

EFFECT OF KINESIOTAPING ON CORONARY ARTERY BYPASS GRAFT (CABG) PATIENTS IN PHASE I REHABILITATION

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INTRODUCTION:

CABG is an open heart surgery in which a section of blood vessel is grafted from aorta to the coronary artery to bypass the blocked section of coronary artery to improve blood supply of heart. Coronary artery disease is a condition in which a substance called plaque builds up inside coronary arteries¹. Coronary arteries supply oxygen rich blood to your heart. Plaque is made up of fat, cholesterol, calcium and other substances. CABG is a gold standard surgical treatment for Coronary artery disease, success rate is 99.8%². There is definitive decline in pulmonary functions seen following open heart surgeries, due to effect of Anaesthesia, Incisional site pain, presence of intercostal drains leading to muscular inhibition³. Normally, cardiac surgeries are mostly associated with occurrence of pulmonary complications which can be called as pulmonary abnormality. These complications mostly occurs during post-operative period produces dysfunction which is clinically significant⁴.

Complications include Pneumonia, Atelectasis or infiltrates, respiratory failure, Pleural effusions⁵, Pneumothorax and pulmonary oedema. High incidence of pulmonary complications is due to alteration of normal ventilator function⁶. Atelectasis are common post surgical conditions mainly following CABG⁷. Reasons for Atelectasis are complex and involve numerous factors such as diaphragmatic dysfunction, pleural effusion and pain⁸. CABG with and without extracorporeal circulation results in impairments of respiratory system mechanics⁹.

IMA dissection may reduce blood supply to ipsilateral intercostal muscle and phrenic nerve leading to respiratory muscle dysfunction, ultimately Atelectasis.¹⁰

KINESIO TAPING

Method is a definitive rehabilitative technique that is designed to target different receptors within the somatosensory system that alleviates pain by enhancing activity of the lymphatic system by microscopically lifting the skin and endogenous analgesic mechanisms as well as improving microcirculation to facilitate the body's natural healing process¹¹. It supports joint function by exerting an effect on muscle function without restricting the body's range of motion as well as provides extended soft tissue manipulation to prolong the benefits of manual therapy to successfully treat a variety of orthopaedic, neuromuscular, neurological and other medical conditions.¹²

Kinesiotape which is developed by kenzo kase in Japan also known as elastic bandage is new method which has been popular over 10 years. It is made up of free latex with elastic polymer strands wrapped in cotton fibres.¹³ KT in conjunction with other therapeutic interventions will facilitate or inhibit muscle function, support joint structure, reduce pain, and provide proprioceptive feedback to achieve and maintain preferred body alignment or motion. Application of tape even improves bioelectrical activity of muscle.¹⁴ Kinesio taping is taping technique widely used for muscle facilitation. Kinesio taping helps in reduction of pain, oedema, and muscular facilitation. Kinesiotaping applied posterior to anterior helps in facilitation of diaphragm.¹⁵

According to American Heart Association, Cardiac rehabilitation is defined as combined and coordinated use of medical, psychosocial, educational, vocational and physical measures to facilitate return to an active and satisfying life style¹⁶.

In Phase I Assisted range of Motion exercises are initiated within 24-48 hrs after extubation. Low risk exercises which included Breathing exercises, thoracic expansion exercises, incentive spirometry are given. Patient is encouraged to sit in bed side chair and to perform self-care activities.

Aims and objectives

- The aim of this study is to determine the effectiveness of Kinesiotaping in post-operative cardiac rehabilitation
- The objective of the study is to know about the result that application of Kinesiotape which is a cotton elastic material would reduce surgical site pain, improve thoracic expansions and reduce rate pressure product.
- To assess effectiveness of Kinesiotaping with outcome measures of pain using VAS score, chest expansion measurements using inch tape, and workload of heart using rate pressure product.

RESEARCH HYPOTHESIS

NULL HYPOTHESIS (H0): Kinesiotaping does not show significant effect in reducing pain and improving chest expansions in post operative CABG patients.

ALTERNATIVE HYPOTHESIS (H1): Kinesiotaping shows significant effect in reducing pain and improving chest expansions in post operative CABG patients.

