Updates to Preoperative Cardiopulmonary Kinesiotherapy in Adult Patients Undergoing Cardiac Surgery: An Integrative Literature Review

ARTIGO DE REVISÃO

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Abstract: This study aimed to identify the scientific literature addressing cardiopulmonary kinesiotherapy in the preoperative period of adult patients undergoing cardiac surgery. It is an Integrative Literature Review developed according to the main items for reporting Systematic Reviews and Meta-Analyses (PRISMA), using the databases Physiotherapy Evidence Database (PEDro), National Library of Medicine of the National Institutes of Health (PubMed), and Virtual Health Library (VHL), with the descriptors *Physical Therapy*, *Cardiopulmonary*, *Preoperative*, *Adults*, and *Cardiac Surgery*. The analysis of the selected articles showed that the application of cardiopulmonary kinesiotherapy before cardiac surgery significantly contributes to the reduction of respiratory complications, shorter hospital stay, and lower dependence on mechanical ventilation, in addition to promoting improvements in functional capacity and quality of life during the postoperative period. Several studies highlighted that specific physiotherapeutic interventions, such as inspiratory muscle training and supervised aerobic exercises, proved effective in preventing pulmonary dysfunctions and optimizing overall physical performance, directly leading to more favorable clinical outcomes. Therefore, preoperative cardiopulmonary kinesiotherapy has been consolidated as an essential strategy in the rehabilitation and preparation of adult patients undergoing cardiac surgery, being effective in reducing morbidity and mortality, optimizing functional status, and contributing to a faster return to daily activities. These findings reinforce the importance of implementing standardized physiotherapeutic protocols in hospital routines and indicate the need for expanding controlled and multicenter studies to further strengthen the scientific basis of this practice.

Keywords: Kinesiotherapy, cardiopulmonary, preoperative, adults, cardiac surgery.

Resumo: O presente estudo teve como objetivo identificar as literaturas científicas produzidas que abordam a cinesioterapia cardiopulmonar no período pré-operatório de pacientes adultos submetidos à cirurgia cardíaca. Trata-se de uma Revisão Integrativa da Literatura desenvolvida conforme os principais itens para relatar Revisões Sistemáticas e Meta-análises (PRISMA), utilizando-se as bases de dados Physiotherapy Evidence Database (PEDro), National Library of Medicine of National Institute of Health (PubMed) e Virtual Health Library (VHL), com os descritores *Physical Therapy*, *Cardiopulmonary*, *Preoperative*, *Adults* e *Cardiac Surgery*. A análise dos artigos selecionados evidenciou que a aplicação da cinesioterapia cardiopulmonar antes da cirurgia cardíaca contribui significativamente para a redução de complicações respiratórias, menor tempo de internação hospitalar e menor dependência da ventilação mecânica, além de promover melhora da capacidade funcional e da qualidade de vida dos pacientes no período pós-operatório. Diversos estudos destacaram que intervenções fisioterapêuticas específicas, como o treinamento muscular inspiratório e exercícios aeróbicos supervisionados, mostraram-se eficazes na prevenção de disfunções pulmonares e na otimização do desempenho físico geral, refletindo diretamente em desfechos clínicos mais favoráveis. Dessa forma, a cinesioterapia cardiopulmonar pré-operatória consolida-se como uma estratégia essencial na reabilitação e preparação de pacientes adultos submetidos à cirurgia cardíaca, sendo eficaz na redução da morbimortalidade, na otimização do estado funcional e no retorno mais rápido às atividades diárias. Essas evidências reforçam a importância da inserção de protocolos fisioterapêuticos padronizados nas rotinas hospitalares e indicam a necessidade de ampliação de estudos controlados e multicêntricos que fortaleçam ainda mais a base científica dessa prática.

Palavras-chave: Cinesioterapia, cardiopulmonar, pré-operatório, adultos, cirurgia cardíaca

1. Introduction

The postoperative period of cardiac surgeries reveals a series of physiological changes to patients, such as respiratory and motor complications that are usually related to cardiopulmonary conditioning before the procedure, in the preoperative period (1). Thus, kinesitherapy aimed at this population becomes essential to prevent clinical complications, using tools that prevent morbidity and mortality (2). Prehabilitation can result in shorter hospital stays, as well as better cardiopulmonary capacity and quality of life (3).

