

Effect of incentive spirometry and inspiratory muscle training on the formation of the therapeutic alliance between physical therapists and cardiac surgery patients

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Abstract

Purpose: to assess the impact of the additional respiratory physical therapy (PT) on the indicators of therapeutic alliance formation in terms of inpatient PT. *Design:* randomized controlled trial. *Participants:* The study involved 120 patients of both sexes, who were submitted to cardiac surgeries. All procedures were performed by sternotomy on cardiopulmonary bypass. The patients were randomly divided into control group (CG), incentive spirometry group (ISG) and inspiratory muscle training group (IMTG). *Interventions:* The groups received standardized PT (early mobilization; therapeutic exercises; coughing). Before surgery, the patients were briefly consulted by a physical therapist. The groups differed in respiratory therapy. ISG patients additionally performed respiratory exercises with a Tri-Ball breathing exerciser (at least three repetitions of 10 strong, full and rapid inhalations through the breathing exerciser at the sessions with a physical therapist, as well as received recommendations to perform 3 sets with 10 repetitions every hour). IMTG patients additionally performed respiratory exercises with Respironics Threshold IMT breathing exerciser and received explanations and recommendations like ISG patients. *Main Outcome Measures:* Therapeutic alliance was assessed with the help of Working Alliance Inventory questionnaire, SF Hatcher Client form in particular. The questions were split into three domains: "goal items", "task items" and "bond items". The questionnaire was filled in on the 7 postoperative day. *Results:* Statistical analysis did not reveal any difference in "goal items" domain between the groups: CG – 17.5 (14.25; 19) points, ISG – 18 (15; 20) points, IMTG – 19 (15; 20) points ($p=0.411$). The results of "task items" domain did not confirm the advantages of any of the groups as well: CG – 17 (14; 18) points, ISG – 16 (15; 18) points, IMTG – 17 (14; 19) points ($p=0.865$). The similar result was obtained in "bond items" domain: CG – 16 (13.25; 18) points, ISG – 16 (13; 18.75) points, IMTG – 16.5 (13; 18) points ($p=0.867$). Statistically similar results were obtained in the total questionnaire score: CG – 51 (43; 54.75) points, ISG – 50.5 (43.25; 55) points, IMTG – 52 (42; 56) points ($p=0.800$). *Conclusions:* Comparison of therapeutic alliance indicators between the groups did not confirm the impact of additional respiratory PT on the results of the questionnaire items, domains and the total score, despite the fact that using breathing exercisers required setting up, adjusting and achieving goals and objectives specific for working with breathing exercisers, as well as additional cooperation of a physical therapist and a patient.

Key words: working alliance, physical therapy, therapeutic exercises, rehabilitation, cardiac rehabilitation.

Introduction

Physical therapy (PT) of cardiac surgery and cardiac patients remains an important healthcare sphere owing to the prevalence of cardiac pathology, its complications and comorbidity (Vitomskiy et al., 2018; Junior et al., 2019; Vitomskiy, 2020; Balazh et al., 2020). On the other hand, biopsychological model of PT and the study of its aspects, particularly patient satisfaction and the therapeutic alliance, are currently relevant areas of the research (Fedorenko et al., 2020; Karpukhina et al., 2020; Kinney et al., 2020).

The therapeutic alliance (also working alliance or therapeutic relationship) is studied in the sphere of PT as well (Hall et al., 2010; Taccolini Manzoni, et al., 2018; Kinney et al., 2020). The amount of evidence for the impact of the therapeutic alliance on achieving excellent results, higher level of satisfaction with PT is gradually

increasing (Taccolini Manzoni et al., 2018; Lawford et al., 2020). There is already evidence for the impact of the therapeutic alliance between physical therapists and patients with chronic low back pain on the results of intervention based on the primary outcomes of global perceived effect of treatment, function, disability, and pain (Ferreira et al., 2013). Therapeutic alliance has been studied in a limited extent in the rehabilitation and PT literature with conflicting frameworks and findings (Babatunde et al., 2017).

Being a general structure, the therapeutic alliance currently includes a number of characteristics according to its definition, such as collaborative nature, efficient relationship and consistency of goals and objectives between a therapist and a patient (Martin et al., 2000). The concept may also include empathy (Mercer et al., 2004) and trust (Hall et al., 2002), which are used to assess the level of alliance formation.

The definition of the therapeutic alliance transitions to the PT setting (Kinney et al., 2020), which confirms the relevance of its study. It is also important to study the impact of PT modalities on the therapeutic alliance, namely inpatient and outpatient therapy, as well as the content of the programs and additional PT interventions.

