can lead to certain complications that, if not diagnosed and treated on time, can be fatal. In view of the fact that nurses' clinical competence affects the quality of clinical judgment, the present study aimed to explore the effect of programmed education and nurses' clinical competence on complications following open-heart surgeries. The results of the present study showed that a closer attention to regular and programmed education and informing of open-heart surgery patients, especially before surgery and at the time of discharge, along with the clinical competence of nurses in ICUs, can reduce the incidence of post-surgery complications. Since the nurses' clinical competence greatly affects their clinical judgments and quality of care, paying greater attention to the nurses' education through systematic programs and increasing the clinical competence can lead to fewer post-heart-surgery complications; this, in turn, reduces the length of stay and the ensuing costs.

Key Words: Post-open-heart surgery complications, Patient education, Nurses' clinical competence.

Introduction:
One of the most effective methods for curing severe heart diseases is heart surgery.(1,2) Despite the education patients receive during their stay in intensive care units, it is common for them to complain of complications, which stresses the need for more accurate research.(3-8)

It is important that patients who are about to undergo open-heart surgery should actively participate in their own treatment, which can help them cope with their current situation better.(9,10) Also pre-surgery education can facilitate and shorten the length of hospitalization also reducing post-surgery complications.(11-15) The provision of such programmed education that fits patients' needs is still a major challenge for health and clinical care-providers.(16,17)

Accordingly, in view of the growing number of cardiovascular patients, the increasing need for heart surgeries, and the importance of paying special attention to such patients, it seems necessary that the effects of programmed and consistent education on post-surgery complications should be studied. In addition, some studies show that nurses' clinical competence affects their clinical judgment and the quality of care.(18,19) Despite the great significance of evaluating the nurses' clinical competence, few studies addressed the issue. Moreover, most of the studies (2,20-23) on patients undergoing open-heart surgery have focused on the effectiveness of a certain education or counselling approach and have not considered the role of nurses' clinical competence in the execution of interventions.

Thus, in the present study on the effectiveness of programmed and consistent education in helping patients who need to have open-heart surgery, the researchers also studied the effect of the clinical competence of nurses in the intensive care units in the duration of the patients' hospitalization. The present study aimed to determine the effect of programmed education and nurses' clinical competence on post-open-heart surgery complications.

Materials and Methods
Participants and Procedures
The present study is a clinical trial with a control and an experimental group in which data were collected in two stages: before the intervention and three weeks after the intervention. The Research samples were patients who were scheduled to undergo open-heart surgery was confirmed by a cardiologist; they had referred to Al-Zahra hospital (the main heart center in south of Iran) and were selected through convenience sampling method between September 2014 and February 2015. The sample size was determined based on previous similar studies (2) and by using the software program of Power SSC: 72 patients in each group.
The inclusion criteria were age over 18 years, being a potential candidate for open-heart surgery at Hazrat Zahra Heart center, willingness to participate in the study, not being affected by any psychological disorders, not being affected by any major visual, hearing, or speech disorders. Patients who were hospitalized for prolonged periods (over one week) were excluded.

Also, the nurses who worked in cardiac intensive care unit were selected through convenience sampling method. Forty nurses worked in the ward in 3 shifts and cared for the patients 24 hours a day. Since they all participated in providing care to the patients, the researchers included all of the nurses in the study and determined their clinical competence scores.

**Measures**

The researchers used a questionnaire that addressed such characteristics as age, gender, and etc. For each subject, the questionnaire was completed before the intervention by the researchers.

Post-surgery complications were recorded using the researcher-made questionnaire which was designed based on a literature review (21, 22) and the comments of the experts (according to medical examinations, medical records, Para clinic results). The questionnaire consisted of 14 yes-no questions which covered five areas: postoperative complications, mood, muscle weakness, digestive complications, infection, and motionlessness-related complications. A positive answer was assigned one point and a negative answer was assigned zero points.

The researchers used Meretoja’s Nurse Competence Scale to evaluate the clinical competence of the nurses. The instrument evaluates 73 nursing skills which fall into 7 categories: helping role, teaching-coaching, diagnostic function, situational management therapeutic interventions, quality assurance, and work role (16 skills). Scores of between 0-25 show poor competence, between 26-50 show average competence, between 51-75 show satisfactory competence, and between 76-100 show excellent competences. In the study of Meretoja et al. (2004), the validity and reliability of the scale were calculated based on experts’ evaluations and reliability was measured using Cronbach’s alpha; the results were found to be 83% and 81% to 94%, respectively (25).