Adult patients in the preoperative period of cardiac surgery usually have a clinical history of ischemic heart disease, valvular disease, or heart failure, conditions that lead to functional limitation and reduced ventilatory capacity, factors that directly contribute to the risk of complications in the immediate and late postoperative period (4). Given the progression of these cardiovascular changes and the negative impact on patient functionality and hemodynamics, surgical intervention becomes necessary, which includes myocardial revascularization to valvular corrections, often indicated in patients with multiple comorbidities, such as diabetes mellitus, hypertension, and obesity, which worsen functional status and increase the incidence of complications (5).

Among the most common complications in the postoperative period of cardiac surgeries are atelectasis, respiratory infections, ventilatory dysfunction, reduced peripheral and respiratory muscle strength, and a significant decrease in functional capacity, leading to longer hospital stays and readmission rates (6). On the other hand, patients who underwent specific kinesitherapy before surgery are benefited by optimizing respiratory and peripheral muscle strength, consequently reducing respiratory work and conserving energy. These interventions favor patient preparation for the surgical procedure and play an important role in preventing respiratory and musculoskeletal complications in the postoperative period, promoting a safer and more efficient recovery (2).

Therefore, preoperative kinesitherapy techniques improve functional capacity and reduce morbidity and mortality, as well as healthcare costs for patients (18). Given this scenario, this study aims to describe the effects of cardiopulmonary kinesitherapy in the preoperative period of adult patients undergoing cardiac surgery, emphasizing its clinical relevance and reduction of postoperative complications.

2. Methodology

This is an Integrative Literature Review (ILR) that characterizes itself as a method for systematizing knowledge already produced in the scientific community through analysis of published studies, establishing a general overview of a specific theme (1; 3; 12).

The stages of identification, screening, and inclusion were followed to construct this review. The bibliographic survey for the study took place in January 2025, in the following databases: Physiotherapy Evidence Database (PEDro), National Library of Medicine of the National Institute of Health (PubMed), and Virtual Health Library (BVS), all chosen due to their storage of a wide range of publications focused on the health area. Furthermore, only articles in English, Portuguese, and Spanish, published between 2020 and 2025, were included in the study.

First, the articles included in this work comprise those that address, alone or in conjunction with other themes, one or more keywords, namely: Physical Therapy, Cardiopulmonary, Preoperative, Adults, and Cardiac Surgery. Regarding the inclusion criteria, the following were considered: Studies conducted with adult patients, aged 18 years or older, of both sexes, who were waiting for cardiac surgery and simultaneously undergoing some physiotherapeutic prehabilitation exercise protocol.

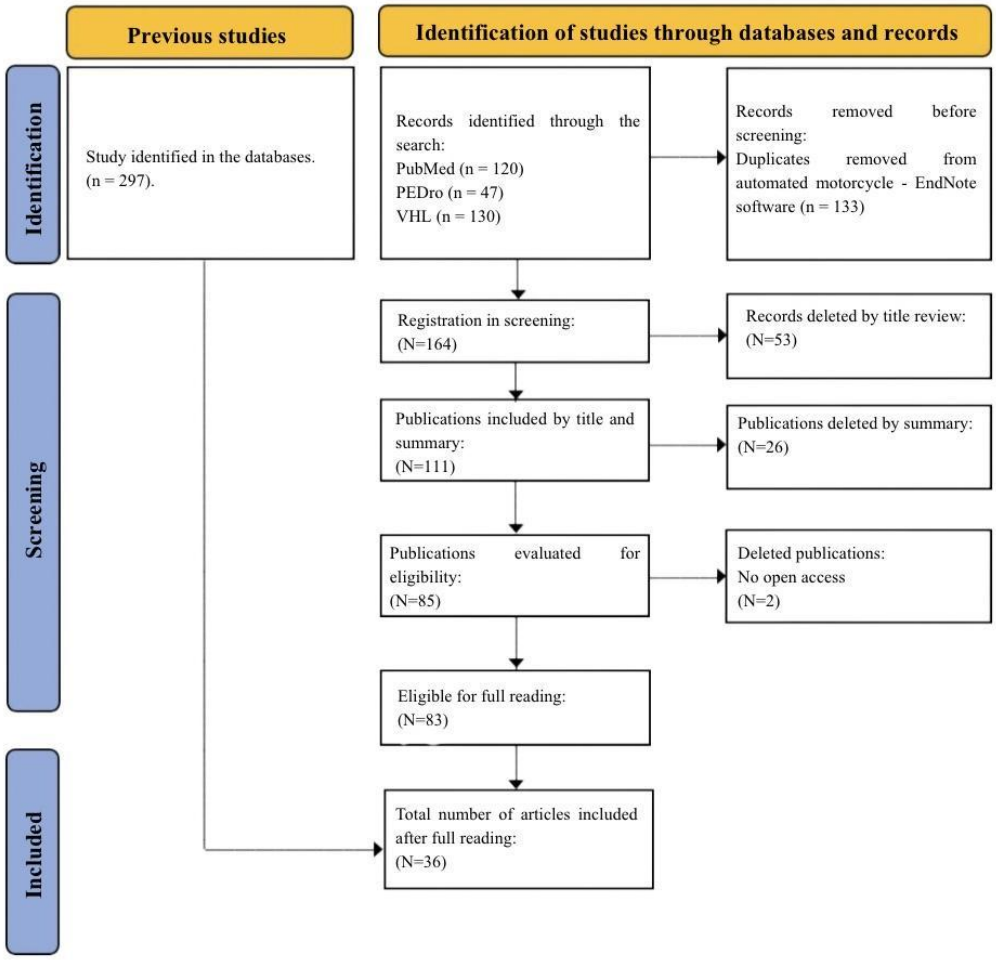
Editorials, booklets, letters, monographs, scientific event annals, dissertations, theses, and books were excluded. In the screening stage, the titles of the articles were first evaluated to verify their relation to the theme, and then analyzed by abstract to filter studies that possibly met the inclusion criteria. Finally, the remaining articles were read in full and selected with caution.