Physical therapy is a routine procedure for patients after cardiac surgeries (CS) aimed at mobilizing the patient and restoring his/her functionalities, since surgery and inpatient care in a cardiac surgery unit are unusual condition for the patients that can increase the feeling of discomfort. Therefore, the study of therapeutic alliance formation seems very interesting under these circumstances. Besides, studying the impact of additional interventions is necessary to improve the quality of PT.

The use of inspiratory PT requires setting up and achieving extra goals, objectives through additional cooperation (explanations and multiple reminders of the features and algorithm of breathing exercisers, implementation, control, error correction to improve technique, motivate patients and increase their diligence) of a physical therapist and a patient.

Purpose: to assess the impact of the additional respiratory PT on the indicators of therapeutic alliance formation in terms of inpatient PT.

Material & methods

Design: randomized controlled trial.

Participants. The study involved 120 patients of both sexes, who were submitted to CS. All procedures were performed by sternotomy on cardiopulmonary bypass with cardioplegic arrest.

The exclusion criteria were: patients with unstable angina pectoris at the moment of selection or during the program, congestive decompensated heart failure, lack of intellectual capacity, complex ventricular and uncontrolled arrhythmia, uncontrolled high blood pressure, cerebrovascular accident, artificial lung ventilation less than 24 hours.

The patients were randomly divided (at 1:1:1 ratio; envelope method) into control group (CG; n=40), incentive spirometry group (ISG; n=40) and inspiratory muscle training group (IMTG; n=40). The study protocol was approved by the institutional review board and the local medical ethics committee of GI «Scientific and Practical Medical Center for Pediatric Cardiology and Cardiac Surgery of the Ministry of Health of Ukraine» (protocol №1 of 21.01.2020). All patients were informed about the study protocol and gave written informed consent.

Interventions. The groups received standardized PT (early mobilization; therapeutic exercises; coughing). Before surgery, the patients were briefly consulted by a physical therapist on the aims and content of PT and activation algorithm after surgery. The postoperative protocol of PT called for the following practice of patient's early mobilization: sitting on the bed with the legs dangling on the 1 postoperative day (POD); standing (getting up with the help and under the control of a physical therapist, holding on a medical movable walker; agreed with an anesthesiologist) and on-the-spot walking if feasible on the 1-2 POD; on-the-spot walking, walking within the ward on the 2 POD; walking in the hospital corridor on the 3 POD; walking up and down the stairs on the 4-5 POD. All patients performed therapeutic exercises with a physical therapist and therapeutic walking under the control of a physical therapist. Sessions (about 20 minutes each) with a physical therapist were conducted 2 times a day on the 1 and 2 PODs, 1-2 times on the 3 POD, 1 time starting from the 4 POD. In case of a necessity (patient's condition, the need for motivation), the physical therapist could increase the number and the length of the sessions. PT was conducted by two physical therapists in equal amount in groups. Each physical therapist was assigned to each group in turn.

The groups differed in respiratory therapy. ISG patients additionally performed respiratory exercises with a Tri-Ball breathing exerciser (at least three repetitions of 10 strong, full and rapid inhalations through the breathing exerciser at the sessions with a physical therapist, as well as received recommendations to perform 3 sets with 10 repetitions every hour to lift all three balls of the breathing exerciser (600, 900 and 1200 cc/sec) with each inhalation. If a participant was not able to lift all three balls this was not considered a treatment failure, since selecting participants on this basis would contribute to the concentration of patients with better scores in ISG. At the same time, such selection would be impossible in CG. ISG patients were asked to start from a lower lung volume before starting the forceful inhalation. Training with breathing exerciser started from the 1 POD.

During the 1 and 2 PODs the exercises performed every hour were supervised by medical staff, afterwards the patient recorded independently performed exercises in the diary.

IMTG patients additionally performed respiratory exercises with Respirationics Threshold IMT breathing exerciser (the intensity was measured according to the Rating of Perceived Exertion – hard level; the pressure to open the valve was 20 cm water level starting from 1 POD and 30 cm water level starting from 3 POD) and received explanations and recommendations like ISG patients.

All participants in ISG and IMTG recorded their daily respiratory workout in the diaries.

Outcome Measures. Demographic variables, clinical history were recorded on entry to the trial. Therapeutic alliance was assessed with the help of Working Alliance Inventory (WAI) questionnaire, SF Hatcher Client form in particular, which consisted of 12 questions (Hatcher & Gillaspay, 2006). The scores were calculated on a 5-point scale: 5 – always; 4 – very often; 3 – fairly often; 2 – sometimes, 1 – seldom. Besides, the questions were split into three groups/domains: "goal items", "task items" and "bond items". Each of these domains was scored from 4 (minimum) to 20 points (maximum); the total questionnaire score ranged from 12 (minimum) to 60 (maximum) points. The questionnaire was filled in on the 7 POD.

