*Physiotherapy Research International*

WILEY

RESEARCH ARTICLE

# Thoracic-Abdominal Rebalancing Method is Superior in Terms of Decreasing Respiratory Distress, Postoperative Pulmonary Complications and Hemodynamic Variables When Compared to Conventional Physiotherapy in Postoperative Patients of Coronary Artery Bypass Grafting Surgery: Randomized Clinical Trial

Karolini Reis Branco[1] | Fernanda dos Santos Silveira[2] | Letícia Ferronato[3] | Simone Cristina Jabuonski[4] | Vinícius Serra Peringer[5] | Mariangela Pinheiro de Lima[6] | João Paulo Heinzmann-Filho[7] | Bruna Eibel[5]

[1]Master's Student in the Graduate Program in Health Sciences: Cardiology, Institute of Cardiology of Rio Grande Do Sul (IC/FUC), Porto Alegre, Brazil | [2]Neonatologist and Pediatric Physiotherapist, Preceptor in Neurofunctional Rehabilitation and Aquatic Physiotherapy at the Lutheran University of Brazil in Canoas, Canoas, Brazil | [3]Physiotherapist Master in Rehabilitation Sciences: Federal University of Santa Catarina (PPGCR/UFSC), Florianópolis, Brazil | [4]Physiotherapist Specialist in Intensive Care: Brazilian Association of Cardiorespiratory Physiotherapy and Intensive Care (ASSOBRAFIR), Porto Alegre, Brazil | [5]Physical Therapist Coordinator of the Multiprofessional and Integrated Residency Program in Health: Cardiology at the Institute of Cardiology of Rio Grande do Sul (IC/FUC), Porto Alegre, Brazil | [6]Physiotherapist Creator of the Thoraco-abdominal Rebalancing Method and Founder of the Brazilian School of RTA and Respiratory Biomechanics, Florianópolis, Brazil | [7]Teaching Physiotherapist at Centro Universitário Cenecista de Osório (UNICNEC), Osório, Brazil

**Correspondence:** Karolini Reis Branco (karolinireis@hotmail.com) | Bruna Eibel (brunaeibel@gmail.com)

**Received:** 28 March 2024 | **Revised:** 30 September 2024 | **Accepted:** 9 March 2025

**Funding:** The authors received no specific funding for this work.

**Keywords:** cardiology | physiotherapy | thoracic-abdominal rebalancing

## ABSTRACT

**Background and Purpose:** TAR method recommends reorganizing ventilatory muscle synergism, reducing respiratory effort, removing secretions from the lungs and upper airways, in addition to promoting diaphragmatic juxtaposition and increasing respiratory muscle strength and adjusting muscle tone. However, there are few scientific publications on this method in cardiac patients CABG. To evaluate the effects of the TAR method on hemodynamic variables, respiratory distress and pulmonary complications in patients after CABG surgery.

**Methods:** This is a single-blind, randomized, clinical trial. Adults (> 35 years old), hemodynamically stable, who had undergone CABG (< 24 h) and with a prescription for physiotherapy were included. Patients were randomized into two groups: IG - TAR; CG—standard physiotherapeutic approach. Interventions were carried out in two days (twice/day), totaling 04 sessions. The following parameters were evaluated pre- and post-intervention: HR, RR, SpO2, MAP, respiratory distress scale. The pulmonary complications scale was applied at the end of the interventions. The sample consisted of 58 patients, 30 in the CG and 28 in the IG. Results: There was no significant difference ($p < 0.05$) in sample characteristics, clinical and perioperative data between groups. There was a significant increase ($p < 0.05$) in RR and MAP after the intervention in CG and IG. Only in GI there was a significant reduction in the respiratory distress score ($p = 0.001$). Furthermore, there was a lower score ($p < 0.0001$) on the scale of pulmonary complications at the end of the interventions in the IG group, compared to the CG.

**Discussion:** The TAR method reduced respiratory distress and pulmonary complications in patients after CABG surgery. Given our findings, it becomes feasible to aim for the applicability of the method in other populations, expanding it to other elective or non-elective surgical conditions, in oncology, traumatology, and neurology, making the recovery process more effective. Keywords: Physiotherapy; Cardiology; Thoracic-abdominal rebalancing.
**Trial Registration:** NTC 04631198

## 1 | Introduction

In recent years, there have been several technological and surgical advances in the diagnosis and treatment of cardiovascular diseases (CVD). As a result, there was a significant reduction in mortality and, consequently, an increase in the survival of these patients (Benseñor 2020). According to estimates from the Global Burden of Disease Study, in 2015, the standardized mortality rate for CVD fell from 429.5 to 256.0 per 100.000 inhabitants, a decrease of 40.4% when compared to the previous year. Year 1990 (Brant et al. 2017).

Coronary artery bypass grafting (CABG) is one of the most frequent interventions in the treatment of heart diseases worldwide (Soares et al. 2017). This procedure consists of restoring cardiac flow by reconstructing the coronary arteries and is indicated for patients with narrowing or blockages of the arteries that supply the heart (Soares et al. 2017). CABG aims to promote the relief of anginal symptoms, such as dyspnea, fatigue, and chest pain, impacting the quality of life of these subjects (Correia et al. 2020).