To assess the quality of the articles, a checklist adapted by the authors according to the Critical Appraisal Skills Programme (CASP) was used, consisting of eleven items that contemplate important perspectives of the scientific study development process and proof of methodological rigor instruments. To identify the presence of the quality indicator, a positive sign (+) was assigned to studies that had the indicator, and a negative sign (-) to studies without the indicator.

3. Results

The studies underwent a 3-stage analysis. From the search process, 2,534 articles were found in the databases during the identification stage, and 216 were excluded due to duplication. In the screening stage, 2,318 were included, and 164 were selected to be read by title and abstract. 42 articles proceeded to the eligibility phase and 38 to full-text reading. Then, 17 articles were included to be part of the review. The organization of data collection can be observed in the flowchart (figure 1).

Figure 1 - Flowchart of Article Selection.



Source: Raiol MFD, et al., 2025.

Table 1 - Synthesis of the main findings on the benefits of cardiopulmonary kinesitherapy in the preoperative period of adult patients undergoing cardiac surgery.

Author/Year	Type of Study	Sample	Intervention	Results
Assouline A, et al., (2021)	Systematic review and meta-analysis	Not specified	Prehabilitation interventions	Reduction of postoperative pulmonary complications
Cursino ML, et al., (2024)	Experimental study	Not specified	Preoperative physiotherapy	Improvement in functional capacity and reduction of postoperative complications
D'Arx A, et al., (2020)	Observational study	108 participants aged over 18 of both genders	Inspiratory muscle training	The prevalence of preoperative inspiratory muscle weakness was 25%
Klotz SG, et al., (2022)	Randomised controlled study	186 eligible patients with minimally invasive cardiac valve surgery, of both genders. GI: $(n=93)$GC: $(n=93)$	GI: Preoperative protocol aims at better preparation for the operation with regard to physical, and psychological activity. GC: Participants in the control group will receive treatment as usual.	Primary outcomes: Functional discharge and duration of hospital care during the first 12 months after the initial surgery. Secondary outcomes: Health-related quality of life, health literacy, and level of physical activity.
López-Hernández et al., (2024)	Randomised clinical trial	70 patients undergoing elective cardiac surgery	Preoperative physiotherapy (respiratory exercises and inspiratory muscle training) vs. control group (without preoperative physiotherapy)	The group that received physiotherapy had fewer pulmonary complications, shorter mechanical ventilation time, fewer days in the ICU, and reduced hospital stay
Macieira, Christiane Luck et al., (2022)	Cross-sectional study (survey)	488 Brazilian physiotherapists	Online questionnaire on physiotherapeutic conduct in the perioperative period of elective major surgery	Most physiotherapists indicated a focus on pulmonary re-expansion techniques, inspiratory muscle training, and early mobilisation as main strategies in the perioperative period,