METHODOLOGY

This study was designed to observe the effect of KT on CABG patients in phase I cardiac rehabilitation. It is a mixed measure study conducted at Cardio Thoracic Post Operative Department, Apollo main Hospital, Jubilee Hills, Hyderabad. The type of sampling used was convenient sampling with which patients were divided into control and experimental groups on the basis of inclusion and exclusion criteria. Subjects chosen for study were men and women of age 45-55 years. Patients with pedal oedema, infections, COPD were excluded.

The purpose of the study and procedure was explained and the written consent was obtained from patient. Both the groups received conventional post-operative physiotherapy, including

breathing exercises, thoracic expansion exercises, incentive spirometer and other chest physiotherapy maneuvers as indicated along with the kinesiotaping techniques which were applied to group B.

PROCEDURE

Based on the inclusion and exclusion criteria patients were divided into two groups:-

Control group:-

In control group A of 30 CABG patients were given spirometry, breathing exercises, chest physiotherapy manoeuvres of two sessions per day for seven days. Pain, chest expansion measurements and RPP were taken as outcome measures and were measured on day 1, 4 and 7 post-operatively.

Days	Treatment	Duration
Day 1	Monitored progression of activity Bed exercises Ankle toe movements	2 sessions of twenty minutes
Day 2	Spirometer-300ml Sitting for 15 minutes Unilateral leg exercises Limited activities of daily living advised	2 sessions of 20 min.
Day 3	Spirometer-400ml Ambulation-5min. Standing leg exercises	2 sessions of 20 min.
Day 4	Spirometer -750ml Hall ambulation-6 min Tolerated Standing trunk exercises(side and back bends)	2 sessions of 15 min.
Day 5	Spirometer-900ml Ambulation-10min. Tolerated Standing trunk exercises(side and back bends) Tolerated Arm exercises	2 sessions of 20 min.
Day 6	Spirometer-1000ml Progressive Ambulation Full flight of stairs	2 sessions of 25 min.
Day 7	Spirometer-1200ml Progressive Ambulation Full flight of stairs	2 sessions of 25 min.

Experimental group:-

In experimental groupB of 30 CABG patients were given spirometry, breathing exercises, chest physiotherapy manoeuvres of two sessions per day for seven days along with kinesiotope techniques were given on day 1 and 4 post-operatively. Pain, chest expansion measurements and RPP were taken as outcome measures and were measured on day 1,4 and 7 post-operatively.

In experimental post-operative physiotherapy:-

Days	Treatment	Duration
Day 1	Monitored progression of activity Kinesiotaping done over diaphragm and subcostal muscles Spirometer -300ml Bed exercises Ankle toe movements	2 sessions of twenty minutes
Day 2	Spirometer-500ml Sitting for 15 minutes Unilateral leg exercises Limited activities of daily living advised	2 sessions of 20 min.
Day 3	Spirometer-600ml Ambulation-5min. Standing leg exercises	2 sessions of 20 min.
Day 4	Spirometer -800ml Kinesiotaping done over diaphragm and subcostal muscles Hall ambulation-6 min Tolerated Standing trunk exercises(side and back bends)	2 sessions of 15 min.
Day 5	Spirometer-1000ml Ambulation-10min. Tolerated Standing trunk exercises(side and back bends) Tolerated Arm exercises	2 sessions of 20 min.
Day 6	Spirometer-1200ml Progressive Ambulation Full flight of stairs	2 sessions of 25 min.
Day 7	Spiromter-1500ml	2 sessions of 25 min.

	Progressive Ambulation Full flight of stairs	
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KINESIOTAPE:-

kinesiotape is made of free latex with acrylic adhesive material made of elastic polymer stranded wrapped in cotton fibres. Kinesiotaping facilitates cutaneous stimulation and reduces pain by neural pathway.

PROCEDURE:-

Kinesiotaping facilitates cutaneous stimulation and reduces pain by neural pathways.

Diaphragmatic and subcostal muscles are given Kinesiotaping. Area 1inch below xiphoid process and anterior axillary area are cleaned properly. Two I strips are used for diaphragm and two Y strips are used for subcostal muscles.

