

# Progress in the Early Mobilization of Patients after Cardiac Intervention

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## Abstract

Early activity has a positive effect on the rehabilitation process of patients after cardiac intervention. This paper summarizes the concept and significance of early activity after cardiac intervention, the best time and mode of different types of early activity after cardiac intervention, and the factors affecting early activity, aiming to provide a basis for clinical medical staff to provide safe and effective guidance of early activity after cardiac intervention.

## Keywords

Cardiac Interventional Therapy, Early Activity, Research Progress, Cardiac Rehabilitation

## 1. Introduction

Due to the rapid development of economy, the unhealthy lifestyle, the continuous growth of the aging population and the absolutely huge population base, China has become the country with the heaviest burden of cardiovascular disease, and the morbidity and mortality rate are still rising [1] [2]. Interventional therapy has become the preferred option for coronary heart disease, structural heart disease and arrhythmia [3], according to statistics, in 2021, there were 1.164 million cases of coronary heart disease, 156,800 cases of arrhythmia catheter ablation, 15,000 cases of transcatheter valve replacement and 36,700 cases of congenital heart disease in mainland China [4]. With the increase of cardiac interventional therapy year by year, postoperative rapid rehabilitation (ERAS) has a positive impact on the prognosis of patients and is increasingly valued by medical staff. As the key content of quick rehabilitation, early activity can effectively shorten the hospitalization day, reduce the complications during the postoperative bedridden, and improve the psychological state of patients [5]-[7]. However, the protocol for early

activity varied among different studies with poor execution in clinical practice [8] and the lack of uniform standards [5]. The progress of the early activity of cardiac intervention is expounded to provide a reference for the early activity of cardiac intervention in clinical practice.

## **2. The Concept of Early Activity**

Domestic and foreign studies usually describe “early activity” as “early ambulation”, “early mobilization”, “early off-bed activity”, “Early exercise”, “early rehabilitation” [9], etc. The timing of early activity after cardiac intervention has not yet formed a unified definition. With the rapid development of cardiac rehabilitation in cardiovascular diseases in China, the early activity after cardiac intervention has also attracted the attention of doctors and patients. The 2015 American Heart Society consensus on secondary prevention of coronary bypass transplantation recommended that postoperative patients start cardiac rehabilitation immediately after surgery [10], passive and active limb movements began immediately during the bed period. The 2018 Chinese Guidelines on Cardiac Rehabilitation and Secondary Prevention also proposed that patients with cardiovascular disease should immediately start cardiac rehabilitation evaluation for rehabilitation treatment at the same time as admission [11]. Early activity is the key indicator and implementation point of ERAS concept. Foreign ERAS concept defines early activity as the first day after surgery [12]. 2018 version of China ERAS China expert consensus in the early activities pointed out that postoperative awake can be in a semi-lying position or an appropriate amount of bed activities, no need to go to the pillow supine for 6 h, the action can be started on day 1 after surgery [13]. It can be seen that the early activity after cardiac intervention means that clinical medical staff should carry out early bed limb activities on the first day after surgery, if the patient’s condition allows, and then transition to bedside activities.

## **3. The Best Time and Way of Early Activities**

Early postoperative activities included postural changes, limb passive/active activity, and ambulation. The timing and method of the early activity after all kinds of cardiac intervention are summarized as follows.

### **3.1. Time and Method of Early Activity after Coronary Heart Disease Intervention**

With the aging of the social population and poor lifestyle, the incidence of coronary heart disease (CHD) continues to rise, and coronary intervention (PCI) has become an important means of treating CHD [14], the surgical method includes the transradial artery and the transfemoral artery, in which the transfemoral approach is the traditional surgical method.

#### **3.1.1. Transradial Coronary Artery Intervention**

Patients after the radial artery intervention, because the surgical site is in the upper limb, the ambulation is not limited, only the postoperative puncture site of the

upper limb radial artery compression hemostasis immediately. It has been shown that in patients undergoing coronary intervention via transradial access, the radial artery compression hemostasis time 2 h is the best time, the hemostasis efficacy (prevention of RAO) and safety (prevention of hematoma/rebleeding in access site) are consistent with conventional compression for 6 - 12 h [15].

