Application of Transtheoretical Model-Based Case Management in Cardiac Rehabilitation for Post-PCI Patients with Myocardial Infarction

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Abstract

Objective This study aims to investigate the effect of case management based on the Transtheoretical Model (TTM) on cardiac rehabilitation in patients after PCI for myocardial infarction, in order to provide an effective rehabilitation management model for clinical practice. Methods A total of 100 patients after PCI for myocardial infarction admitted to a tertiary grade-A hospital from May 2023 to May 2024 were selected and randomly divided into an intervention group and a control group, with 50 patients in each group. The control group received routine care, including condition monitoring, medication therapy, and general health education; the intervention group implemented TTM-based case management on the basis of routine care. A multidisciplinary team was established to develop and implement personalized rehabilitation interventions according to the patient' s stage of behavior change. Results After intervention, the intervention group demonstrated more significant improvement in cardiac function, with left ventricular ejection fraction significantly higher than that of the control group ($P<0.05$); heart rate significantly lower than that of the control group ($P<0.05$); and 6-minute walk distance significantly higher than that of the control group ($P<0.05$). In terms of quality of life, all dimension scores of SF-36 in the intervention group were significantly higher than those in the control group ($P<0.05$). The total incidence of adverse cardiovascular events in the intervention group was lower than that in the control group ($P<0.05$). The total score of "knowledge, attitude, and practice" (KAP) in the intervention group was higher than that in the control group ($P<0.05$); medication adherence was significantly higher than that in the control group ($P<0.05$). Anxiety and depression scores in the intervention group were both significantly lower than those in the control group ($P<0.05$). The positive perception level of primary caregivers was significantly higher than that in the control group ($P<0.05$). Conclusion TTM-based case management in cardiac rehabilitation for patients after PCI for myocardial infarction can effectively improve patients' cardiac function

and quality of life, reduce the incidence of adverse cardiovascular events, and improve patients' psychological status and medical compliance behavior.

Full Text

Application of Transtheoretical Model-Based Case Management in Cardiac Rehabilitation of Patients After PCI for Myocardial Infarction

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Abstract

Objective: This study investigated the impact of transtheoretical model (TTM)-based case management on cardiac rehabilitation in patients after percutaneous coronary intervention (PCI) for myocardial infarction, aiming to provide an effective rehabilitation management model for clinical practice.

Methods: A total of 100 patients who underwent PCI for myocardial infarction at a tertiary Grade A hospital between May 2023 and May 2024 were randomly assigned to either an intervention group or a control group (n=50 each). The control group received routine care, including condition monitoring, medication management, and general health education. The intervention group received TTM-based case management in addition to routine care. A multidisciplinary team was established to develop and implement personalized rehabilitation interventions according to each patient' s stage of behavior change.

Results: Post-intervention, the intervention group demonstrated significantly greater improvement in cardiac function, with higher left ventricular ejection fraction ($P<0.05$), lower heart rate ($P<0.05$), and longer 6-minute walking distance ($P<0.05$) compared to the control group. Quality of life, as measured by SF-36 scores, was significantly higher across all dimensions in the intervention group ($P<0.05$). The total incidence of adverse cardiovascular events was lower in the intervention group ($P<0.05$). Additionally, the intervention group showed higher total scores on the Knowledge-Attitude-Practice (KAP) scale ($P<0.05$), better medication adherence ($P<0.05$), lower anxiety and depression

scores (P<0.05), and significantly higher positive perception scores among primary caregivers (P<0.05).

Conclusion: TTM-based case management effectively improves cardiac function and quality of life, reduces adverse cardiovascular events, and enhances psychological status and medical compliance in patients after PCI for myocardial infarction.