Despite this, respiratory complications tend to occur frequently in the postoperative period of this surgery, since anesthesia is one of the factors that can impair lung ventilation and perfusion due to the global decrease in muscle tone, especially the hypotonia of the abdominal muscles, which contributes to a decrease in total lung capacity by up to 20% (Abreu et al. 2022). This may favor the development of atelectasis, pneumonia, pleural effusion, among others (Abreu et al. 2022). In addition, there is a change in the thoracic -abdominal mechanics of these patients, causing a reduction in the use of diaphragmatic muscles and, consequently, an increase in the use of accessory muscles, thus resulting in a ventilatory pattern often considered uncomfortable for these patients. Individuals due to the cut in the thoracic region (Mathis et al. 2019).

In this sense, physiotherapy is an integral part of patient care after CABG (Almeida et al. 2020). Physiotherapy has the main objective of reducing pulmonary complications, in addition to performing bronchial hygiene and aiming at early cardiopulmonary and motor rehabilitation (Almeida et al. 2020). With this, it aims for the individual to return to their activities of daily living and independence as quickly as possible, thus reducing the length of hospital stay (Almeida et al. 2020).

Previous studies report that physiotherapy in the postoperative period of CABG implies an improvement in quality of life, increase in lung volumes and capacities, muscle strength and independence (Zanini et al. 2019). Among the interventions used, we can list the techniques of lung re-expansion, diaphragmatic stimulation, orthostatism and walking, characterized as early mobilization (Francisco et al. 2020).

Thoracoabdominal synchrony may be suitable alternatives for the treatment of these patients, given the cardiorespiratory implications involved (Vitti et al. 2020). Thus, the thoracic-abdominal rebalancing (TAR) method is a global manual physiotherapy method that aims to encourage pulmonary ventilation and promote the removal of pulmonary secretions and upper airways through the reorganization of ventilatory muscle synergism, which is lost in the presence of respiratory disorders (Vitti et al. 2020). This reorganization, at rest and during functional activities, enables the reduction of respiratory muscle effort, improves pulmonary ventilation, and optimizes functional activities, in addition to increasing respiratory muscle strength and adjusting muscle tone (Oliveira et al. 2018). However, so far, there are still few scientific publications on the method in cardiac patients undergoing CABG, justifying this work. Thus, the objective of the study was to evaluate the effects of the TAR method on hemodynamic variables, respiratory distress, and pulmonary complications in patients in the postoperative period of CABG.

## 2 | Methods

This is a clinical trial, randomized, with blinding of the evaluator. This study complies with the recommendations of *Consort Statement* (Campbell et al. 2004) and has been registered with *Clinical Trials*.

Patients (> 35 years old), male or female, who underwent CABG, had already been extubated and had been prescribed physiotherapy treatment were included. All were hemodynamically healthy, ventilated in room air or with the aid of a nasal catheter, and confined to bed in the supine position. On the other hand, individuals who were intubated and/or who underwent mechanical ventilation for more than 12 h or who required noninvasive mechanical ventilation (NIV) before or during the collection period were excluded. In addition, individuals with suspected or confirmed COVID-19 and who required surgical reintervention were excluded. This work was carried out at the Instituto de Cardiologia do Rio Grande Sul, from July to October 2020. The study was approved by the Ethics and Research Committee of the Fundação Universitária de Cardiologia. All participating individuals and/or family members signed the Informed Consent Form (ICF), in compliance with Resolution 466/12 of the National Health Council (NHC).

After checking the eligibility criteria and consent, the individuals were randomized using a computer program (www.random.org),

containing the coded distribution. Allocation secrecy was ensured by a randomization list that remained in a remote location, preventing the researcher from identifying which intervention was indicated for each patient. The generation of the sequence of numbers was performed by a researcher blinded to the study. The randomization of the subjects in the proposed groups was carried out in two blocks, in which each new participant was randomly assigned to one of the blocks (control group [CG] or intervention group [IG]).

The CG consisted of the standard physiotherapeutic treatment of the hospital service (conventional physiotherapy), performed by 05 collaborating professionals. These were submitted to vibrocompression techniques (VCP), passive manual expiratory therapy (PMET), acceleration of expiratory flow (AEF), slow and prolonged expiration (SPE), fractional inspiration in times, diaphragmatic breathing (Ike et al. 2017). Not all patients in this group necessarily received all the techniques mentioned above. These were chosen according to the needs of each patient, with the intervention lasting approximately 20 min.

The IG consisted of the TAR method, performed by 2 trained and qualified professionals, using some of the following techniques: lower abdominal support, iliocostalis space support, inhaling help, thoracic swing desimpaction joint, relaxation and lengthening of the shoulder girdle muscles and relaxation and lengthening of the pectoralis and deltoid muscles. These were chosen according to the needs of each patient, with the intervention lasting approximately 20 min.

In both groups above, motor exercises were jointly performed, including knee flexion and extension, 80° shoulder flexion and ankle plantar flexion. Also, from 24 h after surgery, sitting at the edge of the bed and orthostasis were performed in both study groups (Freitas et al. 2020). Supporting Information Table S1 shows the number of techniques used in each group, aiming to facilitate the interventions chosen by the professionals.

The evaluations were performed by a blind evaluator over 2 days, the first at time zero (inclusion in the study), the second immediately after the intervention (collection of variables) and the last after 2 days (end of the disciplines, for applicability of the complications scale). A total of four consultations were performed in both groups. The following outcomes were collected: heart rate (HR), respiratory rate (RR), peripheral oxygen saturation ($SpO_2$), mean arterial pressure (MAP), *Downes* and *Raphaelly* (Cordeiro et al. 2003) Respiratory Distress Scale. The Scale of Risk Pulmonary Complications in Postoperative CABG Patients (HulzeboS et al. 2003) was evaluated only after the fourth consultation in both groups.