### 3.1.2. Transfemoral Coronary Artery Intervention

At present, in China, patients are often required to press with sandbags for 6 - 8 h and brake in bed for 24 h after transfemoral artery intervention [16]. However, long-term bed rest brings discomfort to patients and delays the rehabilitation process. Internationally, the early postoperative activity time of CHD patients is not clear. Kobrossi *et al.* [17] study showed that early activity (3 h) and standard (6 h) had similar and low rates of vascular complications, cardiac catheterization laboratories are encouraged to adopt an early policy after femoral CC/PCI to improve patient comfort and accelerate patient discharge. In addition, Wentworth *et al.* [18] study also showed that there was no statistical difference in the reduction in bed rest time from 6 h to 4 h for puncture site-related complications after transfemoral PCI. Regarding the operative limb brake time, the study of Santos *et al.* [19] showed that the reduction of limb fixation after transfemoral PCI from 4 h to 2 h did not change the frequency and intensity of pain, the need for analgesic drugs and the incidence of urinary retention, and the incidence of dry hematoma had no obvious clinical manifestations. Wang *et al.* [20] study showed that the patient was ambulating 2 - 3 h after the transfemoral approach intervention (sheath model: 5 - 7 Fr), which reduced the back pain intensity and urinary system discomfort. The study of Ibdah *et al.* [21] showed that early position changes 1 h after cardiac catheter removal can reduce back pain and dysuria and increase patient comfort without increasing the occurrence of vascular complications such as bleeding and hematoma, which has a significant positive impact on patient prognosis. Suggs *et al.* [22] studies have shown that a bedside elevation of 20° immediately after the removal of cardiac catheterization can improve postoperative pain without increasing bleeding or complications. All the above studies showed that returning to the ward for 1 h or even raising the bedside immediately; reducing the bed rest to 3 - 4 h was more applicable than the conventional long bed rest. The shortening of postoperative bed-rest time can be related to the popularization of PCI and the continuous update of surgical instruments. Therefore, after femoral artery intervention, the head of the bed can be raised 1 h after removing the sheath, and it can move out of bed 3 to 4 h after surgery.

### 3.2. Early Mobilization Time and Manner after Radiofrequency Ablation of Cardiac Arrhythmia

Cardiac radiofrequency ablation (radiofrequency catheter ablation, RFCA) is the main clinical treatment of arrhythmia, in which the transfemoral artery/femoral vein route is a common treatment route. However, complications such as puncture site bleeding, hematoma, and pseudoaneurysm can occur after femoral RFCA

[23], so bed rest is required to control the risk of complications. At present, there is no unified regulation on bedtime after femoral RFCA at home and abroad, and literature reports range from 1.5 to 24 h [24] [25]. Domestic guidelines suggest that bed rest and limb braking for 6 h after femoral vein RFCA [26]. However, there is no uniform standard for postoperative bed rest and early activity in clinical practice.

### **3.2.1. Time and Mode of Early Mobilization after Transfemoral Radiofrequency Ablation**

Transfemoral RFCA early activity, one study [27] showed that transfemoral radiofrequency ablation recommends 12 h ambulation. Li *et al.* [26] an evidence-based practice concluded that the PRCA should be bedridden for 3 to 4 h, 4 h after bed mobilization, 6 to 12 h can reduce the incidence of patients' pain, difficulty in urination and other complications, and greatly improve the patients' medical experience and prognosis. In addition, foreign studies on transfemoral heart interventional surgery [28] [29] also show that early position changes, postoperative return to the ward bed elevation 15°, 30° can relieve patients' low back pain and uncomfortable feeling. Liang *et al.* [30] the results of a study on an evidence-based practice project also showed that patients with transfemoral puncture cerebral angiography began to change the lying position 2 h after surgery, and 6 hours could significantly increase the comfort and reduce the level of pain after surgery without changing the incidence of vascular complications. Transfemoral RFCA and femoral angiography are consistent with compression and hemostasis, but RFCA is usually more complex and requires longer surgical time. Therefore, the first postoperative implantation time is prolonged, so according to the actual situation of the patient, it is suggested that patients with femoral RFCA should brake in bed for 3 to 4 h after femoral radiofrequency ablation, during which the bed can be raised for 15° and 30°, move in bed for 4 h, and get out of bed for 6 to 12 h.

### **3.2.2. Time and Method of Early Mobilization after Femoral Vein Radiofrequency Ablation**

In China, the RFCA was generally braking for 6 to 12 h, and the implantation time was 12 to 24 h after surgery [31] [32]. However, theoretically, the risk of bleeding at the site of femoral vein puncture is less than that of the femoral artery, and it is also easier to achieve hemostasis. Therefore, more studies have compared the effects of relieving postoperative immobilization and early ambulation in a shorter period of time. Zhu *et al.* [33] the study showed that patients with vascular stapler brake for 2 h after surgery and stay in bed for 6 h after rest; the bedside is raised for 15, and turn over every 2 h to help change position. Compared with the patients who are regularly in bed for 12 h, it effectively promoted the early ambulation and rehabilitation process, and shortened the hospitalization time. Li *et al.* [34]-[36] the study showed that the head of the bed was raised to 15° at 1 h after surgery, then the head of the bed was gradually raised to 45°, and the left and right sides were turned over alternately, which could effectively relieve the back pain,