I strip:- Kinesiotaping was done post-operatively day 1 and 4 during inspiration while patient will be in half lying position at about 1 inch below xiphoid process. With 10-15% tension in tape Kinesiotaping was applied from posteriorly towards anteriorly where diaphragmatic muscle is facilitated. On day 1, 4 and 7 postoperative days perception of pain, chest expansion measurements and rate pressure product were measured.

VISUAL ANALOGUE SCALE:- Determination of pain with subjective methods are mostly valid. Visual analogue scale used is simple, reliable means by which patient expresses with high degree resolution and without any cumbersome questionnaires. In both the groups pain measurements were taken on day 1, 4 and 7 post-operatively.

CHEST EXPANSION:-

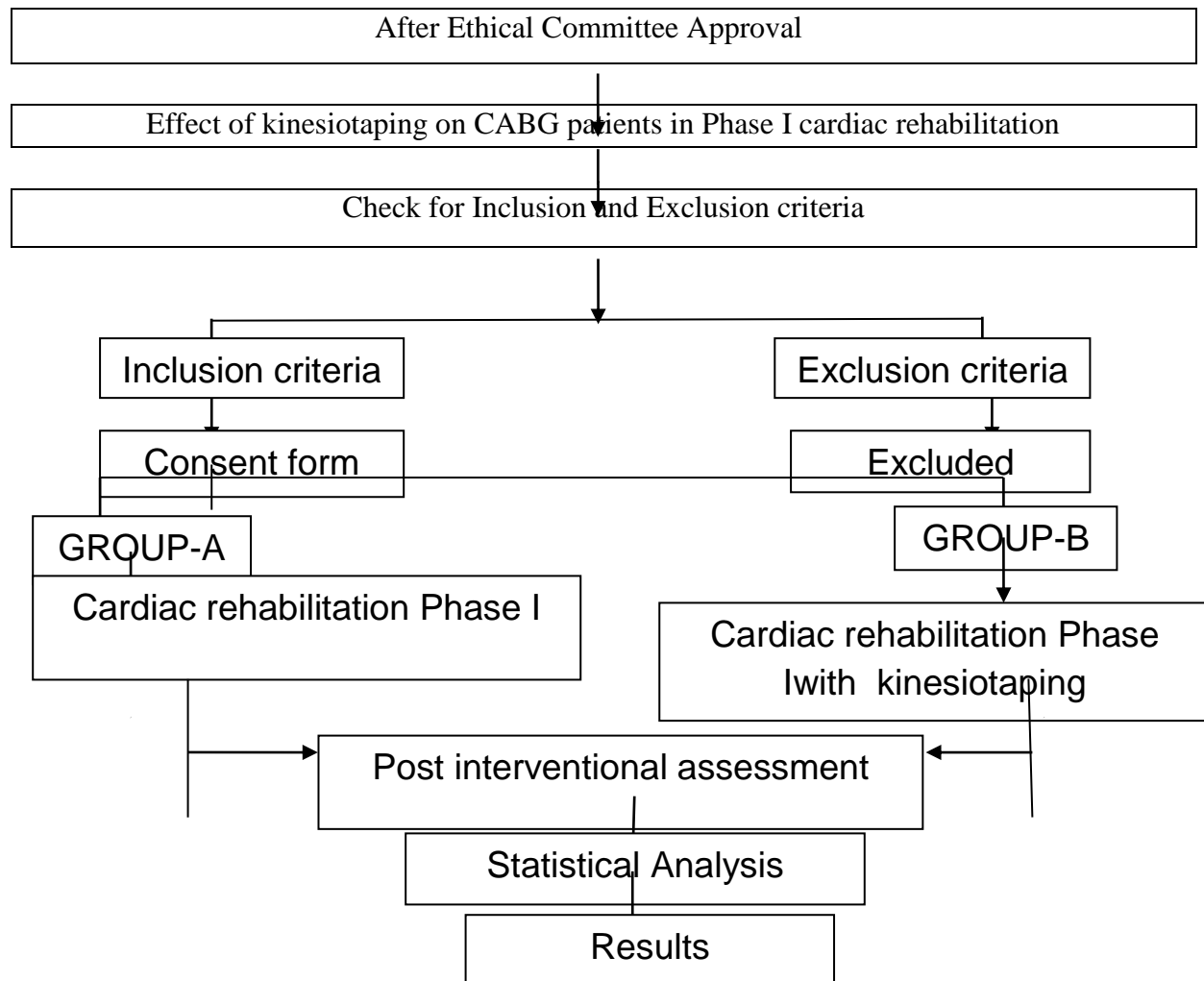
Chest expansion measurements are used to determine treatment effectiveness, extent of respiratory disease with respect to chest wall movements and functions. Here chest of patient is exposed, with the help of non-stretchable inch tape chest expansion was measured at three levels that is i)second intercostals space for Axilla ii)fourth intercostals space for nipple and iii)xiphoid process.