The calculation of the sample size was based on the main outcome of the study, that is, on the score of the Scale of Pulmonary Complications at Risk in Postoperative CABG Patients (Hulzebos et al. 2003), considering the results of the first 20 patients included in this research. Thus, using the results of the CG ($1.50 \pm 0.66$) and IG ($1.11 \pm 0.55$), seeking to detect a minimum difference of 0.5 points, with a power of 80% (i $\beta$) and assuming a significance level of 5% ($\alpha = 0.05$), a sample size of 29 participants per group was estimated.

The normality of quantitative variables was assessed using the *Komolgorovic -Smirnov test*. Quantitative data were expressed as mean and standard deviation or as median and interquartile range, depending on symmetry. Comparison of quantitative (parametric) data between groups was performed using *Student 's T Test* for independent and paired samples, in addition to the one-way ANOVA test (*Bonferroni post-test*). Non-parametric measures were evaluated using the *Man Whitney* and *Wilcoxon U test*, as well as the *Kruskal-Walli's test* (*Dunn's* post-test). Finally, categorical data were analyzed using *Pearson* 's chi-square test. All analyzes and data processing were performed using the SPSS 18.0 program. The adopted significance level was 5% ($p < 0.05$).

## 3 | Results

Out of a total of 68 (100.00%) eligible participants, 10 (14.70%) of them were excluded based on the eligibility criteria. Thus, the sample consisted of 58 patients, of which 30 were in the CG and 28 in the IG. Figures 1 and 2 demonstrates the selection flowchart and the exclusion reasons. The average age of the participants was around 63.70 years in the CG and 62.75 in the IG, with a predominance of males. Of these, one third were smokers or ex-smokers and more than 80.0% of them had systemic arterial hypertension (SAH). In addition, approximately 50% of patients had acute myocardial infarction (AMI). No significant differences were found when comparing sample and clinical characteristics between CG and IG (Table 1).

The average ejection fraction (%) of the individuals was close to 60.0% in both groups, as well as the duration of surgery and cardiopulmonary bypass around 300 min. There were few intercurrences in the immediate postoperative period in these patients. These included atrial fibrillation with high ventricular response, post-pump shock, increased bleeding and complete atrioventricular block. No statistical differences were found in perioperative data between groups (Table 2).

The means of the hemodynamic parameters (HR, RR, $SpO_2$ and MAP) were stable and within the lower limits of normality. Furthermore, the respiratory distress scale maintained a score of 2.0 points in the evaluated groups. There were no differences ($p > 0.05$) in these analyzes between the groups at the beginning of the study (Table 3).

Comparisons of hemodynamic outcomes and respiratory distress scale before and after the end of the intervention in each group are shown in Table 4. Both CG and IG had significant increases in RR and MAP at the end of interventions. Only in IG there was a significant reduction ($p = 0.001$) in the respiratory distress score.

Figure 1 shows the multiple comparison of HR, RR, $SpO_2$, MAP and respiratory distress and respiratory complication scores between the evaluated groups. Again, there were significant differences in RR (baseline CG versus post CG; baseline IG versus post IG), MAP (baseline CG versus post CG; baseline IG versus post IG) and respiratory distress scale (baseline IG versus post IG). Furthermore, there were lower scores ($p < 0.0001$) on