Statistical analysis. The materials of the research were processed in IBM SPSS 21 program of statistical analysis. Mathematical processing of numerical data was fulfilled with the help of variation statistics. The analysis of quantitative indicators distribution's correspondence to the law of normal distribution was checked by Shapiro-Wilk test. Median value (Me) and upper and lower quartiles (25%; 75%) were calculated for the indicators. Kruskal-Wallis test was used to measure the significance of the difference.

Results

CG included 29 males and 11 females, and ISG included 25 males and 15 females, and IMTG included 26 males and 14 females ($p=0.617$). Significant differences in age, body weight, body length, NYHA functional class, operation duration were not found (Table 1). None of the patients had significant complications aggravating the process of postoperative recovery.

Table 1

The main characteristics of the samples

Indicators	CG (n=40)	ISG (n=40)	IMTG (n=40)	p
Age, years	62.5 (53.3; 68)	64 (56.8; 70)	64 (57.3; 69)	0.690
Body weight, kg	85 (71.8; 90)	79.5 (70.3; 90)	80 (69.3; 87.3)	0.424
Body length, cm	170.5 (163.3; 175.3)	167.5 (160; 176)	167.5 (162; 174)	0.453
Body mass index, kg/m ²	28,6 (26,7; 30,4)	28,7 (25,9; 32)	27,7 (24,8; 31)	0.731
EF, %	54 (47.25; 58)	55 (47; 59.5)	53 (44.25; 58)	0.731
AH, degree	2 (1; 3)	2 (2; 3)	2 (2; 3)	0.699
NYHA, class	2 (2; 3)	3 (2; 3)	3 (2; 3)	0.597
AVL duration, hour	7 (6; 8,8)	8 (6; 11)	8 (6; 9)	0.216
Operation duration, min.	377.5 (330; 427.5)	337.5 (285; 407.5)	360 (320; 455)	0.254
CPB duration, min.	156.5 (146; 212.3)	179 (140.25; 220.3)	194 (141.3; 245.5)	0.460

Note: EF - ejection fraction; AH – arterial hypertension; AVL - artificial lung ventilation; CPB - cardiopulmonary bypass.

Comparison of the questionnaire results did not confirm statistical advantages of any of the groups in any questionnaire item (Table 2). Comparison of the results in groups of patients in the domains and the total score of the therapeutic alliance did not reveal any significant difference between the groups (Table 3).

Table 2

The characteristics of the therapeutic alliance formation in the questionnaire items, points

Item	CG	ISG	IMTG	p
1 As a result of these sessions I am clearer as to how I might be able to change	4 (3; 5)	4 (3; 5)	4 (3; 5)	0.641
2 What I am doing in therapy gives me new ways of looking at my problem	4 (3; 5)	4 (3; 4)	4 (3; 5)	0.903
3 I believe PT likes me	2 (2; 4)	3 (2; 4)	3 (2; 4)	0.783
4 PT and I collaborate on setting goals for my therapy	4 (3; 5)	4 (3; 5)	4 (3; 5)	0.692
5 PT and I respect each other	5 (4; 5)	5 (4; 5)	5 (4; 5)	0.802
6 PT and I are working towards mutually agreed upon goals	5 (4; 5)	5 (4; 5)	5 (4; 5)	0.488

7	I feel that PT appreciates me	4,5 (3; 5)	4 (3; 5)	4 (3; 5)	0.588
8	PT and I agree on what is important for me to work on	5 (4; 5)	5 (4; 5)	5 (4; 5)	0.841
9	I feel PT cares about me even when I do things that he/she does not approve of	4 (3; 5)	5 (3; 5)	5 (3,25; 5)	0.412
10	I feel that the things I do in therapy will help me to accomplish the changes that I want	4 (3; 5)	4,5 (4; 5)	4,50 (3; 5)	0.696
11	PT and I have established a good understanding of the kind of changes that would be good for me	4 (3; 5)	5 (4; 5)	5 (4; 5)	0.299
12	I believe the way we are working with my problem is correct	5 (4; 5)	5 (4; 5)	5 (4,25; 5)	0.483

Note: PT – physical therapist.