Keywords: Myocardial infarction; Post-PCI; Transtheoretical model; Case management; Cardiac rehabilitation

Introduction

Myocardial infarction (MI) is a leading cardiovascular disease worldwide, characterized by acute and persistent myocardial ischemia and hypoxia resulting in myocardial necrosis, with high morbidity and mortality rates. While advances in medical technology have significantly reduced mortality after PCI, the incidence of non-fatal adverse outcomes such as heart failure, stroke, and rehospitalization has increased [1]. Furthermore, quality of life deteriorates post-MI, with the proportion of patients experiencing poor quality of life continuing to rise with age. Cardiac rehabilitation (CR) is a comprehensive treatment approach that provides holistic rehabilitation services through multidisciplinary collaboration, aiming to improve quality of life and reduce readmission and mortality rates [2]. Substantial evidence demonstrates that cardiac rehabilitation significantly reduces mortality and recurrent cardiac events while improving quality of life in post-MI patients after PCI [3], leading the American Heart Association and European Society of Cardiology to classify it as a Class I recommendation for cardiovascular disease treatment [4]. Personalized cardiac rehabilitation services that tailor interventions to individual patient characteristics can further enhance rehabilitation outcomes [5].

The Transtheoretical Model (TTM) is a behavior change theory that enables development of personalized interventions based on an individual' s stage of change [6]. Case management (CM) emphasizes providing continuous, comprehensive care to ensure effective support throughout the rehabilitation process [7]. Integrating TTM with CM offers a more precise and personalized rehabilitation service for post-MI patients after PCI, potentially improving medical compliance and quality of life.

Methods

1.1 General Information

This randomized controlled trial enrolled 100 patients who underwent PCI for myocardial infarction at a tertiary Grade A hospital between May 2023 and

May 2024. Participants were randomly divided into intervention and control groups (n=50 each). The two groups showed no statistically significant differences in baseline characteristics including age, gender, ethnicity, marital status, education level, disease understanding, or religious beliefs (P>0.05), confirming comparability. Inclusion criteria were: (1) diagnosis of post-MI PCI [8]; (2) age $ $18 years; (3) voluntary participation. Exclusion criteria included severe hepatic or renal insufficiency, cognitive dysfunction, or psychiatric disorders. This study was approved by the Medical Ethics Committee of The First Affiliated Hospital of University of Science and Technology of China, and all participants provided informed consent.

1.2 Intervention Methods

1.2.1 Control Group The control group received routine care, including standard health guidance, completion of preoperative examinations and preparations, postoperative rehabilitation guidance, dietary and medication counseling, psychological nursing, and provision of a quiet environment for rest.

1.2.2 Intervention Group The intervention group received TTM-based case management in addition to routine care. A multidisciplinary team comprising physicians, case managers, specialist nurses, nutritionists, and psychological counselors was established to develop and implement personalized rehabilitation interventions based on each patient' s stage of behavior change. Prior to initiating the integrated TTM-CM cardiac rehabilitation program, patients' rehabilitation behavior stages were assessed [Figure 1: see original paper].

Pre-contemplation Stage: Patients had no intention of participating in cardiac rehabilitation. The objectives were to raise rehabilitation awareness and motivate lifestyle changes. Strategies included: (1) Relationship building: The case manager introduced themselves, explained the rehabilitation program' s purpose and significance, established rapport, and added patients on WeChat to facilitate communication and share rehabilitation articles; (2) Consciousness raising: Specialist nurses conducted two face-to-face health education sessions (20-30 minutes each) to discuss risk factors and encourage questions; (3) Environmental reevaluation: Non-judgmental exploration of patients' risk factors, perspectives, and feelings to deepen understanding; (4) Dramatic relief: Patients recalled their pre- and post-illness experiences, with psychological counselors providing emotional support and teaching coping strategies when anxiety emerged.

Contemplation Stage: Patients recognized the importance of cardiac rehabilitation and intended to make changes within six months. Objectives included building confidence and correcting risk factors. Strategies comprised: (1) Environmental reevaluation: Guiding patients to envision positive life changes from rehabilitation to strengthen motivation; (2) Self-efficacy enhancement: Emphasizing exercise-based rehabilitation as an effective approach; (3) Self-

reevaluation: Encouraging reflection on unhealthy lifestyles and their cardiovascular consequences, identifying barriers, and developing feasible solutions.

Preparation Stage: Patients had made rehabilitation plans to implement within one month. The objective was collaborative goal-setting and case management service initiation, including establishing patient profiles in the hospital information system and developing individualized management plans.

