

Cardiopulmonary Physiotherapy in Patients Undergoing Cardiac Surgery: Advances, Challenges, and Outcomes

Meghana Rao¹, Arnav Khanna²

ABSTRACT

Cardiac surgery, including coronary artery bypass grafting and valve procedures, is life-saving but associated with significant postoperative pulmonary complications, reduced functional capacity and prolonged recovery. Cardiopulmonary physiotherapy is an integral component of perioperative care aimed at preventing complications and restoring function. This review synthesises current evidence on cardiopulmonary physiotherapy in patients undergoing cardiac surgery, examining its advances, challenges and outcomes across the perioperative continuum. It considers preoperative interventions, including inspiratory muscle training and education, early postoperative care in intensive and ward settings, and structured cardiac rehabilitation. The literature indicates that cardiopulmonary physiotherapy, particularly preoperative inspiratory muscle training and early mobilisation, reduces postoperative pulmonary complications, shortens hospital stay and improves functional capacity. Advances include the evolution of sternal-precaution guidance and the integration of structured early-mobilisation protocols, while challenges include haemodynamic instability, variability in practice and limited high-quality evidence for some interventions. This review concludes that cardiopulmonary physiotherapy is a valuable, evidence-supported component of cardiac-surgical care, and highlights the need for standardisation and further research to optimise its delivery.

KEYWORDS: *Cardiopulmonary Physiotherapy, Cardiac Surgery, Inspiratory Muscle Training, Early Mobilisation, Pulmonary Complications, Cardiac Rehabilitation, Sternal Precautions, Functional Capacity*

INTRODUCTION

Cardiac surgery, encompassing coronary artery bypass grafting, valve repair and replacement and other procedures, is among the most commonly performed major operations and provides substantial benefit for patients with cardiovascular disease [1]. However, cardiac surgery is associated with significant postoperative challenges, including postoperative pulmonary complications, reduced functional capacity, prolonged immobility and slow recovery, which can affect outcomes and prolong hospital stay [1], [2]. Cardiopulmonary physiotherapy is a core component of perioperative care directed at preventing these complications and restoring function.

The rationale for cardiopulmonary physiotherapy after cardiac surgery is grounded in the physiological effects of surgery. Median sternotomy, cardiopulmonary bypass, general anaesthesia and postoperative pain impair respiratory mechanics, reduce lung volumes and predispose to atelectasis and pulmonary complications [2], [3]. Prolonged immobility additionally contributes to deconditioning and functional decline. Physiotherapy interventions, including breathing exercises, lung-expansion techniques, inspiratory muscle training and early mobilisation, are designed to counter these effects across the perioperative period [3], [4].

Cardiopulmonary physiotherapy spans a continuum from the preoperative period, through intensive-care and ward-based postoperative care, to structured cardiac rehabilitation [4], [5]. Preoperative interventions such as inspiratory muscle training aim to improve respiratory reserve before surgery, while early postoperative physiotherapy promotes lung expansion and mobilisation, and later rehabilitation restores functional and exercise capacity. The field has seen advances in practice, including the evolution of sternal-precaution guidance and structured early-mobilisation protocols, alongside continuing challenges.

The clinical importance of these complications, and of the interventions that address them, is heightened by the profile of contemporary cardiac-surgical patients, who are frequently older and carry greater comorbidity than in previous eras [1], [2]. Such patients are at elevated risk of postoperative pulmonary complications and slow functional recovery, making effective physiotherapy across the perioperative period especially valuable. This context has driven both the expansion of physiotherapy roles and the search for more effective, evidence-based

protocols.

The problem addressed in this review is the need to synthesise current evidence on cardiopulmonary physiotherapy in cardiac surgery, encompassing its advances, challenges and outcomes. Accordingly, this review examines the role of cardiopulmonary physiotherapy across the perioperative continuum, evaluates the supporting evidence, and identifies the challenges and future directions relevant to optimising its delivery.