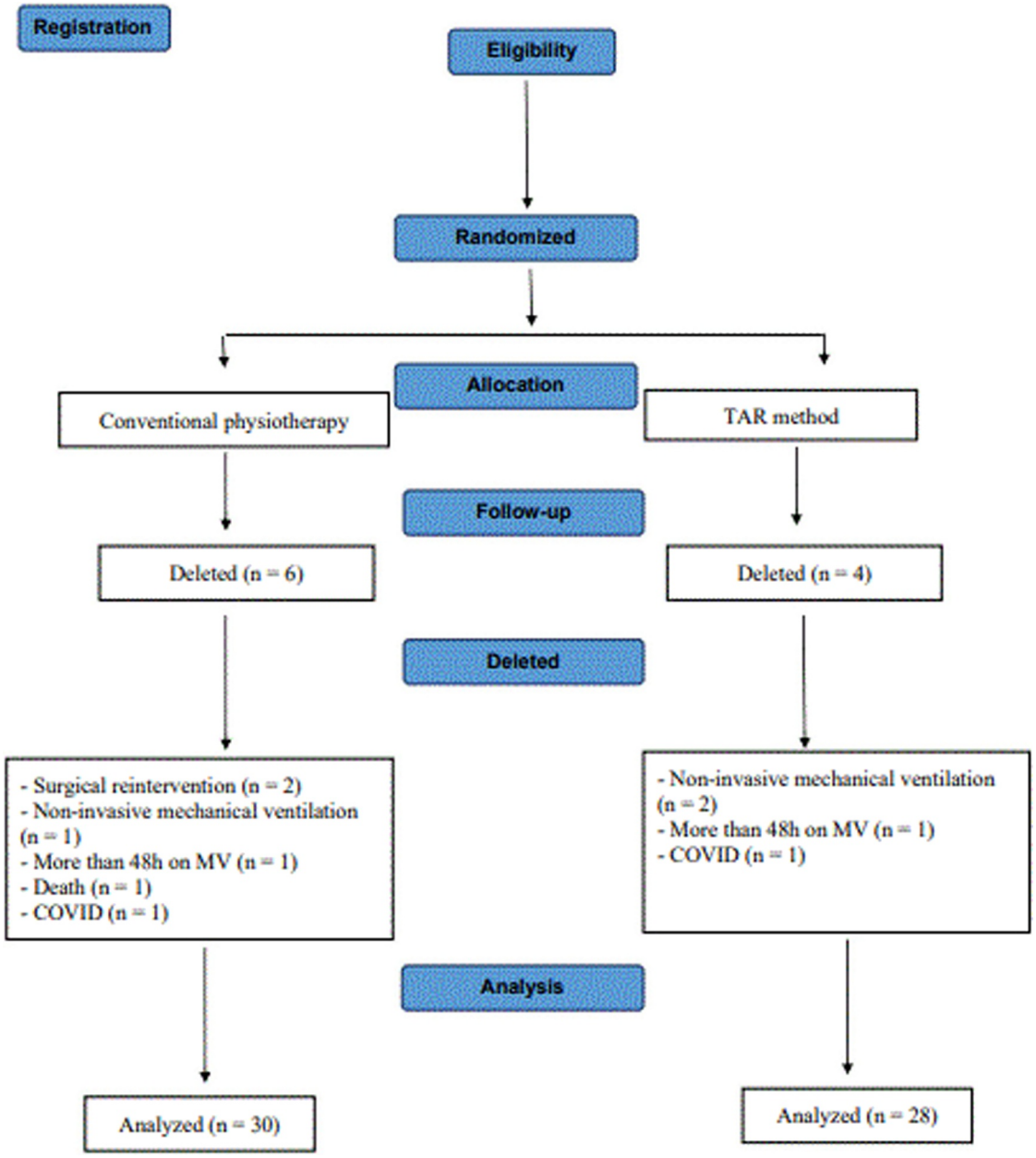


**FIGURE 1** | Flowchart of the consort (Campbell et al. 2004) study.

the scale of pulmonary complications at the end of the interventions in the IG group, compared to the CG.

## 4 | Discussion

To the best of our knowledge, this is the first clinical trial that evaluated the effects of the TAR method on hemodynamic variables, respiratory distress, and pulmonary complications in patients after CABG surgery. Our findings showed a reduction in the scale of respiratory distress and pulmonary complications in the group submitted to the TAR. The *Downes* and *Raphaely* ventilatory discomfort scale was created in 2003 and used to assess patients with signs of respiratory distress after tracheal intubation, comparing with endoscopy (Cordeiro et al. 2003). In recent years, it has been used in several clinical conditions, including tracheal injury, bronchiolitis, extubation protocols and education of newborn health professionals (Ferguson et al. 2017; Caballero et al. 2001; Rodríguez et al. 2002; Carvalho 2012). The scale assesses inspiratory sounds, coughing, hoarse or barking voice, nose retractions and/or flaring (NR) and the presence of cyanosis (Cordeiro et al. 2003). Each item scores between zero and two, totaling up to 10 points, with higher values indicating greater respiratory distress (Cordeiro et al. 2003). In the present study, both groups obtained a median of 2.0 points, indicating little initial ventilatory impairment in the samples. Even so, there was a reduction in this short-term outcome only in IG. So far, there are no studies that use this scale in the evaluation of the postoperative period of CABG, which makes it difficult to interpret these findings. TAR handling, as it is considered gentler, without compressing or vibrating the thorax of individuals, mainly because it generates a slower reorganization of the synchrony between the thorax and