Table 3

The characteristics of therapeutic alliance formation in the questionnaire domains, points

Domains	CG	ISG	IMTG	p
Goal items	17.5 (14.25; 19)	18 (15; 20)	19 (15; 20)	0.411
Task items	17 (14; 18)	16 (15; 18)	17 (14; 19)	0.865
Bond items	16 (13.25; 18)	16 (13; 18.75)	16.5 (13; 18)	0.867
Total score	51 (43; 54.75)	50.5 (43.25; 55)	52 (42; 56)	0.800

Discussion

The obtained results confirm that additional respiratory PT, which implied working with breathing exercisers, had no influence on the indicators of the therapeutic alliance between cardiac surgery patients and their physical therapists. Therefore, setting up and achieving specific goals and objectives when working with breathing exercisers do not increase the indicators of the therapeutic alliance in any item, domain and overall score of the questionnaire, despite the fact that the use of breathing exercisers presupposed additional cooperation between a physical therapist and a patient. Such cooperation involved explanation of features and algorithm of work with the breathing exerciser; control of practising respiratory exercises to form a correct habit; timely error correction to improve the technique and results of inspiratory muscle training; motivating and increasing patient's diligence when working with breathing exercisers.

The lack of differences between the groups suggests that it is difficult to increase the level of the therapeutic alliance, which is formed within the standardized PT program, if PT program is implemented in accordance with the specified features of physical therapists' interventions. Besides, it can be assumed that setting up and achieving goals and objectives when physical therapist mobilizes the patient, provides assistance in performing exercises and coughing, as well as cooperation in the process of restoring patient's functionality are key factors that form the therapeutic alliance between a cardiac surgery patient and a physical therapist. The analysis of scientific literature confirmed the lack of research focused on the impact of additional respiratory PT or additional interventions on therapeutic alliance formation between cardiac surgery patients and physical therapists. This gives grounds to state that the results presented in the current survey are the first to evaluate the impact of additional interventions of physical therapists on the level of therapeutic alliance formation within the inpatient physical therapy program after CS.

The authors of most preceding surveys have studied the factors that influence therapeutic alliance formation between the physical therapist and the patient, as well as the relationship between the level of the therapeutic alliance and the effectiveness of PT. It should be noted that almost all studies of the therapeutic alliance in the sphere of PT involved patients with musculoskeletal disorders.

For instance, it has been confirmed that the therapeutic alliance affects pain, functionality indicators, the overall effect of PT in treating patients with chronic low back pain (Ferreira et al., 2013). On the other hand, the survey of Taccolini Manzoni A.C. et al. (2018) showed the lack of relationship between the therapeutic alliance and pain in the studies, which excluded measures to stimulate therapeutic alliance improvement.

At the same time, an earlier literature review (Hall et al., 2010) confirmed positive correlation between the indicators of the therapeutic alliance and PT efficiency in patients with musculoskeletal disorders. According to the study of Zaproudina N. et al. (2007), patients with chronic neck pain who had better dynamic showed higher scores assessing the ability to communicate and to interact.

Besides, the studies confirmed the impact of PT on the therapeutic alliance measured on the global assessment score, the dynamic of pain (Zaproudina et al., 2009), indicators of treatment satisfaction (Beattie et al., 2005). In this aspect, it should be noted that communication skills that contribute to improving the therapeutic alliance can be taught (Lewin et al., 2001; Moore et al., 2004; McGilton et al., 2009).

One of the studies confirmed the impact of the attitude to the disease on the indicators of the therapeutic alliance in patients with musculoskeletal disorders undergoing an outpatient PT program (Fedorenko et al.,

2019). In particular, patients with the irrational attitude to the disease had lower scores on the eight items of the WAI questionnaire out of twelve, as well as lower scores in goal, task, bond items.

Besides, according to the preceding studies, patients consider the therapeutic alliance in terms of collaborative work relationship, active commitment, confident progress, bond, agreement on tasks/goals and productive work (Bachelor, 2013). However, the study involving cardiac surgery patients did not confirm the improvement of the therapeutic alliance based on the increase of these components as additional respiratory PT with breathing exercisers.

Conclusion

Comparison of the therapeutic alliance between cardiac surgery patients and physical therapists in three intervention groups confirmed the lack of difference between the obtained results, as well as the lack of impact of the additional respiratory PT performed with breathing exercisers (incentive spirometry and inspiratory muscle training) on the results of questionnaire items, domains and the total score. Accordingly, setting up, adjusting and achieving specific goals and objectives did not improve the results even in "goal items" and "task items" domains, as well as in the related items of the questionnaire as compared to the control group, despite the fact that the work with breathing exercisers implied additional cooperation between physical therapists and patients in two groups of patients.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study. All subjects of the institutional survey gave consent for anonymized data to be used for publication purposes.

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