**Intervention**

In this study, the patients attended 3 group sessions of education, each lasting between 1 to 2 hours. 3 to 5 patients, each accompanied by their significant others, were present in each session. The educational sessions, which were held on the day before and the second (when the patients were allowed to leave their beds and move) and fifth days following the operations (when the patients were discharged from the cardiac unit), included group discussion, asking and answering questions, and providing the participants with an educational booklet (created based on review of literature 25-27) and comments of the expertise included the nature of cardiovascular diseases and heart surgery, post-op complication, post-op care: diet, medication, exercise, rehabilitation etc.). Alongside educating the patients, the researchers monitored and followed their conditions for three weeks after their surgery via the telephone.

The participants in the control group received routine instructions provided in the cardiac unit. At the end of the study, they were given the educational pamphlet contain summery of educational session contents.

The participants’ post-surgery complications were recorded in the complications questionnaires from the beginning of their admission in the cardiac unit by the research assistant-expert nurse- (in a double-blind manner with research assistant and participants-patients / nurses) at different shifts.

During the three-week follow-up, each patient was contacted 3 to 4 times via the telephone and asked about his/her condition, possible complications, and the necessary instructions were given. The final recording of complications was performed 3 weeks after the intervention, based on the results of the subjects’ Para clinical tests and their surgeons’ clinical examinations.

In order to evaluate the clinical competence of the nurses in the ICU, after the nurses had completed the consent form before the beginning of the intervention, the researchers had them and their head nurse complete the nurses’ clinical competence scale separately. The mean of the nurses’ self-assessment scores and the head nurse’s scores were used as the nurses’ competence scores. Finally, based on statistical methods, the effect of nurses’ clinical competence on patients’ post-surgery complications was analyzed for both groups.

**Data analysis**

To analyze the collected data, the researchers used SPSS (version 19, SPSS Statistics; IBM Corporation, Chicago, Illinois, USA). To ensure homogeneity between the two groups in terms of demographics, the researchers used the Chi-square test for the qualitative variables and t-test for the quantitative variables. Independent t-test was used to compare the mean scores between the two groups and paired sample t-test was employed to compare mean scores within each group. Finally, the researchers used Poisson regression to study the impact of the nurses’ clinical competence on post-surgery complications; significance level was set at 0.05.

**Results**

Overall, 144 open-heart surgery patients with the mean age of 18.6±6.9 participated in the study. The results of independent t-test (for comparing the quantitative variables) and Chi-square (for comparing the qualitative variables) showed that there were no significant differences between the control and experimental groups in terms of demographics (p>0.001). In other words, the two groups were similar in terms of the distribution of age, gender, marital status, education, occupation, smoking, and the history of such pre-existing diseases as diabetes, hypertension, and elevated blood fat levels. Table 1 shows the two groups’ demographics in detail.

### Table 1: Demographics of the subjects in the experimental and control groups Surgical procedures included in this study

<table>
<thead>
<tr>
<th>Group/Variable</th>
<th>Control Frequency</th>
<th>Control %</th>
<th>Experimental Frequency</th>
<th>Experimental %</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uneducated</td>
<td>30</td>
<td>39.4</td>
<td>32</td>
<td>38.9</td>
<td>0.706</td>
</tr>
<tr>
<td>High school</td>
<td>2</td>
<td>2.8</td>
<td>5</td>
<td>6.9</td>
<td>0.612</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>40</td>
<td>55.6</td>
<td>44</td>
<td>61.1</td>
<td>0.602</td>
</tr>
<tr>
<td>Female</td>
<td>32</td>
<td>44.4</td>
<td>28</td>
<td>38.9</td>
<td>0.487</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20-40</td>
<td>39</td>
<td>54.2</td>
<td>33</td>
<td>45.8</td>
<td>0.602</td>
</tr>
<tr>
<td>&gt;60</td>
<td>32</td>
<td>44.4</td>
<td>38</td>
<td>52.8</td>
<td>0.602</td>
</tr>
</tbody>
</table>

With regard to post-surgery complications, it was discovered that in the control group, productive coughs, shortness of breath, lethargy, constipation and flatulence were the most common complications. Based on the results of the Chi-square test, there was a statistically significant difference between the control and the experimental group regarding the incidence of productive coughs, shortness of breath, lethargy, constipation and flatulence (p<0.001) (Table 2).