shorten the hospital stay and improve the satisfaction of patients. Tan's research [33]-[37] showed that the turning and bed movement within 4 h to 6 h can effectively improve the comfort and meet the physiological needs of 12 h after the operation and does not increase the postoperative complications. Study [38]-[40] demonstrated that 4 h after surgery can effectively relieve the discomfort during bed rest without increasing vascular related complications. Foreign patients with arrhythmia began to change their position during and after radiofrequency ablation, and the earliest time to get out of bed was 4 h after surgery [41] [42]. Lee's [43] studies have shown that intraoperative elevation of the head of the bed by 25° and hand massage can relieve postoperative back pain and promote comfort. Combining the above research conclusions, after femoral vein radiofrequency ablation, the head of the bed can be raised immediately after returning to the ward, and the decubitus position can be changed thereafter. According to the patient's condition, she can get out of bed 4 to 6 h after the operation.

### 3.3. Time and Mode of Early Activity after Pacemaker Implantation

After pacemaker implantation, patients are routinely required to stay bedridden for 1 - 3 d in order to avoid complications such as electrode dislocation [44], however, long bed rest can lead to back pain, constipation and other discomfort. Two Meta analyses [45] [46] showed that after fixing the surgical shoulder joint, the patient can get out of bed in 3 - 24 h, which can promote the patient's comfort and ensure the safety and early rehabilitation. The study of Li *et al.* [47] showed that the patient was changed from the supine position to the semi-lying position 2 h after surgery, and the sitting position was 4 h. The early activity intervention could effectively reduce the related discomfort symptoms and improve the comfort and satisfaction of patients in rehabilitation. The study of Yuan [48] showed that 6 h mobilization could improve patient comfort without increasing the risk of postoperative bleeding and electrode dislocation. Wan *et al.* [49] study showed that the semi-lying position at 12 h and 24 h could effectively improve their shoulder joint function and improve their quality of life. Liu *et al.* [50] study showed that the head of the bed after the position, and the left and right side position, the sitting position and the bed after 8 h, which could promote the physical and mental comfort after surgery without increasing the postoperative complications. Zhang *et al.* [51] studies have shown that assisting in the sitting position and gradually leaving the bed after 6 h after surgery, which can effectively reduce postoperative back pain, urinary retention, shorten hospital stay and increase patient comfort. Budano [52] and Miracapillo [53] also showed that early mobilization after 3 h was safe and feasible compared with standard 24 h, independent of an increased risk of intraoperative complications. It can be seen that the shoulder joint after pacemaker surgery can prevent the pacemaker electrode dislocation, so the position can be changed early to reduce the related discomfort symptoms. Considering all the above studies, the semi-lying and sitting positions were taken 4 h after pacemaker implantation, and moved after 6 - 12 h.

### 3.4. Early Activity and Mode after the Intervention of Congenital Heart Disease

Over the years, advances in medical technology have allowed more than 90 percent of children with congenital heart disease (CHD) to live to adulthood, the number of adults with congenital heart disease (ACHD), and the number of transcatheter interventions [54]. A Meta-analysis showed that implementing exercise rehabilitation training has positive significance for children with congenital heart disease, which can improve the quality of life and shorten the hospital stay [55]. However, the timing and content of the specific postoperative rehabilitation exercise were not explained. According to the consensus of standardized diagnosis and treatment of patent foramen ovale, Chinese experts stayed in bed for 12 h after occlusion [56]. Qin *et al.* [57] study showed that after occlusion of patent foramen ovale, no nausea and vomiting can raise the bed 30° after 2 h, relieve compression at 6 h, get out of bed for 12 h, and at 2 h after straight raise the lower limbs 20° to 30°, and appropriately turn on the side. Compared with conventional puncture site compression for 12 h, supine and bracing for 24 h, it can improve anxiety and depression, stabilize blood pressure and heart rate, and reduce postoperative complications. Different types of surgery for congenital heart disease lead to different operation time. In order to ensure the safety after surgery, the bed time is longer than other types of surgery. Therefore, 2 h after congenital heart disease intervention can raise the head of the bed, gradually bed activity, 12 h later can get out of bed activity.

