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Research Report

Effects of Kinesiotaping on Pain and Pulmonary Function following Open Heart Surgery: A Randomized Control Trial

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Abstract: Background: Kinesiotaping is a therapeutic technique, used widely in sports and neuro rehabilitation to reduce swelling and pain. It is also used to facilitate or inhibit the muscles to enhance function. However its role in the reduction of post-operative pain and facilitating pulmonary function is yet to be studied. **Aim**: To study whether the application of Kinesiotape reduces pain and improves pulmonary function post operatively. **Objectives**: To study the changes in pulmonary function and pain after application of Kinesiotape in post open heart surgery patients. **Methods:** All patients undergoing open heart surgery at a tertiary health care centre during 6 month duration were screened**.** Sixty patients were included as per inclusion criteria and randomly divided using lottery method into experimental and control groups. Kinesiotape was applied to the patients in experimental group to facilitate the diaphragm on Day 1 post operatively and removed on post-operative Day 7. The pulmonary functions and subjective measure of pain were recorded post-operatively Day1 and 7. **Results:** Comparing pre and post intervention results, there was statistically significant improvement in $FEV_{1,}$ FVC, PEFR, PIFR and pain score within both group. Inter group comparisons showed significant improvement only in PEFR. There was no statistically significant difference in PIFR, FEV1, FVC or pain scores between the experimental and control group. **Conclusion:** Kinesiotaping does not offer any additional advantage over conventional chest physiotherapy in improving pulmonary function parameters or pain.

Keywords: Physical function, Psychological function, Pain, Fatigue, Functional capacity.

Introduction

Open heart surgeries is the term used to describe various surgeries performed on the internal structures of the heart.[1] Median sternotomy incision performed during these surgeries leads to alteration in thoracic wall biomechanics and normal functioning.[2] There are number of factors in the post-operative period which inhibits respiratory function, namely pain and respiratory depression because of general anesthesia. Pain results in muscle inhibition of respiratory muscles and reduced thoracic cage mobility post open heart surgery. Post-operative respiratory care and early mobilization is directed towards improving respiratory functions by enhancing secretion clearance and improving thoracic mobility.[3] Various modalities and therapeutic protocols are used to reduce pain and restore function.

Kinesio Taping, a definitive rehabilitative taping technique is designed to facilitate the body's natural healing process. It is used widely in sports and

neuro rehabilitation to reduce swelling and pain. It is also used to facilitate or inhibit the muscles to enhance function. It provides support and stability to muscles and joints without restricting the body's range of motion .It lifts the skin microscopically stimulating different receptors within the somatosensory system, alleviating pain and facilitating lymphatic drainage.[4] Kinesio Tape can be applied in many ways and has the ability to re-educate the neuromuscular system, reduce pain and inflammation, enhance performance and promote good circulation and healing (Chenet. al).[5] It has been established that the use of Kinesio taping method in conjunction with an established rehabilitation program resulted in the reduction of soft tissue inflammation, muscle weakness and postural malalignment.[6] Post operatively surgical trauma causes pain and inflammation of soft tissue cut. Kinesiotaping to reduce pain and facilitate respiratory muscles post operatively has not been extensively studied. Hence, the aim of this study was to determine the effect of Kinesiotaping as an adjunct to facilitate respiratory muscles and hence improve pulmonary function flow rates in patients following open heart surgery and also evaluate its role in reduction of postoperative pain.

Materials and Methods

The study was approved by institutional ethics committee and written informed consent was obtained from patients**.** It was a prospective interventional randomized controlled trial. Randomization was done using lottery method. The investigator was blinded to allocation of the patients. All patients were treated by the therapist in charge, who had been trained and certified for kinesiotaping. Pulmonary Function test (PFT) were measured by PFT technician using portable spirometer and peak flow meter pre operatively, postoperative day 1 and day 7. As per the standard institutional technique, the technician uses 3 trial methods and the best of 3 trials was noted.

All patients in age group of 25-75 years undergoing open heart surgery during six months duration were screened and included in the study. A total of 98 patients were screened. Patients with pre-existing pulmonary disease such as COPD (n=3), bronchial asthma (n=3) and severe pulmonary hypertension (n=9) were excluded. Post operatively patients were excluded if the patient developed pulmonary complication, showed signs of infection (determined by rise in temperature, excessive pain) or were on ventilator for more than 12 hours, had unstable hemodynamics (n=8). Of the included patients, 23 were excluded post-operatively because of prolonged duration of ventilation (n=15) and unstable hemodynamics (n=8). Data of 60 patients was analyzed with thirty in each group (Figure 1).