Action and Maintenance Stages: The action stage involved patients who had started rehabilitation exercise for less than six months, while the maintenance stage required sustained rehabilitation for at least six months. Strategies included: (1) Reinforcement management: Maintaining relationships, providing self-rewards for achieving goals, and discussing barriers when goals were not met; (2) Stimulus control: Providing methods for sustained exercise (e.g., exercising with companions, using apps or music) and medication reminders (e.g., smart pill boxes, timed alarms). The detailed TTM-based cardiac rehabilitation case management protocol is presented in Table 1 .

1.2.3 Evaluation Methods

Cardiac function was assessed using left ventricular ejection fraction (LVEF), heart rate, and 6-minute walking test (6MWT) during hospitalization and at six months post-discharge. Quality of life was evaluated using the SF-36 survey covering physical condition, emotional function, and social functioning. Adverse cardiovascular events including arrhythmia, recurrent MI after PCI, and cardiogenic shock were recorded. Health behavior and compliance were measured using a self-developed Knowledge-Attitude-Practice (KAP) scale and the Morisky Medication Adherence Scale. Anxiety and depression were assessed using the Hamilton Anxiety Scale (HAMA, total score 56, higher scores indicating greater anxiety) [9] and Hamilton Depression Scale (HAMD, total score 12-48, higher scores indicating greater depression) [10]. Primary caregivers' positive experiences were evaluated using the Positive Aspects of Caregiving (PAC) scale [11], a 9-item instrument with two dimensions developed by Tarlow et al., scored using a 5-point Likert scale (higher scores indicating more positive perceptions). The Chinese version of PAC demonstrated good reliability and validity (Cronbach' s α=0.9) [12].

1.2.4 Data Collection

Trained case managers conducted face-to-face surveys within 24 hours of admission, one day before discharge, and six months post-discharge. Participants were informed about questionnaire instructions, completed surveys under guidance, and submitted them on-site for completeness checking. Of 100 patients surveyed, the effective response rate was 98.00%.

1.2.5 Statistical Analysis

Data were analyzed using SPSS 23.0 software. Continuous variables were expressed as mean±standard deviation (x±s) and compared using t-tests. Categorical variables were expressed as frequencies (%) and compared using ^{2} tests. P<0.05 was considered statistically significant.

Results

2.1 Baseline Characteristics Comparison

The two groups showed no statistically significant differences in baseline characteristics including gender, age, medical history, or geographic region (P>0.05), confirming comparability .

2.2 Cardiac Function Comparison

Post-intervention, the intervention group demonstrated significantly greater cardiac function improvement than the control group . LVEF was significantly higher $(60.5\$\pm4.2\pm3.8\pm6.3 vs. 78.5\pm7.2 beats/min, t = 5.42, P < 0.05), and 6-minute walking distance was significantly longer$ (550.2±45.3*vs*.480.5±$42.1 meters, t=7.98, P<0.05).

2.3 Quality of Life Comparison

Post-intervention, the intervention group showed significantly greater quality of life improvement across all SF-36 dimensions . Physical functioning $(78.5\$\pm8.2 vs. 65.3\pm7.5, t = 7.65, P < 0.05)$, *social functioning*$(80.2\pm9.1 vs. 68.5\pm8.3, t = 6.98, P < 0.05)$, *and emotional functioning*$(79.3\pm7.8 vs. 66.2\pm\$6.9,$ t=7.45, P<0.05) were all significantly higher in the intervention group.

2.4 Adverse Cardiovascular Events Comparison

During the intervention period, the intervention group had a significantly lower total incidence of adverse cardiovascular events . Arrhythmia occurred in 1 patient (2%) versus 5 (10%) in the control group (^{2}=4.23, P<0.05); recurrent MI after PCI occurred in 2 patients (4%) versus 5 (12%) (^{2}=4.23, P<0.05); cardiogenic shock occurred in 2 patients (4%) versus 1 (2%) (^{2}=0.21, P>0.05). The total event rate was significantly lower in the intervention group (10% vs. 24%, ^{2}=5.12, P<0.05).

2.5 Health Behavior and Compliance Comparison

Post-intervention, the intervention group demonstrated better health behaviors and medication adherence . KAP total scores were significantly higher $(85.6\$\pm6.7 vs. 72.3\pm7.1, P < 0.05)$, *and medication adherence was superior*$(96\hat{}\{2\}\$=6.45,$ P<0.05).