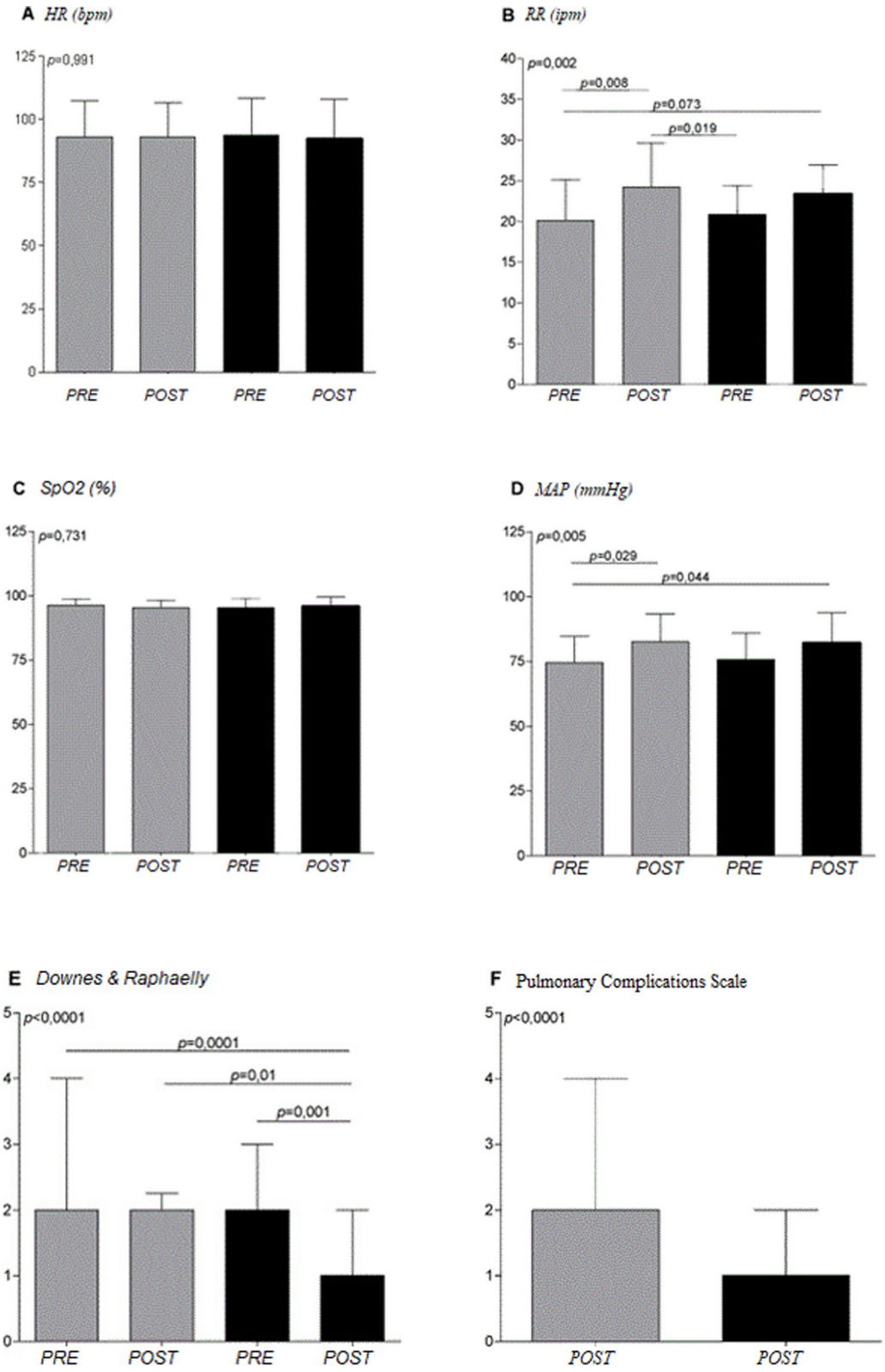


**FIGURE 2** | Comparison of HR (A), RR (B), $SpO_2$ (C), MAP (D) [mean ± SD] and respiratory distress score (E) and respiratory complication (F) [median and interquartile range] among the evaluated groups. Extra data: Pulmonary complications scale [post CG: 2.0 (2.0–4.0) versus post IG: 1.0 (0.25–2.0)].

abdomen of these patients (Ruppenthal et al. 2011; Ajambuja et al. 2012), may be one of the reasons for the decrease of the score of this score in the IG.

Hulzebos et al. (Hulzebos et al. 2003) built a tool that assesses postoperative pulmonary complications using a score ranging from zero (no complications) to four (severe complications)

**TABLE 1** | Comparison of sample and clinical characteristics between the control group (CG) and the intervention group (IG) at the beginning of the study.

| Evaluated variables | CG ($n = 30$) | IG ($n = 28$) | $p$ |
|---|---|---|---|
| Demographic characteristics | | | |
| Age (years), mean ± SD | 63.70 ± 8.40 | 62.75 ± 13.30 | 0.749 |
| Female gender, *n* (%) | 06 (20.0) | 05 (17.9) | 0.891 |
| Male gender, *n* (%) | 24 (80.0) | 23 (82.1) | |
| Anthropometry | | | |
| Body mass (kg), mean ± SD | 80.20 ± 11.51 | 82.00 ± 18.11 | 0.656 |
| Height (m), mean ± SD | 1.67 ± 0.06 | 1.70 ± 0.09 | 0.298 |
| BMI (absolute), mean ± SD | 28.30 ± 3.20 | 28.23 ± 5.20 | 0.949 |
| Clinical data | | | |
| Current smoking, *n* (%) | 07 (23.3) | 10 (35.7) | 0.390 |
| Former smoker, *n* (%) | 10 (33.3) | 08 (28.6) | 0.780 |
| Time (months) ex-smoker, median (IQ) | 84.0 (48.0–240.0) | 210.0 (135.0–420.0) | 0.230 |
| SAH, *n* (%) | 24 (80.0) | 24 (85.7) | 0.732 |
| DM, *n* (%) | 15 (50.0) | 08 (28.6) | 0.114 |
| Dyslipidemia, *n* (%) | 06 (20.0) | 09 (32.1) | 0.373 |
| COPD, *n* (%) | 02 (6.7) | 00 (0.0) | 0.492 |
| CHF, *n* (%) | 04 (13.3) | 00 (0.0) | 0.113 |
| AMI, *n* (%) | 13 (43.3) | 14 (50.0) | 0.793 |
| PTCA, *n* (%) | 06 (20.0) | 04 (14.3) | 0.732 |

*Note:* Extra data: NYHA [GC: Class II: 2 participants and Class III: 01 participant].
Abbreviations: AMI: acute myocardial infarction; CHF: congestive heart failure; COPD: chronic obstructive pulmonary disease; DM: diabetes Mellitus; PTCA: percutaneous transluminal coronary angioplasty; SAH: systemic arterial hypertension.