2
Table 2: Frequency distribution of post-surgery complications in the control and experimental groups

<table>
<thead>
<tr>
<th>Group/Variable</th>
<th>Control Frequency</th>
<th>Experimental Frequency</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infected incision</td>
<td>Yes 7, 9.7%</td>
<td>Yes 2, 2.8%</td>
<td>0.166</td>
</tr>
<tr>
<td></td>
<td>No 65, 90.3%</td>
<td>No 70, 97.2%</td>
<td></td>
</tr>
<tr>
<td>Dry coughs</td>
<td>Yes 1, 1.4%</td>
<td>Yes 1, 1.4%</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>No 71, 98.6%</td>
<td>No 71, 98.6%</td>
<td></td>
</tr>
<tr>
<td>Productive coughs</td>
<td>Yes 37, 51.1%</td>
<td>Yes 35, 48.9%</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>No 58, 60.6%</td>
<td>No 61, 70.0%</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>Yes 6, 8.3%</td>
<td>Yes 6, 8.3%</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>No 66, 91.7%</td>
<td>No 66, 91.7%</td>
<td></td>
</tr>
<tr>
<td>Lethargy</td>
<td>Yes 34, 47.2%</td>
<td>Yes 38, 52.8%</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>No 58, 80.6%</td>
<td>No 58, 80.6%</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Loss of appetite</td>
<td>Yes 14, 19.4%</td>
<td>Yes 15, 24.4%</td>
<td>0.661</td>
</tr>
<tr>
<td></td>
<td>No 25, 35.7%</td>
<td>No 25, 35.7%</td>
<td></td>
</tr>
<tr>
<td>Constipation &amp; flatulence</td>
<td>Yes 18, 25%</td>
<td>Yes 20, 30%</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td>No 42, 75%</td>
<td>No 42, 75%</td>
<td>p&gt;0.05</td>
</tr>
</tbody>
</table>

With regard to the nurses' clinical competence, the range of the competence scores of the nurses in the control group (44.28-74.68) and the experimental group (44.28-72.12) were both significantly higher after the intervention than before it; the subjects in both groups were homogeneous in terms of their clinical competence scores (Table 3).

Table 3: The mean of the nurses' clinical competence score in the control and intervention groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Nurses' clinical competence score Mean±SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Minimum 44.28</td>
<td>Maximum 74.68</td>
</tr>
<tr>
<td>intervention</td>
<td>Minimum 44.28</td>
<td>Maximum 72.12</td>
</tr>
</tbody>
</table>

To analyze the impact of the nurses' clinical competence on the number of complications experienced by the subjects after surgery, the researchers used Poisson regression: in this model, nurses' clinical competence and the groups were considered as the independent variables whose impact on the number of complications (the dependent variable) was to be studied. OR (odds ratio) represents the possibility of the occurrence of the dependent variable in response to either of the dependent variables. OR=0.98 indicates that a one point increase in the nurses' clinical competence score reduces the possibility of the occurrence of post-surgery complications by 2%, which is a statistically significant value (Table 4).

Table 4: The impact of the clinical competence of nurses on the subjects' post-surgery complications

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Independent variable</th>
<th>P-value</th>
<th>OR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of post-surgery complications</td>
<td>Group</td>
<td>&lt;0.001</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Nurses' clinical competence</td>
<td>&lt;0.001</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Discussion

The present study was an attempt to determine the effects of programmed education and nurses' clinical competence on post-surgery complications in patients who had undergone open-heart surgery. Overall, the results of the study showed that the educational interventions and nurses' clinical competence were effective in reducing post-open-heart surgery complications. A comparison of the occurrence of complications between the two groups showed that such conditions as productive coughs, shortness of breath, lethargy, constipations and flatulence were significantly less frequent in the experimental group than in the control group. The frequency of appetite loss and an infected incision was also lower in the case of the experimental than the control group; however, according to the statistical tests, the correlation between the occurrence of these two conditions in the two groups was not significant. The occurrence of dry coughs in the experimental and control group was equal. It appears that the lack of significance of the statistical test results as to appetite loss, infected incisions and dry coughs is due to the infrequency of these complications among the subjects, the sample size and the limited duration of sampling.