Across these phases, the physiotherapist's role has broadened from a predominantly respiratory focus toward comprehensive management of mobility, exercise capacity and functional recovery, reflecting the wider evidence on the harms of immobility and the benefits of structured activity after major surgery [4], [5]. This expansion has been accompanied by growing recognition of physiotherapy as a contributor to the core surgical outcomes of complications and length of stay, rather than as a purely supportive service.

REVIEW METHODOLOGY

This narrative review was based on a structured search of peer-reviewed literature concerning cardiopulmonary physiotherapy in cardiac surgery. Databases were searched using terms relating to cardiac surgery, physiotherapy, inspiratory muscle training, breathing exercises, early mobilisation, postoperative pulmonary complications and cardiac rehabilitation. Systematic reviews, meta-analyses, randomised controlled trials and relevant guidelines were prioritised, and findings were organised across the perioperative continuum from preoperative to rehabilitation phases. The phases of cardiopulmonary physiotherapy are illustrated in Figure 1, and the principal interventions are summarised in Table 1.

Throughout the synthesis, attention was paid to the strength and consistency of evidence for each intervention and to the outcomes most relevant to patients and services, namely postoperative pulmonary complications, length of stay and functional capacity. Areas of practice variation, particularly sternal precautions and early-mobilisation criteria, were examined as themes in their own right, reflecting their clinical importance and the ongoing evolution of guidance.

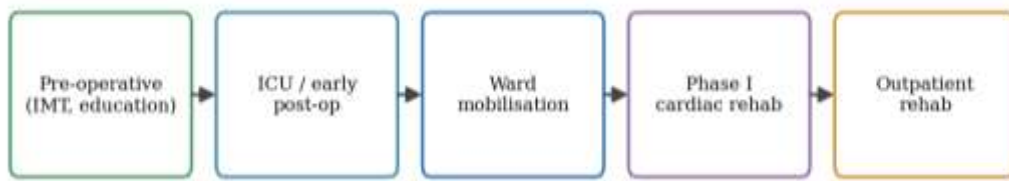


Figure 1: The continuum of cardiopulmonary physiotherapy across the perioperative period

Table 1: Phases and interventions of cardiopulmonary physiotherapy.

Phase	Principal interventions
Preoperative	Inspiratory muscle training, education, optimisation
ICU / early post-op	Breathing exercises, lung expansion, early movement
Ward	Progressive mobilisation, secretion clearance
Phase I cardiac rehab	Graded activity, functional restoration
Outpatient	Structured exercise-based cardiac rehabilitation

ADVANCES, CHALLENGES AND OUTCOMES

Preoperative Physiotherapy

The interventions discussed below are organised across the perioperative continuum, but in practice they are interdependent, each phase building on the last. Considering them together highlights both their individual contributions and the value of coordinated delivery.

Preoperative physiotherapy, particularly inspiratory muscle training, has emerged as an important advance. By strengthening the respiratory muscles before surgery, inspiratory muscle training improves respiratory reserve and has been shown in trials and meta-analyses to reduce postoperative pulmonary complications and shorten hospital stay after cardiac surgery [3], [4]. Preoperative education and optimisation further prepare patients for the postoperative period. These interventions exemplify the shift toward proactive, prehabilitation-based approaches.

The mechanism by which preoperative training confers benefit is now reasonably well understood. Strengthening the inspiratory muscles increases their endurance and capacity, partially offsetting the postoperative fall in lung volumes and the diaphragmatic dysfunction that follow sternotomy and bypass [3], [4]. Patients entering surgery with greater respiratory reserve are better able to maintain effective ventilation and cough postoperatively, reducing the likelihood of atelectasis and infection. This prehabilitation logic, well established in other surgical fields, is increasingly applied to cardiac surgery with encouraging results.

Early Postoperative Care

Secretion clearance is an additional priority in this phase, since impaired cough and retained secretions contribute to atelectasis and infection after cardiac surgery [2], [3]. Techniques to support effective coughing and airway clearance, combined with positioning and breathing exercises, help maintain airway patency during the vulnerable early recovery period.