Experimental Group (n=30)

Figure 1: Flow chart of patient selection and allocation

Demographic data, surgical details were recorded. Patients in both groups received pre-operative and post-operative care as per standard care protocol. The standard care protocol included chest physiotherapy and graded cardiac mobilization. Kinesiotape was applied in experimental group (Group 1) by a trained therapist with anterior and posterior application to facilitate maximum muscle fibres (Kenzo Kazi). Control group (Group 2) received standard care protocol only. The tape was allowed to be for 7 days and changed only if it lost its adherence (Manual of Kinesiotaping by Kenzo Kazi). None of the patients complained of any itching sensation.

Technique for taping the respiratory muscles

Posterior application: Post extubationthe patient was assisted to flex the trunk slightlywith arms hanging or lying at the side. T_{10} spinous process was marked where base of the tape was secured and patient was asked to exhale fully. Centre of the tape was applied without any stretch on the spinous process (up to 1 cm in length).The Tape was applied on eitherside laterally along the lower ribs with 25-30% of tension stretch. Ends were

applied without any stretch approximately in mid axillary line. (Figyre 2)

Anterior application: The patient was made to sit in reclined position with arms by the side. Base of the tape was applied just lateral to xiphoid process and continued along the lower ribs with approximately 30% of stretch till mid-axillary line where end was applied without any stretch. Same procedure is repeated on the other side with patient having exhaled completely (KenzoKase, Kim Rock Stockheimer).

Figure 2: Posterior taping

Outcome Parameters: Pain was measured on Visual Analog Scale (VAS). Forced Expiratory volume in one second (FEV1) and Forced Vital capacity (FVC) was measured using portable DT spirometer. Peak inspiratory flow rate (PIFR) and Peak expiratory flow rates (PEFR) were measured using Wright's peak flow meter.

Data Analysis

The Data was analyzed using SPSS software, version 16. Data normality was assessed by Kolmogorov Smirnov test. Inter and Intra group comparison was done using Paired T Test for Pulmonary function variables. Pain Score on VAS was analyzed using Wilcoxon Signed rank test and Mann -Whitney U test. Level of significance was accepted at $p<0.05$.

Results

The mean age of patients in Group 1 was 47.67 (±12.19) and group 2 was 46.63 (±11.96). There were 60% males and 40% females in both groups. The baseline data of both groups was comparable for Pulmonary function values (PIFR, PEFR, FEV_1, FVC) with the binder on day 1 (Table 1). Within group change between Day 1 and Day 7 was analyzed using paired t test in both experimental and control groups. Pulmonary function values showed a significant improvement from day 1 to day 7 in both the groups (Table 2) for all variable tested Within group pain was analyzed using Wilcoxon signed rank test (Table 3) and showed significant reduction in pain in both groups ($p<0.01$). Inter group analysis between experimental and control was done using paired t test. It showed statistically significant differences only in PEFR. No significant differences in PIFR, FEV_1, FVC and pain were seen (Table 4 & 5).

Table 1 Baseline parameters of Group1 (experimental) and Group 2 (control) on Day1

Parameter	Group	Mean	Standard Deviation (±)	Sig. (2-tailed)	95% C I of the Difference	
					Lower	Upper
PEFR	1	153.10	56.04	0.45#	-37.22	16.76
	2	163.33	48.10			
PIFR	1	84.66	36.17	0.14#	-33.79	5.12
	2	99.00	39.07			
FEV1	1	1.07	0.37	0.03#	-0.40	-0.01
	2	1.27	0.37			
FVC	1	1.05	0.43	0.68#	-0.14	0.22
	2	1.01	0.26			

Not significant

Table 2: Mean difference between pre (day 1) and post (day 7) of pulmonary function variables of both groups. Within group comparisons of pulmonary function variables of both Group 1 and Group 2.

Day1 & Day 7-Difference	Paired Differences				
			95% CI of the Difference		Sig. (2-tailed)
Group 1	Mean	Std. Deviation(±)	Lower	Upper	
PEFR	-60.73	29.67	-71.81	-49.65	0.001*
PIFR	-32.66	12.01	-37.15	-28.18	0.001*
FEV1	-0.35	0.15	-0.41	-0.30	0.001*
FVC	-0.70	0.27	-0.80	-0.60	0.001*
Group2					
PEFR	-38.00	13.03	-42.86	-33.13	0.001*
PIFR	-34.33	22.69	-42.80	-25.85	0.001*
FEV1	-0.32	0.08	-0.35	-0.28	0.001*
FVC	-0.60	0.12	-0.65	-0.56	0.001*