## 4. The Significance of the Early Activity

### 4.1. Reduce the Incidence of Complications

The cardiac interventional puncture requires not only effective compression and hemostasis, but also surgical limb brake, and absolute bed rest if necessary. Most of the patients during the bed back pain, anxiety and urination difficulties many discomfort. Wang *et al.* [58] study found that early standardized activities can improve the left ventricular ejection fraction and 6 min walking test distance after PCI, and improve the quality of life. There is a study [24] suggesting that ambulation 2 - 3 h after removal of the sheath after femoral vein intervention reduced back pain and urinary tract symptom discomfort, and the incidence of vascular-related complications was unchanged. Cha *et al.* [28] study showed that early positioning changes can significantly improve lower back pain during bed rest after coronary intervention. Meanwhile, the study of Valiee *et al.* [29] also showed that the early positioning changes after angiography can reduce the symptoms of groin pain, back pain, urinary retention, and increase patient comfort. Liang *et al.* [30] study showed that early ambulation programs can effectively and safely increase comfort and reduce coronary intervention levels of lower back pain without increasing vascular-related complications. Haghshenas's study [42] has shown that an early ambulation regimen can be effective in increasing postoperative comfort and relieving low-back pain levels without changes in the incidence of vascular

complications. There is also a study [36] showed that early positioning intervention and ambulation can reduce the incidence of physical discomfort caused by braking and being bedridden after radiofrequency ablation in patients with atrial fibrillation, reduce patient anxiety, improve the comfort of postoperative patients, and will not increase the incidence of bleeding and hematoma at the puncture site.

Therefore, it seems that early activity has a positive effect in reducing related postoperative complications after cardiovascular intervention, and most studies show that early activity does not increase related complications after interventional surgery. However, most of the studies have focused only on the effect of the wish during hospitalization after the activity, and no follow-up and research on out-of-hospital and long-term effects. Therefore, subsequent studies can further explore the impact of early postoperative activity on long-term cardiac rehabilitation therapy.

## 4.2. Significance of Health Economics

Early activity can bring great economic benefits. Early activity of patients in neurological intensive care units reduces health care costs by 15% to 30%, the main reason may be that early activity can reduce the incidence of complications, shorten the length of hospital stay and reduce the readmission rate of patients [59]. Yue *et al.* [60] study showed that Apply early cardiac rehabilitation care to acute myocardial infarction Dead interventional surgery, the average length of stay can be reduced by 2 days. At the same time, Wan *et al.* [49] the study concluded that early cardiac rehabilitation intervention in the experimental group could reduce the complication rate by 15% relative to the control group after pacemaker implantation. There is also research [51] [61] studies that showed that early postoperative pacemaker mobilization can reduce postoperative complications and shorten hospital stay. Thus, early activity reduces the complications after cardiac intervention, shortens the hospital stay and saves medical costs to a large extent.

## 5. Factors Affecting Early Activity

### 5.1. Factors of the Medical Personnel

Although early mobilization has become a major element of postoperative care, early mobilization interventions for heart-related surgery are in a developmental stage [62], there is no consensus at home and abroad on the starting time and content of the early postoperative activities [6]. As a result, health care workers have some concerns about their early activity programmes. As an important part of cardiac rehabilitation, the early activity of cardiac rehabilitation personnel lacks a training and access system in China, which leads to some doctors and nurses' lack of understanding and attention to the theory and practice of cardiac rehabilitation [5]. Therefore, medical personnel need to deepen the training of early postoperative activities and cardiac rehabilitation theory knowledge, and spread the concept of early rehabilitation to patients and their families in the course of medical

activities.

## 5.2. Patient Factors

The degree of knowledge of cardiac rehabilitation directly affects the participation rate and compliance of cardiac rehabilitation [63]. The traditional thinking is that patients should rest and rest more after surgery [64]. At the same time, the fear of wound bleeding so that the patient is afraid to move after surgery. It can be seen that patients' lack of knowledge of cardiac rehabilitation and insufficient understanding of early activities lead to the resistance to early activities after interventional surgery. Medical staff can learn the relevant knowledge and gradually participate through health education videos, manuals and bedside displays.

## 6. Summary

In summary, after transradial coronary intervention, the optimal time was 2 h; after the femoral artery intervention, the bedside can be raised 1 h after the sheath removal to change the position, 3 - 4 h can be out of bed activity; after femoral radiofrequency ablation, bed braking should be performed for 3 to 4 h, bed mobility after 4 h, 6 to 12 h out of bed activity; after radiofrequency ablation of the femoral vein, the head of the bed can be raised immediately after returning to the ward, thereafter can change the lying position, according to the patient's condition, 4 to 6 h after surgery can get out of bed activities; semi-lying and seated positions were taken 4 h after pacemaker implantation, after 6 to 12 h can get out of bed activity; raise the bed 2 h after congenital heart disease intervention, gradually bed activity, you can get out of bed after 12 h. Early mobilization is safe and feasible, and can reduce the complication rate, improve physiological function, and reduce medical costs. However, there were some differences in early activity patterns and content in related studies, and no continuity studies were conducted to explore long-term effects. Subsequent studies could further explore standard early activity protocols to maximize patient safety and cardiac rehabilitation.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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