In the immediate postoperative period, physiotherapy focuses on promoting lung expansion, clearing secretions and initiating early mobilisation in the intensive-care and ward settings [4], [5]. Breathing and lung-expansion techniques counter the reduced lung volumes that follow sternotomy and bypass, while early mobilisation addresses immobility and deconditioning. A key advance has been the development of structured early-mobilisation protocols, supported by evidence that early activity is safe and beneficial, accelerating recovery without compromising stability.

The safe delivery of early postoperative physiotherapy depends on careful monitoring, since patients in this period may experience haemodynamic fluctuation, arrhythmia and pain that influence their tolerance of activity [2], [5]. Skilled clinical judgement is required to progress mobilisation at a pace matched to each patient's cardiovascular stability. When delivered appropriately, early mobilisation counters the rapid deconditioning that accompanies bed rest and lays the foundation for subsequent functional recovery, and contemporary protocols increasingly specify graded, criteria-based progression.

Sternal Precautions and Their Evolution

The management of sternal precautions has been an area of notable change. Traditional restrictive precautions limited upper-limb and trunk activity to protect sternal healing, but emerging evidence and expert opinion have questioned overly restrictive approaches, favouring more individualised, activity-based guidance that balances protection with the benefits of movement [5], [6]. This evolution reflects a broader move toward enabling rather than restricting activity, although practice remains variable and consensus is still developing. The clinical importance of resolving the sternal-precaution debate is considerable, because overly restrictive precautions can impede functional recovery, delay return to daily activities and contribute to deconditioning and reduced confidence [6]. Conversely, inadequate protection risks sternal complications. The contemporary trend toward individualised, pain-guided activity progression seeks to optimise this balance, but the persistence of widely varying practice underscores the need for stronger evidence and clearer consensus guidance.

Cardiac Rehabilitation and Functional Outcomes

Importantly, hospital-based phase I rehabilitation serves as a bridge to outpatient programmes, and the transition between them is a recognised point of attrition where many patients are lost to follow-up [1], [5]. Ensuring continuity from inpatient mobilisation to structured outpatient cardiac rehabilitation is therefore essential if the long-term cardiovascular and functional benefits of rehabilitation are to be realised.

Exercise-based cardiac rehabilitation is among the most strongly evidenced interventions in cardiovascular care, with established benefits for functional capacity, quality of life and secondary prevention [1]. Its inclusion within the physiotherapy continuum means that the same discipline contributes both to immediate postoperative recovery and to long-term cardiovascular health.

Beyond the acute period, structured cardiac rehabilitation restores functional and exercise capacity and supports long-term cardiovascular health [1], [5]. Phase I rehabilitation begins in hospital with graded activity, progressing to outpatient exercise-based programmes that improve functional capacity, quality of life and secondary prevention. The reported benefits of

cardiopulmonary physiotherapy across pulmonary, length-of-stay and functional outcomes are summarised in Figure 2 and Table 2.

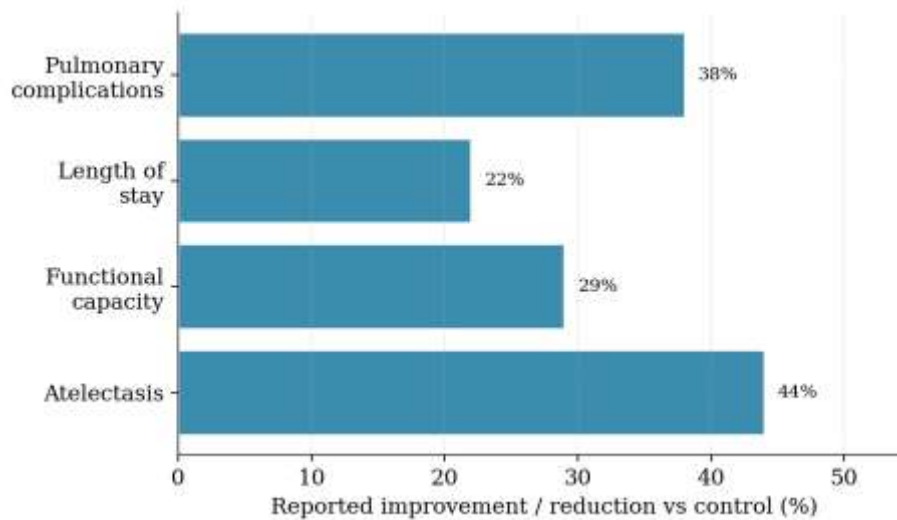


Figure 2: Reported improvements associated with cardiopulmonary physiotherapy after cardiac surgery