				showing good adherence to recommended practices, but with variations according to region and clinical experience
Scheel PJ 3rd, et al., (2020)	Observational study	38 patients aged over 18 of both genders	This study sought to determine the safety and prognostic utility of CPET in patients with ARVC/D	CPET is safe to perform in patients with ARCA/D. Ve/VCO2 can be used for risk stratification and to guide referral for cardiac transplant in ARVC/D
Seo YG, et al., (2022)	Case report	3 patients aged 35, 59, and 26 years of the female gender	Protocol: Stretching for warm-up for 5 to 10 min. Aerobic exercise using exercise bike and treadmill for 25 to 30 min. Mat exercise or weight training for 15 to 20 min. Stretching for cool-down for 5 to 10 min.	Preoperative exercise before cardiac surgery is a beneficial intervention to improve postoperative clinical outcomes
Shahood H, et al., (2022)	Randomised controlled study	100 patients, aged over 18, of both genders	GI: Performed respiratory exercises preoperatively after ventilator weaning. GC: Only performed postoperative exercises	It was concluded that the physiotherapy protocols reduced the incidence of PPC
Shahhood H et al., (2022)	Systematic review and meta-analysis	1,458 patients were scheduled for CABG/elective cardiac surgery, aged over 18 and of both genders	Plan I: Respiratory training protocols, with an incentive spirometer. Plan II: Combined the incentive spirometer with a threshold loading device. Plan III: Used only threshold loading devices for respiratory physiotherapy	There was a significant difference in mechanical ventilation time and hospital stay time
Steinmetz A, et al., (2022)	Systematic review and meta-analysis	752 patients	Respiratory, aerobic, resistance,	Improvement in physical function

			and stretching exercises	and reduction of ICU stay time
Tew GA, et al., (2022)	Systematic review	197 participants, aged over 18 of both genders	Study I: Inspiratory muscle training, with participants performing one 15-minute exercise session, 6 days per week, for at least 2 weeks before surgery. Study II: Exercise classes in hospitals with a mix of aerobic and resistance exercises used in the three exercise stations, three times a week for 6 weeks before surgery. Study III: Hospital exercise sessions with high-intensity interval training on a cycle ergometer, three times a week for 4 weeks before surgery	The evidence on preoperative physical training for people undergoing AAA correction is promising, but currently insufficiently robust for this intervention to be recommended in clinical guidelines
Wee IJY, et al., (2020)	Systematic review	No sample	Study I: Inspiratory muscle training. Study II, III, IV, V: Continuous moderate-intensity exercises. Study VI: High-intensity interval training program	It is still premature to recommend them as a preoperative intervention
World JCC., (2023)	Systematic review and meta-analysis	12 studies	Preoperative inspiratory muscle training (IMT) in patients undergoing cardiac surgery	Preoperative IMT significantly reduced the risk of pulmonary complications, mechanical ventilation time, length of stay in the ICU and hospitalisation, in addition to improving postoperative functional respiratory capacity

Zhang Y., Zhao Z., Wang H., Li C., Wang Z., (2023)	Systematic review with meta-analysis	15 studies (randomised clinical trials)	Preoperative inspiratory muscle training (IMT) in patients undergoing cardiac surgery	Preoperative inspiratory training significantly reduced respiratory complications, ventilation time, ICU and hospital stay, in addition to improving respiratory capacity post-surgery
Zheng YT, et al., (2020)	Meta-analysis	752 patients GE: $(n=275)$GC: $(n=477)$	Exercise programmes include inhaled muscle training, aerobic, resistance training, and stretching	Decrease in ICU stay time and the physical function of patients
Zheng YT, Li Z., Zhu YQ, Wang X., (2020)	Meta-analysis	9 studies	Preoperative rehabilitation (respiratory exercises, inspiratory muscle training, and physiotherapy) in patients undergoing cardiac surgery	Preoperative rehabilitation significantly reduced pulmonary complications, mechanical ventilation time, ICU stay time, and total hospitalisation time, showing clear clinical benefit for patient preparation before surgery

Legend: Min. = Minutes. GI = Intervention Group. GC = Control Group. PET = Preoperative Exercise Therapy. CRM = Coronary Artery Bypass Grafting (CABG). ARVC/D = Arrhythmogenic Right Ventricular Cardiomyopathy/Dysplasia. Heart-ROCQ = Combined Preoperative and Postoperative Multidisciplinary Cardiac Rehabilitation Programme. CPP = Postoperative Pulmonary Complications (PPC). CPET = Cardiopulmonary Exercise Test. Ve/VCO2 = Ventilatory Efficiency. AAA = Abdominal Aortic Aneurysm. CR = Cardiac Rehabilitation.

Source: Raiol MFD, et al., 2025.