At the time of sampling, it was noticed that the patients who were suffering from lethargy were unable to cough effectively, use a spirometer or leave their beds alone and had to use either a walking stick or a support person. Thus, when the researchers were interpreting the results, they examined lethargy together with the four conditions mentioned above. Discrepancies of these findings are consistent with the results of the study of Ettema et al. (2014) which addressed the effects of education prior to heart surgery on preventing post-operation complications; the results of their study showed that pre-surgery education can reduce depression, infection, pulmonary complications and length of stay in the ICU.(20) Similarly, the study of Tang et al. (2012) showed that education and training plans can significantly improve such recovery variables as quality of life, reduction in pulmonary complications, and early bed leaving.(2) Also, the results of the present study are consistent with those of the study of Huizelos et al. (2006) which examined the impact of training in breathing techniques before surgery on preventing pulmonary complications in patients who were to undergo CABG. They found that such training prior to surgery significantly reduced the incidence of pulmonary complications after surgery.(21) Moreover, the results of the study of Yanez-Brages et al. (2009), which addressed the influence of lung physiotherapy before CABG on pulmonary complications, are in agreement with those of Huizelos' study and the present study.(22) Parts of the results of the three above-mentioned studies stress the significant effect of education on reducing pulmonary complications. Similarly, the results of the present study showed that programmed education can reduce pulmonary complications (shortness of breath and productive coughs). The breathing condition of "atelectasis," which was in one of the items of the questionnaire, was not spotted in any of the subjects in either group in the duration of sampling. In the study of Esmath et al. (2011), likewise, rehabilitation programs, in which education played a major part, were found to be influential in improving the patients' physical performance, general health, social performance, and physical limitation; the difference between the experimental group and control group was significant.(23) With regard to evaluating the nurses' clinical competence, the clinical competence scores of the nurses in both experimental and control groups were found to be similar and "satisfactory." This finding is in part consistent with the results of the study of Salonen et al. (2007) which examined the nurses' perception of clinical competence. In Salonen's study, the nurses' level of clinical competence was determined to be "average to satisfactory". However, Bahreini et al (2012), who studied the effect of using professional portfolios on the nurses' clinical competence, found their subjects' clinical competence after the intervention to be "excellent". This discrepancy can be due to the researchers' use of portfolios and its positive effects on the nurses' clinical competence; the present study, however, merely included an evaluation of the nurses' clinical competence and no interventions were made in this respect. According to the study of Ching-yu Cheng et al (2014), which addressed clinical competence, clinical stress, and tendency to quit one's job in newly-graduated nurses, the mean of the subjects' clinical competence scores was found to be significantly higher after the intervention than before it;
moreover, a comparison of the means of the subjects’ clinical competence scores as obtained 3, 6, and 12 months after they had started work showed that their scores were significantly higher.19,27 In the present study, however, the clinical competence of all the nurses in the intensive care unit was evaluated and the results were limited to a single period. In general, in view of the results of the mentioned studies (25,27) the nurses’ clinical competence scores can improve as a result of such factors as education and experience.

With regard to the effect of the nurses’ clinical competence on post-surgery complications, it can be inferred from the results that their clinical competence is an effective factor in reducing post-surgery complications; the higher the nurses’ clinical competence, the lower the number of post-surgery complications. Yet, this finding is not consistent with the results of the study of Goldi et al. (2012). In their study on the effect of the presence of nurses with high clinical competence in the ICU, the researchers discovered that even though those patients who had received care from nurses with high clinical competence had more satisfaction with their nurses’ instructions, answers, and listening skills and were more successful at controlling pain than the patients in the control group, there was not a significant difference between the two groups in terms of the number of post-surgery complications, length of stay, rate of readmission, need for a family doctor and heart specialist, or attention to cardiac rehabilitation.28 The reason for this discrepancy can be the fact that, in the present study, the patients received care from the current nurses in the ward with different levels of clinical competence; the educational intervention was performed by the researchers, while in Goldi’s study, both the care and education were provided by the ward nurses. Also, Goldi’s study was a cross-sectional study, while the present study is of the intervention type.

In the present study, there was a significant correlation between the incidence of post-surgery complications and the nurses’ clinical competence scores. This finding is consistent with some of the results of the study of Lisa et al. (2015) which examined the presence of nurses with high clinical competence in heart surgery wards. The patients in the experimental group were found to have fewer pulmonary complications and shorter lengths of stay than the patients in the control group.29

Conclusion
The recovery period following open-heart surgery is a critical and stressful time that can lead to physiological disorders. The results of the present study showed that a closer attention to regular and programmed education and informing of open-heart surgery patients, especially before surgery and at the time of discharge, along with the clinical competence of nurses in ICUs, can reduce the incidence of post-surgery complications. Since the nurses’ clinical competence greatly affects their clinical judgments and quality of care, paying greater attention to the nurses’ education through systematic programs and increasing the clinical competence of nurses who work in ICUs can lead to fewer post-heart-surgery complications; this, in turn, reduces the length of stay and the ensuing costs.

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Conflict of Interest
The authors declare no conflict of interest in this study.

Limitations
Their limitations of the study are related to the number of patients under the study and the length of follow-up. Therefore, it is suggested that future studies should use larger sample sizes, longer lengths of follow-up and a variety of hospitals to obtain more evidence concerning the effect of education and nurses’ clinical competence on post-heart surgery complications. It is also suggested that in future studies, educational plans should be developed based on patients’ needs assessment.

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