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Development and Implementation of a Clinical Pathway for Care of Cardiac Surgical Patients

Talal Ali Hussein Al-Qalah[1], Hayat Fadlalla Mukhtar[2]

[1*]Lecturer in Medical-Surgical Nursing Faculty of Medicine- Nursing Department, Sana'a University-Yemen

[2]Associated Professor of Medical-Surgical Nursing-Karary University-Sudan

Abstract: ***Standardization of care is essential for improving cardiac surgery outcome and it is beneficial for patients, professionals and hospitals. Clinical pathway is a standardized protocol for management of patients who undergo cardiac surgery. Objective: To evaluate the effect of a clinical pathway implementation on patient outcomes. Methods: Quasi-experimental research design was conducted in the Sudan Heart Center and Ahmed Qasim Hospital at Khartoum state-Sudan. A convenience sample of 90 adult cardiac surgical patients was divided into two groups (preclinical pathway and pathway groups). Data collection took approximately 11months (between 20-March-2016 and 28-February-2017). Designed clinical pathway was implemented after a training course was given to the health care professionals. Results: After implementation of a clinical pathway, the patient outcomes were improved as indicated by significant reduction in decrease duration on mechanical ventilator (p=0.027), early extubation (p=0.028), length of ICU stay (p=0.048), decease length of stay (p=0.043), improvement in patients satisfaction (p=0.025), and decrease invasive device duration (endotracheal tube, arterial line, and central venous catheter were p=0.028, p=0.025, and p=0.016 respectively), while investigations, complication, chest tube and Foley's catheter were insignificant different among patient groups were all p>0.05. Conclusion: Clinical pathway for care of cardiac surgical patients had a positive impact on an improved patient outcome.***

Keywords: Clinical pathway, cardiac surgery, outcome

1. Introduction

Cardiovascular diseases (CVDs) remain the most common causes of death, responsible for 35% of all deaths, almost one million deaths each year [1] .In Africa and the Middle East Countries, bear a heavy burden from cardiovascular disease. The prevalence of coronary heart disease is promoted in turn by a high prevalence of cardiovascular risk factors [2] . Cardiovascular disease deaths in Sudan reached 5.5% of total deaths and were the first of tenth leading causes of death in hospitals for 2014 according to the annual health statistical report [3] .

Cardiac surgery is one of the most expensive surgical procedures. In this era of cost containment and physician report cards, we are increasingly held accountable for patients' outcomes in terms of mortality, morbidity, quality of life, length of stay, and costs of care [4] . The incidence of cardiac complications after CABG is at least 10% and costs $2 billion annually. Morbidity and mortality associated with cardiac surgery is significant to the patient and costly to the health care system [5] .

As the best and standard mode of medical service and management, a clinical pathway can standardize the treatment behavior, improve the medical quality, shorten the course of treatment, and save health resources [6] . A clinical pathway is a treatment or nursing mode formulated by medical workers according to a disease or surgery process, by which the activities involving the patients, such as admission, diagnosis, treatment and nursing, are carried out according to a standardized process, formulated in advance according to a clinical pathway form [7] .

A clinical pathway (CP) has emerged as a potentially important knowledge translation strategy for promoting effective healthcare [8] . Nurses have a key role in all aspects of a clinical pathway use. Participating in the development of the pathway is the first step. Because they begin and end the chain of staff involved in delivering care, nurses possess a unique perspective in how health care systems work to enhance or impede the delivery of care [9] .

2. Methods

A quasi-experimental research design was conducted at the cardiac surgical ward and intensive care unit in the Sudan cardiac center and Ahmed Qasim hospital at Khartoum State-Sudan from 20-March-2016 till 28-February-2017.

Patient groups (n=90), adult patients were scheduled for cardiac surgery, were admitted to the previous mentioned setting. 45 patients were taken before implementing a clinical pathway (preclinical pathway group), and 45 patients were taken after implementing a clinical pathway (clinical pathway group).The participants were limited to adults (18-60 years). Patients with the following conditions were excluded: 1) Patients with other incapacitating diseases, and cognitive impairments. 2) Those admitted for emergent/urgent conditions. 3) Those who did not agree to participate in study. 4) European System for Cardiac Operative Risk Evaluation EuroSCORE (≥6).