In order to evaluate the rigour of the selected articles, the CASP checklist was used, with a positive sign (+) indicating the presence of rigour and a negative sign (-) indicating the absence of rigour (Table 2).

Table 2 – Results regarding the application of the CASP checklist for the classification of the methodological quality of the included articles*.

CASP Scale	Aili SR, et al., (2022)	Assouline A, et al., (2021)	Cursino ML, et al., (2024)	D'Arx A, et al., (2020)	Klotz SG, et al., (2022)	López-H, et al., (2024)

Clear and justified objective	+	+	+	+	+	+
Appropriate methodology	+	+	+	+	+	+
Coherent theoretical-methodological sequence	+	+	+	+	+	+
Adequate sample	+	+	+	+	+	+
Detailed data collection	+	+	+	+	+	+
Appropriate statistical results	+	+	+	+	+	+
Substantiated data analysis	+	+	+	+	+	+
Ability to present and debate results	+	+	+	+	+	+
Synthesise and relate to existing evidence	+	+	+	+	-	-
Explanation of contribution and study limitations	+	+	+	+	-	-
Indication of new study questions	+	+	+	+	-	-
Total Score	**11**	**11**	**11**	**11**	**10**	**10**

CASP Scale	Macieira, CL, et al., (2022)	Scheel PJ 3rd, et al., (2020)	Seo YG, et al., (2022)	Shahood H, et al., (2022)	Shahood H et al., (2022)	Steinmetz A, et al., (2022)
Clear and justified objective	+	+	+	+	+	+
Appropriate methodology	+	+	-	+	+	+
Coherent theoretical-methodological sequence	+	+	+	+	+	+
Adequate sample	+	+	-	+	+	+
Detailed data collection	+	+	-	+	+	+
Appropriate statistical results	+	+	+	+	+	+
Substantiated data analysis	+	+	+	+	+	+
Ability to present and debate results	+	+	+	+	+	+
Synthesise and relate to existing evidence	+	-	+	+	+	+
Explanation of contribution and study limitations	+	-	+	+	+	+
Indication of new study questions	+	-	+	+	+	+

Total Score	**11**	**10**	**10**	**11**	**11**	**10**

CASP Scale	**Tew GA, et al., (2022)**	**Wee IJY, et al., (2020)**	**World JCC., (2023)**	**Zhang Y, et al., (2023)**	**Zheng YT, et al., (2020)**	**Zheng YT, et al., (2020)**
Clear and justified objective	+	+	+	+	+	+
Appropriate methodology	+	+	+	+	+	+
Coherent theoretical-methodological sequence	+	+	+	+	+	+
Adequate sample	+	-	+	+	+	+
Detailed data collection	-	-	+	+	+	+
Appropriate statistical results	+	-	+	+	+	+
Substantiated data analysis	+	-	+	+	+	+
Ability to present and debate results	+	+	+	+	+	+
Synthesise and relate to existing evidence	+	+	+	+	+	+
Explanation of contribution and study limitations	+	+	+	+	+	+

*Adapted from the Critical Appraisal Skills Programme (CASP). Milton Keynes Primary Care Trust 2013. All rights reserved.

Source: Moraes ES, et al., 2025.

4. Discussion

The data obtained in the selected studies consistently indicated that the application of this physiotherapeutic intervention was associated with a reduction in postoperative complications, decreased hospital stay, significant improvement in functional capacity, and less dependence on invasive ventilatory support (7). Zheng et al. (8) demonstrated, in a robust meta-analysis involving 752 adult patients of both sexes, that those undergoing kinesitherapy protocols — including inspiratory muscle training, aerobic exercises, resistance exercises, and stretching — showed expressive clinical benefits. Among these benefits, the reduction in ICU stay stands out, in addition to the improvement in physical functions during the postoperative period, which reinforces the effectiveness of adequate exercise prescription in this context.

Complementarily, Zhang et al. (9) confirmed that structured cardiopulmonary rehabilitation in the preoperative period plays an essential preventive role against ventilatory dysfunctions after surgery, favoring both the reduction of prolonged mechanical ventilation needs and promoting early weaning. These findings support the idea that prior physical conditioning provides greater clinical stability in the post-surgical period.

However, it is worth noting that Scheel et al. (10) identified that the positive results of prehabilitation can vary considerably, especially depending on patient adherence to the program. Patients who demonstrated lower engagement had less satisfactory results regarding complication reduction, which points to the relevance of motivational factors and educational support in therapeutic success.