**TABLE 2** | Comparison of perioperative data between the control group (CG) and the intervention group (IG) at the beginning of the study.

| Evaluated variables | GC ($n = 30$) | IG ($n = 28$) | $p$ |
|---|---|---|---|
| Perioperative data | | | |
| Ejection fraction, mean ± sd | 55.83 ± 13.87 | 59.11 ± 8.83 | 0.291 |
| Duration of surgery (minutes), mean ± SD | 278.23 ± 38.88 | 291.39 ± 42.27 | 0.223 |
| CPB, mean ± sd | 78.00 ± 21.65 | 83.36 ± 21.17 | 0.345 |
| ACT, mean ± sd | 56.07 ± 17.57 | 58.39 ± 15.86 | 0.598 |
| MV duration (minutes), median (IQ) | 414.00 (256.50–753.00) | 427.50 (303.75–535.50) | 0.703 |
| Complications, *n* (%) | 06 (20.0) | 08 (28.6) | 0.545 |

Abbreviations: ACT: aortic clamping time; CPB: cardiopulmonary bypass; MV: mechanical ventilation.

**TABLE 3** | Comparison of hemodynamic variables and respiratory distress scale between the control group (CG) and the intervention group (IG) at the initial moment of the study.

| Evaluated variables | CG ($n = 30$) | IG ($n = 28$) | $p$ |
|---|---|---|---|
| HR (bpm), mean ± SD | 92.83 ± 14.31 | 93.50 ± 14.86 | 0.863 |
| RR, mean ± SD | 20.13 ± 4.97 | 20.86 ± 3.55 | 0.525 |
| $SpO_2$ (%), mean ± SD | 96.33 ± 2.33 | 95.39 ± 3.40 | 0.229 |
| MAP (mmhg), mean ± SD | 74.53 ± 10.08 | 75.64 ± 10.22 | 0.679 |
| *Downes* score (points), median (IQ) | 2.0 (2.0–4.0) | 2.0 (2.0–3.0) | 0.171 |

Abbreviations: HR: heart rate; MAP: mean arterial pressure; RR: respiratory rate; $SpO_2$: peripheral oxygen saturation.

**TABLE 4** | Comparison of hemodynamic variables and respiratory distress scale between the control group (CG) and the intervention group (IG).

| | CG ($n = 30$) | | | IG ($n = 28$) | | |
|---|---|---|---|---|---|---|
| **Evaluated variables** | **Pre** | **Post** | ***p*** | **Pre** | **Post** | ***p*** |
| HR (bpm), mean ± SD | 92.83 ± 14.31 | 93.03 ± 13.45 | 0.937 | 93.50 ± 14.86 | 92.39 ± 15.49 | 0.552 |
| RR (ipm), mean ± SD | 20.13 ± 4.97 | 24.20 ± 5.43 | **0.001** | 20.86 ± 3.55 | 23.39 ± 3.56 | **0.002** |
| $SpO_2$ (%), mean ± SD | 96.33 ± 2.33 | 95.33 ± 2.91 | 0.084 | 95.39 ± 3.40 | 95.86 ± 3.61 | 0.569 |
| MAP (mmHg), mean ± SD | 74.53 ± 10.08 | 82.57 ± 10.71 | **0.001** | 75.64 ± 10.22 | 82.07 ± 11.65 | **0.037** |
| *Downes* score (points), median (IQ) | 2.0 (2.0–4.0) | 2.0 (2.0–2.25) | 0.121 | 2.0 (2.0–3.0) | 1.0 (0.0–2.0) | **0.001** |

*Note:* Bold represent values that were considered significantly different between the collection times.
Abbreviations: HR: heart rate; MAP: mean arterial pressure; RR: respiratory rate; SpO2: peripheral oxygen saturation.

points. This scale evaluates cough, abnormal pulmonary findings or dyspnea, hypoxemia, body temperature and the use of mechanical ventilation, among others (Hulzebos et al. 2003). Some studies that include thoracic surgeries and, specifically CABG, use this platform to guide results based on pulmonary complications, for example, Hulzebos et al., used this tool to build a randomized clinical trial where they compared the effects of an inspiratory muscle training in the period preoperative period of CABG and evaluated whether these individuals had fewer pulmonary complications. This corroborates our findings, as there was a reduction in this domain in IG compared to CG (Hulzebos et al. 2006; Jensen et al. 2007). However, this scale was used only after the completion of the proposed interventions, which limits the analysis of the evolution of this domain.

It should be noted that no adverse events were observed in individuals who underwent conventional physiotherapy and the TAR method. This agrees with other previous studies, which also did not report adverse events with the application of this method in patients with congenital heart disease, transient tachypnea or premature newborns (Roussenq et al. 2013; Carvalho de OliveirA et al. 2017; Coelho et al. 2012). From the point of view of patient safety, its practice is recommended within physiotherapy in adults (> 35 years) undergoing CABG, hemodynamically stable and with clinical characteristics like our sample.

Although in care practice, hemodynamic variables (HR and $SpO_2$) are frequently evaluated during consultations, they may not immediately improve with the application of both conventional techniques and TAR. This fact can be attributed to the fact that the parameters directly reflect on the heart pump and rapid lung clearance/expansion, requiring more time for expressive modification (Silva et al. 2019). This differs from the scores for discomfort and respiratory complications, as they more broadly assess the interaction between other aspects involved in the cardiorespiratory system (Silva et al. 2019). This corroborates previous studies in which they reported that hemodynamic outcomes do not seem to undergo significant clinical changes after physiotherapy interventions (Silva et al. 2019; Cavalcante et al. 2018). On the other hand, after analyzing multiple comparisons, a significant increase in RR and MAP was also noticed in the CG. This can be explained, at least in part, by the fact that interventions in the CG are considered less mild, since they impose compressions and thoracic vibrations in most of them. In addition, studies point out that parameters such as mean arterial pressure tend to increase in patients who are submitted to techniques where the thorax is manipulated with vibrations or compressions, that is, it is believed that the application of techniques that favor bronchial hygiene or the abrupt increase in tidal air volume, cause an increase in pulmonary vascular resistance and, consequently, generate an increase in vascular pressure, thus justifying this increase in MAP of the individuals in this research (Silva et al. 2019). These inferences make us reflect that the use of the TAR method after CABG may be less abrupt for these markers than conventional physiotherapy.