The pattern of reported benefits, with the largest effects on atelectasis and pulmonary complications, is consistent with the respiratory focus of much cardiopulmonary physiotherapy and with the physiological vulnerability of the lungs after sternotomy and bypass [2], [3]. Improvements in functional capacity and modest reductions in length of stay follow from the combination of preserved respiratory function and earlier mobilisation.

Table 2: Summary of evidence for cardiopulmonary physiotherapy interventions.

Intervention	Evidence level	Main reported benefit
Preoperative IMT	Strong	Reduced pulmonary complications
Early mobilisation	Strong	Faster recovery, shorter stay
Breathing / lung expansion	Moderate	Reduced atelectasis
Cardiac rehabilitation	Strong	Improved functional capacity

DISCUSSION

The evidence reviewed indicates that cardiopulmonary physiotherapy is a valuable and evidence-supported component of cardiac-surgical care, with benefits spanning the perioperative continuum. The strongest evidence supports preoperative inspiratory muscle training and early mobilisation, both of which reduce postoperative pulmonary complications and accelerate recovery, and structured cardiac rehabilitation, which restores functional capacity and supports long-term health [3], [4], [5]. The overall effect is a reduction in complications, hospital stay and functional decline.

Several advances characterise the contemporary field. The adoption of preoperative inspiratory muscle training reflects a proactive, prehabilitation-based approach that prepares patients before surgery rather than only treating complications afterward [3], [4]. The development of structured early-mobilisation protocols has formalised and strengthened a key intervention, and the evolution of sternal-precaution guidance toward more individualised, activity-enabling approaches represents an important shift away from unnecessarily restrictive practice [5], [6]. These advances collectively enhance both the safety and the effectiveness of postoperative physiotherapy.

Important challenges remain. Haemodynamic instability, arrhythmia and other postoperative complications can limit the early delivery of physiotherapy and require careful, individualised judgement. Practice varies considerably between centres, particularly regarding sternal precautions and mobilisation protocols, reflecting both evolving evidence and institutional tradition. The evidence base, while strong for some interventions such as inspiratory muscle training and early mobilisation, is more limited for others, and heterogeneity in interventions and outcomes complicates comparison [4], [5]. Addressing these challenges through standardisation and high-quality research is essential.

A further consideration is the continuity of care across the perioperative phases. The benefits of preoperative conditioning are most fully realised when followed by effective early postoperative physiotherapy and structured rehabilitation, so that gains are consolidated rather than lost [4], [5]. Fragmentation between these phases, for example when prehabilitation is not linked to postoperative follow-through, may dilute the overall benefit. An integrated pathway

spanning prehabilitation, acute care and rehabilitation is therefore likely to be more effective than any single component in isolation.

The clinical significance of cardiopulmonary physiotherapy lies in its capacity to reduce the substantial burden of postoperative complications and functional decline after cardiac surgery using interventions that are largely low-cost and widely applicable. The integration of physiotherapy across the perioperative continuum, from prehabilitation to rehabilitation, supports comprehensive, patient-centred care. Realising its full potential requires standardised, evidence-based protocols and the resolution of areas of practice variation.

Finally, the heterogeneity of cardiac-surgical patients argues for individualised rather than uniform application of physiotherapy. The intensity and timing of interventions should reflect each patient's preoperative status, comorbidity and postoperative course, with prehabilitation targeted particularly at higher-risk patients who stand to gain most [3], [4]. Tailoring care in this way is likely to improve both efficiency and outcomes, and represents a sensible direction as the field moves toward more personalised perioperative rehabilitation.