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Two tools were used to collect data. They consisted of two parts:

Part I: An observation checklist was developed to assess the effect of a clinical pathway on patient outcomes which included the length of hospital stay, complications, duration on mechanical ventilators, investigation, ICU Stay, and invasive device duration.

Part II: A self-administrated questionnaire was developed in order to assess patients' satisfaction to a clinical pathway.

Scoring of Satisfaction: The 'satisfaction' was based on the level of agreement using a five point Likert scale, the satisfaction to a clinical pathway subsection was comprised of 17 items for cardiac surgical patients rated on a 5-point 'Likert Scales [10] ' from 1 to 5 (Strongly Disagree=1, Disagree=2, Neutral=3, Agree=4, Strongly Agree= 5). The total scores ranged between 17 and 85 for cardiac surgical patients, an individual score for each section were calculated in percent. Items in the satisfaction checklist were rated on the Likert scale. In analyzing the data in satisfaction, the scores were categorized as satisfaction and dissatisfaction. Scores ≤51 were labeled as dissatisfaction, and scores above 51 were considered as satisfaction.

A pilot study was conducted in the field of the study in order to clarify and modify the tools according to the participant responses. The tools were tested for their reliability using Cronbach's alpha reliability method on 10% of sample. Clinical pathways were reviewed by experts in the field of study to test the validity, three cardiac surgeon professors, two anesthesiologists, three professional nurses, and a physiotherapist.

A protocol for early extubation of the uncomplicated cardiac patient was developed. A preclinical pathway group was taken first. Patient outcomes were assessed daily until discharge the patients from hospital and before discharging the patient satisfaction was assessed.

The researcher was responsible for teaching and training staff nurses and other health care professionals about the purpose and implementation process of a clinical pathway. A clinical pathway was designed to have clear daily goals and implemented by trained nurses under the researcher's supervision.

A clinical pathway provides not only a pathway for the multidisciplinary team to follow, but also the patient and their family members to engage them in the care. A simple Arabic instructional clinical pathway was developed for the patients to attract their attention, motivate them and help in reviewing at ward, home and support teaching and practice. Variance that may affect the implementation of clinical pathway was monitored, analyzed, and action plan was developed to manage it.

Table 1: Distribution of cardiac surgical patients according to their demographic data

Items		*Preclinical Pathway n=45*		*Clinical Pathway n=45*		p value
		n	%	n	%	
Age Group	18-30	8	17.80%	9	20.00%	0.873
	31-40	5	11.10%	7	15.60%	
	41-50	8	17.80%	6	13.30%	
	51-60	24	53.30%	23	51.10%	
	Mean±SD	46.755±14.435		44.622±15.4081		
Sex	Male	31	68.90%	30	66.70%	0.822
	Female	14	31.10%	15	33.30%	
Diagnosis	Ischemic Heart Disease	16	35.60%	17	37.80%	0.203
	Congenital Heart Disease	1	2.20%	5	11.10%	
	Rheumatic Heart Disease	28	62.20%	23	51.10%	
Type of Surgery	CABG	14	31.10%	15	33.30%	0.363
	Valve Surgery	28	62.20%	23	51.10%	
	Congenital Repair	1	2.20%	5	11.10%	
	CABG+ Valve Surgery	2	4.50%	2	4.50%	

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Table 2: Effectiveness of a clinical pathway on patients' outcome

Items		Patient Groups				p value
		Preclinical Pathway n=45		Clinical Pathway n=45		
Duration on mechanical ventilator	Mean±SD	8.40±4.17		6.73±2.73		0.027*
Intubation time	Mean±SD	8.78±4.30		7.07±2.77		0.028*
ICU stay	Mean±SD	3.04±0.95		2.69±0.72		0.048*
Investigation	Mean±SD	67.28±15.65		64.29±13.17		0.328
Length of hospital stay	Mean±SD	7.93±1.36		7.40±1.09		0.043*
		n	%	n	%	
Complication	Yes	10	17.8%	4	6.7%	0.083
	No	35	82.2%	41	93.3%	
Satisfaction	Satisfaction	30	66.7%	39	86.7%	0.025*
	Dissatisfaction	15	33.3%	6	13.3%	