Given our findings, demonstrating the feasibility and safety of using TAR in this sample of middle-aged adults or elderly with heart disease, it becomes feasible to aim for the applicability of the method in other populations in these age range, expanding it to other elective or non-elective surgical conditions, in oncology, traumatology, and neurology, making the recovery process more effective. Among the limitations is the fact that the techniques were performed by multiple professionals, even if previously trained. In addition, the application of the pulmonary complications scale just in the post-intervention period. It is expected that future clinical trials will evaluate and confirm our inferences, especially in the long term, with the aim of recommending TAR for this target patients.

### 4.1 | Implications of Physiotherapy Practice

This will be the first clinical trial that will evaluate the effects of the TAR method on hemodynamic variables, respiratory discomfort and in pulmonary complications in patients after CABG. The patients undergoing TAR procedures have lower scores on the pulmonary complications scale, the Downes and Raphaelly respiratory distress scale and, consequently, they show improvement in the other variables. The benefits of this article will result in better conduct that prevents or reduces complications and/or respiratory discomforts as well as accelerating the patient's recovery, aiming for a quickly and safe hospital discharge.

#### Ethics Statement

CAAE 33545120.7.0000.5333 - Ethics and Research Committee of the Fundação Universitária de Cardiologia.

## Conflicts of Interest

The authors declare no conflicts of interest.

## Data Availability Statement

The data that support the findings of this study are openly available in Karolini Reis Branco at https://orcid.org/0000-0003-0627-1015.

## References


Abreu, A. P.A, et al. 2022. "Profile of Patients Who Evolved With Stroke in the Postoperative Period of Cardiac Surgery." *Context & Health Magazine* 22, no. 46.

Ajambuja, D. E., A. Zimmermann, et al. 2012. "Immediate Effects of Thoracic -Abdominal Rebalancing in Children With Gastroesophageal Reflux Disease - Case Series Report." *Revista ConScientiae Saúde: Rehabilitation Sciences of the Nove de Julho University* 11, no. 4: 607–617.

Almeida, D. E., B. Rodrigues, et al. 2020. "Physiotherapy in the Postoperative Period of Myocardial Revascularization: Reflections on Rehabilitation in the Approach of Integrality in Health." *Revista Fisioterapia Brasil* 21, no. 1: 31–38.

Benseñor, I. M. 2020. "Non-Fatal Diseases and Quality of Life: Perspectives in Brazil." *Brazilian Journal of Medicine and Health* 25, no. 1.

Brant, L. C. C.A, et al. 2017. "Variations and Differentials in Mortality From Cardiovascular Disease in Brazil and its States, in 1990 and 2015: Estimates From the Global Burden of Disease Study." *Brazilian Journal of Epidemiology* 20: 116–128.

Caballero, D. G., and E. González. 2001. "Acute Bronchiolitis: Bases for a Rational Protocol." In *Anales de Pediatría*, 355–364. Elsevier Doyma.

Campbell, M. K., D. R. Elbourne, and D. G. Altman. 2004. "CONSORT Statement: Extension to Cluster Randomized Trials." *BMJ* 328, no. 7441: 702–708. https://doi.org/10.1136/bmj.328.7441.702.

Carvalho, M. A. 2012. Proposal for Computerization for Decision-Making In a Neonatal and Pediatric Intensive Care Unit.

Carvalho DE Oliveira, M., C. Ortiz Sobrinho, and M. Orsini. 2017. "Comparison Between the Thoracoabdominal Rebalancing Method and Conventional Respiratory Physiotherapy in Newborns With Transient Tachypnea: A Randomized Clinical Trial." *Revista Fisioterapia Brasil* 18, no. 5.

Cavalcante, E. A. F. P.O, et al. 2018. "Repercussions of Passive Mobilization on Hemodynamic Variables in Patients Under Mechanical Ventilation." *Journal of Health & Biological Sciences* 6, no. 2: 170–175.

Coelho, R.A, et al. 2012. "Infants With Heart Disease Submitted to the Support of the Rebalancing- Thoracic -Abdominal Method." *Manual Therapy Magazine* 10, no. 48: 154–160.

Cordeiro, A. M. G., et al. 2003. "Comparison Between a Discomfort Score and Respiratory Endoscopy for Detection of Airway Injuries Associated With Tracheal Intubation in Children." *Jornal de Pediatria* 79, no. 6: 543–549.

Correia, L. B., D. O. S. Santos Almeida, R. Guimarães, and K. A. W. A. K. A. M. E. Patricia Moita Garcia. 2020. "Quality of Life of People Undergoing Coronary Artery Bypass Grafting: An Integrative Review." *Brazilian Journal of Health Review* 3, no. 6: 16654–16673.

Ferguson, K. N., C. T. Roberts, B. J. Manley, and P. G. Davis. 2017. "Interventions to Improve Rates of Successful Extubation in Preterm Infants: A Systematic Review and Meta-Analysis." *JAMA Pediatrics – The Science of Child and Adolescent Health* 171, no. 2: 165–174. https://doi.org/10.1001/jamapediatrics.2016.3015.