*significant

Table 3 .Pre -Post Pain scores (VAS) in Group 1 and Group 2

PAIN	N	Percentiles			Wilcoxon Signed Ranks Test
Group 1		25th	50th (Median)	75th	Day 7 - Day1 PAIN
Day1	30	3.0	4.0	5.0	Z = -4.893a
Day 7	30	0.0	1.0	1.25	Asymp. Sig. (2-tailed) = 0.001*
Group 2					
Day 1	30	4.0	5.0		Z = -4.884a
Day 7	30	1.0	2.0		Asymp. Sig. (2-tailed) = 0.001*

*significant

Table:4 Inter group differences in PFT variables

Intra group difference	group	Differences of Mean	Std. Deviation±	Sig. (2-tailed)	95% Confidence Interval of the Difference	
					Lower	Upper
PEFR	1	60.73	29.67	0.00*	10.88	34.57
	2	38.00	13.03			
PIFR	1	32.66	12.01	0.72	-11.05	7.71
	2	34.33	22.69			
FEV1	1	0.35	.15	0.26	-0.02	0.10
	2	0.32	.08			
FVC	1	0.70	.27	0.08	-.015	0.20
	2	0.60	.12			

*significant

Table 5: Inter group difference in pain score (VAS) analysed with Mann Whitney U test

Group n=30 each	Mean rank	Sum of ranks	p value
1	33.15	994.50	-1.29
2	27.85	835.50	

Discussion

There is marked reduction in pulmonary functions following open-heart surgeries, as a result of anesthesia, immobilization and pain.[7] Reduced lung volumes affect gas exchange and an inverse correlation between atelectatic area and arterial oxygenation (PaO2) during the first postoperative days after open-heart surgery have been described.[8, 9] This study assessed the effect of Kinesiotaping as an adjunct to conventional chest physiotherapy on pulmonary functions (PEFR, PIFR, FVC, and FEV1) and perception of pain in patients who have undergone open heart surgery. Statistically significant difference was found within both the experimental and control groups in all the pulmonary function variables between day 1 and day 7.

Effects of general anesthesia on diaphragm and other inspiratory muscles lead to altered rib cage biomechanics during breathing and reduction in pulmonary volumes. These effects are ameliorated by post-operative chest physiotherapy maneuvers.[10]

Deep breathing techniques and incentive Spirometer cause improvement in ventilation and reduction prevention of atelectasis. Positioning and secretion clearance techniques help in clearing retained secretions.[11] A previous study[14] showed that chest physiotherapy including deep breathing exercises improved spirometry values following CABG surgery on fourth post-operative day.

Inter group comparisons found statistically significant difference only in PEFR values. Addition of Kinesiotape applied to the skin surface provides tactile input, which interact with motor fibres by altered the excitability of the central neuron system.[12] These may have in turn reduced the inhibition of Muscle.[13] Diaphragm is involved in respiratory movements, retention of posture and mobility of the trunk.[14] Zubeyer et al. applied diaphragmatic kinesiotape to one group and to the accessory muscles of the second group. He measured respiratory muscle strength, measured with micro mouth pressure measurement. The results showed no significant increase in strength. In the present study, we did not measure muscle strength but performance parameters as flow rates, Forced vital capacity and pain. There was no significant difference in these flow parameters. Hence the diaphragm may have not been facilitated to increase inspiratory capacity. Also as the study was of small sample size hence the net effect could have been nullified due to this. Variability in physiological parameters may also affect the level of patient cooperation hence the performance on PFT was not found significant. Though there was no significant difference in pain scores between the groups; subjectively the patients in experimental group reported that they felt better with kinesiotape and more confident in body transitions. This could be because of reduction in inflammatory processes and progression to stage 2 of healing, reduction in apprehension, removal of intercostal and/ or mediastinal drains. Kinesiotape, when applied with adequate stretch, causes improvement in pain and range of motion.[15] The tension in the tape creates tension in the soft tissue structures, hence providing effective and less painful movement. The tape also blocks the transmission of nociceptive stimuli to spinal cord via cutaneous stimulation (pain gate mechanism) or via the inhibitory mechanism.

The use of kinesiotape is expensive. As this study does not show any significant changes in any of the pulmonary function variables except PEFR, its use as an adjunct to inhibit pain in post-operative

care and facilitate diaphragm is doubtful. A more extensive study with large sample size is required to justify the use of kinesiotape.

Conclusion

The results of this study suggest that application of Kinesiotaping in addition to chest physiotherapy does not enhance pulmonary function variables (FEV1, FVC, and PIFR) or reduce pain significantly more than chest physiotherapy. Hence addition of Kinesiotape as an adjunct does not offer any additional advantage.

Conflict of Interest: None

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