In line with this, López-Hernández et al. (11) argue that the personalization of kinesitherapy protocols is a determining factor for the success of treatment. According to the authors, when the therapeutic plan is individualized, respecting each patient's clinical conditions and functional limitations, there is an increase in the effectiveness of the intervention and a consistent reduction in negative outcomes in the postoperative period. Furthermore, they highlight that the early introduction of kinesitherapy in the preoperative care routine for cardiac surgeries is associated with a significant decrease in morbidity and mortality rates, especially in individuals who already have impaired lung function before the procedure, reinforcing the importance of this practice in hospital routine.

Regarding ventilatory and gasometric parameters, the analyzed studies show that preoperative kinesitherapy provides a significant improvement in oxygen consumption (VO_2), which tends to increase due to the improvement in cardiorespiratory efficiency and physical conditioning acquired, favoring greater functional capacity in the postoperative period (8,11). The literature also indicates an improvement in peripheral oxygen saturation (SpO_2), since prior respiratory and aerobic training optimizes ventilation-perfusion, reducing transient hypoxemias frequently observed in the postoperative period of cardiac surgeries (11). Regarding minute ventilation (VE), there are indications that patients undergoing kinesitherapy have greater capacity for voluntary ventilation and greater minute volume in the immediate postoperative period, a fact that contributes to the prevention of pulmonary complications and facilitates early ventilatory weaning (7; 12). Additionally, there is an improvement in the alveolar-arterial oxygen gradient and a reduction in arterial carbon dioxide levels ($PaCO_2$), denoting greater ventilatory efficiency in these patients (10). These findings reinforce that the introduction of kinesitherapy in the preoperative period positively influences ventilatory and gasometric variables, effectively modulating the physiological

profile of patients in the postoperative period and contributing to clinical stability, early recovery, and reduction of respiratory complications during hospitalization (13, 11).

Given these evidences, it is clear that the benefits of preoperative kinesitherapy are not limited to the immediate physiological sphere, but also have an impact on the patient's overall functional recovery and early reintegration into daily activities. This finding reinforces the value of physical therapy as a preventive and strategic intervention in the context of cardiac surgery (12). In addition to physical gains, as pointed out by Seo et al. (13), preoperative kinesitherapy significantly contributes to psychological well-being, reducing anxiety and increasing patients' self-confidence regarding the surgical process, factors that, in turn, favor a smoother recovery and greater adherence to treatment.

In the same vein, López-Hernández et al. (11) observed that global muscle strengthening associated with respiratory kinesitherapy, when started in the preoperative period, resulted in relevant hemodynamic improvements in the postoperative period, as well as a lower rate of respiratory infections and reduced hospital stay. Corroborating this perspective, Scheel et al. (10) reinforce that the early implementation of physical therapy programs decisively assists in preserving lung capacity and maintaining respiratory muscle strength, reducing the risk of pulmonary complications in the postoperative period.

Furthermore, Zhang et al. (9) demonstrated that combined programs of aerobic exercises and respiratory training in the preoperative period contribute not only to improving cardiorespiratory function. Additionally, López-Hernández et al. (11) point out that, in addition to positively impacting functional recovery, the systematic practice of kinesitherapy in the preoperative period favors the modulation of the immune and inflammatory response, reducing the risk of clinical complications in the postoperative period, which reinforces its applicability as a complementary resource to conventional medical therapy.

Given the critical analysis of the included articles, it is possible to affirm that preoperative kinesitherapy is a strategy of high clinical value, contributing to the reduction of complications, improvement of functional recovery, and reduction of hospital costs, in addition to reaffirming the role of the physical therapist in the interdisciplinary team that cares for surgical patients.

5. Final Considerations

It was evident that patients undergoing cardiopulmonary physical therapy during the preoperative period of cardiac surgery showed a significant decrease in aerobic effort during exercises and training, reduction in the number of post-surgical complications, and dependence on mechanical ventilation during breathing. Furthermore, studies prove the effectiveness in reducing the length of hospital stay in the postoperative period, favoring the patient's return to daily activities and, consequently, a rapid return of cardiac and muscle functionality. Thus, it is worth mentioning that this integrative review had limitations, such as the heterogeneity of the protocols adopted in the included studies, as well as the limitation in the number of randomized clinical trials with large samples, which restricts the standardization of physiotherapeutic practices. These aspects signal the need for new controlled studies that can validate, with greater methodological rigor, the benefits of physical therapy in the preoperative period of cardiac surgeries, identifying contraindications that may be encountered in the dissemination of this method on a global scale.

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