2.6 Psychological Status Comparison

Post-intervention, the intervention group showed significantly better psychological status and primary caregivers reported higher positive perception scores . Anxiety scores were lower ($35.2\$\pm5.1 vs. 45.3\pm6.2, t = 8.76, P < 0.05$), $depressionscoreswerelower(34.5\pm4.8 vs. 44.8\pm5.5, t = 8.54, P < 0.05), andcaregiverpositiveperceptionscoreswerehigher(80.5\pm7.2 vs. 68.3\pm\$6.5$, t=7.89, P<0.05).

Discussion

3.1 TTM-Based Case Management Promotes Health Behavior Formation

The Transtheoretical Model effectively promotes health behavior formation and maintenance by assessing patients' stages of change and implementing targeted interventions. In this study, the intervention group demonstrated better behavior change trends across all cardiac rehabilitation stages, particularly showing higher proportions in the action and maintenance stages compared to the control group. This indicates that TTM-based case management better facilitates health behavior development. Furthermore, family empowerment strategies that enhance family involvement and responsibility strengthened behavior change outcomes [13,14].

3.2 Enhancing Cardiac Rehabilitation Willingness and Compliance

Participation and adherence are crucial factors affecting rehabilitation outcomes [15]. This study' s integration of TTM with family empowerment significantly improved patients' cardiac rehabilitation willingness and compliance. Results showed that post-intervention, the intervention group had significantly higher rehabilitation autonomy and lower process and outcome anxiety compared to the control group, demonstrating that targeted interventions can effectively alleviate anxiety about rehabilitation while enhancing autonomy and adherence.

3.3 Improving Psychological Status and Quality of Life

Psychological status significantly impacts cardiac rehabilitation [16]. This study found that post-intervention, the intervention group had significantly lower anxiety and depression scores with substantially improved quality of life. These results indicate that TTM-based case management addresses not only physical recovery but also psychological well-being through targeted interventions and family support, thereby enhancing overall quality of life. Multidisciplinary team collaboration provides comprehensive support that further improves rehabilitation outcomes.

3.4 Enhancing Primary Caregivers' Positive Perceptions

Caregivers' psychological status and involvement significantly influence patient recovery. This study' s family empowerment strategy substantially improved caregivers' positive perceptions, with intervention group caregivers scoring significantly higher post-intervention. This suggests that enhancing caregiver engagement and responsibility creates better support for patient recovery and establishes a positive feedback cycle.

3.5 Comprehensive Impact of TTM-Based Case Management

TTM-based case management provides personalized, continuous rehabilitation services for post-MI patients after PCI through precise assessment of behavior change stages. This management model addresses physical rehabilitation, psychological support, health behavior modification, and family empowerment. Additionally, strength training ensures muscle preservation, enhances independence and autonomy, and improves quality of life [17-19]. This study demonstrates that the intervention group outperformed the control group across multiple indicators including cardiac function, quality of life, adverse event rates, health behavior compliance, psychological status, and caregiver positive perceptions. These findings confirm that TTM-based case management comprehensively improves rehabilitation outcomes for post-MI patients after PCI.

In summary, post-MI rehabilitation requires not only medical technology but also personalized, continuous care. TTM-based case management provides tailored rehabilitation services through precise needs assessment, covering psychological support, health guidance, exercise, and dietary management while leveraging multidisciplinary team strengths. By developing stage-specific interventions, this approach better meets individual patient needs, improves rehabilitation effectiveness, enhances cardiac function and quality of life, reduces adverse cardiovascular events, and improves health behavior compliance and psychological status. This offers new management strategies and methods for improving patient prognosis with significant clinical application value and promotion potential.

Limitations and Outlook

Despite positive results, this study has several limitations. First, the relatively small sample size and short observation period may affect generalizability and long-term efficacy assessment. Second, conducting the study at a single tertiary hospital may not fully reflect outcomes across different regions and healthcare settings. Future research should expand sample sizes, extend observation periods, and validate the model across multiple institutions to confirm broad applicability. Additionally, integrating modern technologies such as telemedicine and mobile health applications may further enhance intervention effects and warrant exploration in subsequent studies.

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Note: Figure translations are in progress. See original paper for figures.