Francisco, L. M., R. B. D. Nascimento, W. B. Sales, and R. R. Tomaz. 2020. "The Intervention of the Physiotherapist in the Pre and Postoperative Period of Cardiac Surgery: An Integrative Review." *Research, Society and Development* 9, no. 7: e890973446. https://doi.org/10.33448/rsd-v9i7.3446.

Freitas, D. E., E. Moreira, and A. F. Miquelote. 2020. "Physiotherapy Intervention in Early Mobilization in A Hospital Unit With Ensafe in ICU." *Theory & Practice: Journal of Humanities, Social Sciences and Culture* 2, no. 1: 14–26.

Hulzebos, E. H. J., P. J. M. Helders, N. J. Favié, R. A. De Bie, A. Brutel de la Riviere, and N. L. U. Van Meeteren. 2006. "Preoperative Intensive Inspiratory Muscle Training to Prevent Postoperative Pulmonary Complications in High-Risk Patients Undergoing CABG Surgery: A Randomized Clinical Trial." *JAMA* 296, no. 15: 1851–1857. https://doi.org/10.1001/jama.296.15.1851.

Hulzebos, E. H. J., N. L. Van Meeteren, R. A. De Bie, P. C. Dagnelie, and P. J. Helders. 2003. "Prediction of Postoperative Pulmonary Complications on the Basis of Preoperative Risk Factors in Patients Who Had Undergone Coronary Artery Bypass Graft Surgery." *Physical Research Therapy* 83, no. 1: 8–16. https://doi.org/10.1093/ptj/83.1.8.

Ike, D., D. I. Lorenzo, V. Amorin, D. Costa, and M. Jamamid. 2017. "Postural Drainage: Practice and Evidence." *Revista Fisioterapia em Movimento* 22, no. 1.

Jensen, L., and L. Yang. 2007. "Risk Factors for Postoperative Pulmonary Complications in Coronary Artery Bypass Graft Surgery Patients." *European Journal of Cardiovascular Nursing* 6, no. 3: 241–246. https://doi.org/10.1016/j.ejcnurse.2006.11.001.

Mathis, M. R., N. M. Duggal, D. S. Likosky, et al. 2019. "Intraoperative Mechanical Ventilation and Postoperative Pulmonary Complications After Cardiac Surgery." *Journal of the American Society of Anesthesiologists* 131, no. 5: 1046–1062. https://doi.org/10.1097/aln.0000000000002909.

Oliveira, D. E., M. Carvalho, C. O. Sobrinho, and M. Orsini. 2018. "Comparison Between the Thoracoabdominal Rebalancing Method and Conventional Chest Physiotherapy in Newborns With Transient Tachypnea: A Randomized Clinical Trial." *Magazine Physiotherapy Brazil* 18, no. 5: 598–607.

Rodríguez, J., V. O. N. D. E. S. S. A. U. E. R. Bettina, and G. Duffau. 2002. "Laryngitis Postextubation." *Chilean Journal of Pediatrics* 73, no. 2: 142–151.

Roussenq, K. R., J. C. Scalco, G. J. d. Rosa, G. J. d. S. Honório, and C. I. S. Schivinski. 2013. "Thoracic- Abdominal Rebalancing in Premature Newborns: Effects on Cardiorespiratory Parameters, Behavior, Pain and Respiratory Distress." *Revista Acta Fisiátrica* 20, no. 3: 118–123. https://doi.org/10.5935/0104-7795.20130019.

Ruppenthal, J. B., et al. 2011. "Techniques of Thoracic Manual Therapy Through the Rebalance- Thoraco -Abdominal (RTA) Method Improve Lung Ventilation in Mechanically Ventilated Patients." *Manual Therapy Magazine* 9, no. 42: 102–107.

Silva, D. A., D. H. Marques, et al. 2019. "Hemodynamic Repercussions of Manual Chest Vibration in Patients Uunder Invasive Mechanical Ventilation." *Journal of the Brazilian Association of Cardiorespiratory Physiotherapy and Physiotherapy in Intensive Care (ASSOBRAFIR)* 7, no. 3: 13–29.

Soares, J. L., D. E. S. O. U. S. A. Anderson Moura Bonfim, and D. A. S. I. L. V. A. M. E. D. E. I. R. O. S. Joelson. 2017. "Physiotherapeutic Treatment in the Pre and Postoperative Period of Cardiac Surgery: Integrative Review." *Revista Ciência & Saberes- Facema* 3, no. 3: 624–629.

Vitti, J. D., F. V. Ferreira, and N. F. S. Junior. 2020. "Physiotherapeutic Techniques of Lung Re-Expansion in the Postoperative Period of Congenital Heart Surgery, in Newborns and Infants: An Integrative Literature Review." *Research, Society and Development* 9, no. 10: e9999109484.

Zanini, N., R. M. Nery, J. B. de Lima, R. P. Buhler, A. D. da Silveira, and R. Stein. 2019. "Effects of Different Rehabilitation Protocols in Inpatient Cardiac Rehabilitation After Coronary Artery Bypass Graft Surgery: A Randomized Clinical Trial." *Journal of Cardiopulmonary Rehabilitation and Prevention* 39, no. 6: 19–25. https://doi.org/10.1097/hcr.0000000000000431.

**Supporting Information**

Additional supporting information can be found online in the Supporting Information section.