LIMITATIONS

This review has several limitations. As a narrative review rather than a systematic review with meta-analysis, it is subject to selection bias and does not provide pooled quantitative estimates. The evidence base varies in quality across interventions, being robust for some, such as inspiratory muscle training and early mobilisation, and more limited for others, and heterogeneity in patient populations, surgical procedures, interventions and outcome measures limits direct comparison. The rapidly evolving nature of some areas, particularly sternal-precaution guidance, means that conclusions may change as new evidence emerges, and the review emphasises widely studied interventions.

FUTURE SCOPE

Future research should prioritise high-quality randomised controlled trials and the standardisation of cardiopulmonary physiotherapy protocols across the perioperative continuum, particularly for areas of practice variation such as sternal precautions and early-mobilisation criteria. Studies establishing evidence-based, individualised sternal-precaution

guidance would address an important gap and reduce unnecessary activity restriction. Research into optimising preoperative prehabilitation, including the ideal content and timing of inspiratory muscle training, and into strategies for safely advancing early mobilisation in haemodynamically complex patients, would further enhance care. Evaluation of long-term functional and quality-of-life outcomes, and of the integration of technology and tele-rehabilitation, offers promising directions for advancing the field.

CONCLUSION

Taken together, the literature supports a model in which physiotherapy begins before surgery, continues safely through the acute postoperative phase and extends into structured rehabilitation, with each phase reinforcing the others [3], [5].

Cardiopulmonary physiotherapy is an integral and evidence-supported component of care for patients undergoing cardiac surgery, with benefits across the perioperative continuum. Preoperative inspiratory muscle training and early mobilisation reduce postoperative pulmonary complications and accelerate recovery, while structured cardiac rehabilitation restores functional capacity and supports long-term health. Advances including prehabilitation, structured early-mobilisation protocols and the evolution of sternal-precaution guidance have strengthened the field, although challenges relating to haemodynamic stability, practice variation and uneven evidence persist. Standardisation of protocols and further high-quality research are needed to optimise the delivery of cardiopulmonary physiotherapy and to maximise its benefits for patients undergoing cardiac surgery.

REFERENCES

1. Anderson L, Thompson DR, Oldridge N, et al. Exercise-based cardiac rehabilitation for coronary heart disease. Cochrane Database of Systematic Reviews. 2016;(1):CD001800.
2. Wynne R, Botti M. Postoperative pulmonary dysfunction in adults after cardiac surgery with cardiopulmonary bypass. American Journal of Critical Care. 2004;13(5):384-393.
3. Hulzebos EH, Smit Y, Helders PP, van Meeteren NL. Preoperative physical therapy for elective cardiac surgery patients. Cochrane Database of Systematic Reviews. 2012;(11):CD010118.

4. Katsura M, Kuriyama A, Takeshima T, et al. Preoperative inspiratory muscle training for postoperative pulmonary complications. Cochrane Database of Systematic Reviews. 2015;(10):CD010356.
5. Cordeiro ALL, de Melo TA, Neves D, et al. Inspiratory muscle training and functional capacity following cardiac surgery. Brazilian Journal of Cardiovascular Surgery. 2016;31(2):140-144.
6. Katijjahbe MA, Granger CL, Denehy L, et al. Standard restrictive sternal precautions and modified sternal precautions after cardiac surgery: a randomised trial. Journal of Physiotherapy. 2018;64(2):97-106.

***Author for Correspondence**

Dr. Meghana Rao

E-mail: rao.meghana218@yahoo.com

¹Associate Professor, Department of Cardiopulmonary Physiotherapy, SGT University

²PG Scholar, Department of Cardiopulmonary Physiotherapy, SGT University

Received Date: February 11, 2026

Accepted Date: February 23 2026

Published Date: March 21, 2026

Citation: Dr. Meghana Rao, Arnav Khanna. Cardiopulmonary Physiotherapy in Patients Undergoing Cardiac Surgery: Advances, Challenges, and Outcomes. Journal of Physiotherapy in Medical and Surgical Conditions. 2026; 2(1): 23-33p.