Table 3: Distribution of cardiac surgical patients according to the postoperative invasive device duration

Items	Patient Groups						pvalue
	Preclinical Pathway n=45			Clinical Pathway n=45			
	Mean±SD	Min	Max	Mean±SD	Min	Max	
Endotracheal tube	8.78±4.30	3	28	7.07±2.77	3	16	0.028*
Chest tube	44.40±12.79	23	96	48.98±17.52	20	89	0.160
Arterial line	51.87±16.92	24	89	44.64±12.96	20	86	0.025*
Central venous catheter	68.42±24.84	31	139	56.56±20.65	25	94	0.016*
Foleys catheter	56.71±23.80	21	136	54.11±21.16	22	98	0.585

*=Significant differences at $p<0.05$

3. Ethical Considerations

An implementation of this study was approved by the research and Ethics Committee of the Faculty of nursing (Karry University), National Research Ethics Review Committee at Federal Ministry of Health, and administration of health care institutions where the study was conducted. The anonymity of the patients and data confidentiality are guaranteed.

4. Results

The data in **table (1)** demonstrated that more than half of patients age was ranged between 51-60 years 53.3% of preclinical pathway group and 51.1% of clinical pathway group. Male patients were the most prevailed in both groups 68.9% of preclinical pathway group and 66.7% of clinical pathway group. Most of the patients were diagnosed as rheumatic heart disease among preclinical pathway group and clinical pathway group (62.2% and 51.1% respectively). Valve surgery was more prevalent 62.2% of preclinical pathway group and 51.1% of clinical pathway group, and CABG was the second surgical procedure operated 35.6% and 33.3% respectively, while CABG and valve surgery as two surgical procedures operated were less frequency 4.5% of both groups. There were no significant differences between the two groups surveyed

Table (2) shows the effect of a clinical pathway on patients' outcome. The table illustrated that a clinical pathway had a positive effect on patients' outcome, all mean scores of duration on mechanical ventilator, intubations time, ICU stay, and length of hospital stay are significant different were all $p<0.05$. While a clinical pathway had slightly effect on diagnostic test (investigation) and postoperative complication with insignificant difference were ($p=0.328$ and $p=0.083$ respectively). In addition, a clinical pathway increases patients' satisfaction 86.7% in clinical pathway group compared with 33.3% in preclinical pathway group with significant difference were $p=0.025$.

The data reported in **table (3)** described the postoperative invasive device duration. The maximum invasive device stay in patients was the central venous catheter 120 hours in preclinical pathway and 94 hours in clinical pathway group, while the minimum invasive device duration was endotracheal tube 3 hours in both groups. In addition, there were significant difference between patients' group in relation to endotracheal tube, arterial line, and central venous catheter were $p=0.028$, $p=0.025$, and $p=0.016$ respectively. On the other hand, chest tube and Foley's catheter were insignificant among patient groups were $p=0.160$, $p=0.585$ respectively.

5. Discussion

As the best and standard mode of medical service and management, a clinical pathway can standardize the treatment behavior, improve the medical quality, shorten the course of treatment, and save health resources [6] .A clinical pathway a diagnosis and treatment standardization model specific to the diagnosis, treatment, rehabilitation and nursing of a single disease. It's a standardized medical and nursing plan with exact time requirements and strict work procedures, anembodiment of the procedure management method in the diagnosis and

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treatment of a disease, a novel management model which continues to ensure and improve the medical [11].

Therefore, the present study was conducted to evaluate the effect of a clinical pathway implementation on patient outcomes. The study hypothesis which used a clinical pathway leads to improved cardiac surgical patient outcomes. This study partially confirmed the effects of implementing a CP.

Discussion of the study results will be presented within the following: The demographic background of the present study showed that the cardiac surgery was seen in males more than females and were diagnosed as rheumatic heart disease and age was ranged between 51-60 years, valve surgery was more prevalent surgical procedures operated. In concordance with the most of the previous studies, the current study considered aging as one of the risk factors of the disease as 52.2% were more than 51 years old.

Some studies have pointed out that the most cases were males (81%), and the average patient age was 64 years old. [12] Fredericks., [13] Azer et al. [14] reported that the most of patients were males and older than 53years. Moreover, rheumatic heart disease is the most common cardiac disease and valve replacement was the most common open heart surgery procedure [15, 16] .Another study by Suliman pointed that the rheumatic heart disease was one of the most cardiovascular disease in Sudan [17]. Valve replacement was the most common operation type 85% [18]. On the other hand, the coronary artery bypass surgery was the most common operation type [19, 20].

The results of this study also demonstrated that a clinical pathways had a positive effect on patient outcomes, such as duration on mechanical ventilator, intubations time, ICU stay, and length of hospital stay were significant different ($p<0.05$), while the CP had slightly effect on diagnostic test (investigation) and postoperative complication with insignificant different were $p>0.05$.

These outcomes, as an indicator of quality care improvement, reduce staff workload, and reduced costs. These findings underscore the importance of CP implementation and confirm the positive effect of the intervention on nurses' practice, which was positively reflected on patient outcomes. The formulated hypotheses were accepted as a clinical pathway leads to improved patients outcome.

Most of the previous studies that analyzed clinical pathways, such as the studies of El-Baz, [21] Chen et al., [11] Verdu et al., [22] Frei et al., [23] Rotter et al., [24] Yue et al., [25] Zhang et al., [26] Loeb et al., [27] lin et al., [12] Schwarzbach et al., [28] Burgers et al., [29] DeSomma et al., [30] and Tarin et al., [31] focused on the evaluation of a clinical pathways implementation benefits, they pointed out that the clinical pathway are a safe way to reduce the length of hospital stay, medical costs and it improves the quality of care which enhances efficiency, patient safety and outcomes.

Institutions that have implemented such pathways have reported a decrease in length of stay, number of laboratory tests, and use of blood products with the greatest outcome noted in the decrease in total hospital costs [32]. Rotter et al. also stated that clinical pathways are associated with reduced in-hospital complications and improved documentation without negatively impacting on length of stay or hospital costs [33]. Another studies pointed out that an implementation of clinical pathway increase patient satisfaction [22, 25, 34-37].

The present study used a weaning protocol and pointed that there was significant reduction in the duration of mechanical ventilation and ICU stay. This finding is supported by Blackwood et al. who used weaning protocols for reducing duration of mechanical ventilation in critically ill adult patients, asserted that there is evidence of a reduction in the duration of mechanical ventilation, weaning, and stay in the intensive care unit when standardized weaning protocols are used [38]. There was a significant decrease in the mean duration of mechanical ventilation in the post vs pre CP [39].

The current study revealed that the postoperative invasive device duration was significantly different between patient groups in relation to endotracheal tube ($p=0.028$), arterial line ($p=0.025$), and central venous catheter ($p=0.016$). On the other hand, chest tube and Foleys catheter were insignificant among patient groups as ($p=0.160$ and $p=0.585$) respectively. Decrease invasive device duration can reduce postoperative infection, which means an improvement in nurses' practice and importance of a CP to reduce invasive device duration.

In the same line to our study, Shalaby who implement a clinical pathway for cardiac valvular surgery pointed out that there were significant reductions in invasive device duration such as endotracheal tube ($p=0.048$), arterial line ($p=0.029$), central venous catheter ($p=0.029$), and chest tube ($p=0.000$) [40].

Foley catheter removal and length of stay did not differ between the clinical pathway groups [41, 42]. There were no significant differences regarding morbidity, mortality, re-operations and readmissions [41]. Yeh et al. concluded that the professional abilities of the medical personnel increased, and the nursing quality increased as (increased prescribed procedure efficiency, helped new recruits learn work procedures, while decreased hospital internal infection rate, increased patient medical results, and decreased waiting time between each medical procedure) [34].

The average number of days of requirement of a urinary catheter and deep vein catheterization was decreased significantly. CP regulates the behavior of medical care staff, strengthens the execution of infection control measures, reduces the risk factors for infection, and effectively reduces the infection rates [6]. Quality of care was significantly higher in the CP group for the following indicators: timely removal of central venous catheters, wound drains, and Foley's catheters [43].

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An implementation of clinical pathways needs cooperation among physicians, nurses and staff from multiple disciplines. It is important to develop explicit clinical pathway protocols to help improve practice, coordination and to improve the quality of perioperative treatment by standardizing care.

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