Patient is asked to exhale as much as possible and then take maximum deep inspiration. Difference between full expiration and full inspiration was noted. Three trials were made at each level and average readings noted. Patients are assessed for chest expansions for three days. In both the groups pain measurements were taken on day 1,4 and 7 post-operatively

RATE PRESSURE PRODUCT:-

Rate pressure product is a valuable marker of oxygen requirement of heart. RPP is defined as the RHR and SBP. Stress influenced RPP is found out through heart rate and BP changes.

Patients are assessed for RPP for 3 days. In both the groups pain measurements were taken on day 1,4 and 7 post-operatively

EQUIPMENTS AND MATERIALS: K-tape, Inch tape, Scissor**DATA- COLLECTION PROCEDURE:****Table I: Between Groups Ist day**

Sl. No:	Variable	Group A control	Group B Experimental	P-value
1	Pain	5.57±0.90	5.60±1.10	>0.926
2	Chest Expansion Axilla	0.85±0.33	0.80±0.29	>0.527
3	Chest Expansion Nipple	0.82±0.28	0.82±0.25	=1.00
4	Chest Expansion Xiphoid	1.07±0.47	1.03±0.35	>0.755
5	RPP	12099.17±2125.20	12288.63±1928.79	>0.719

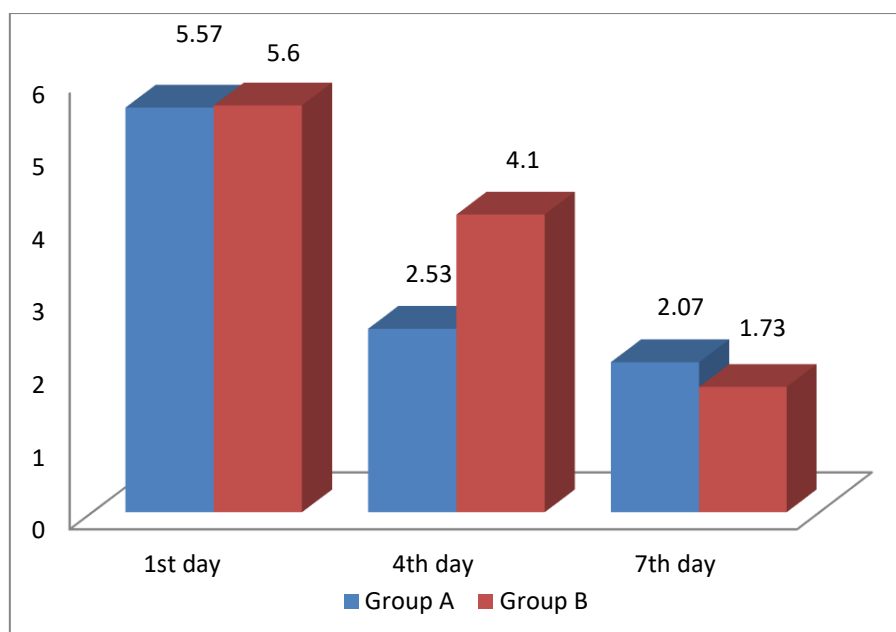
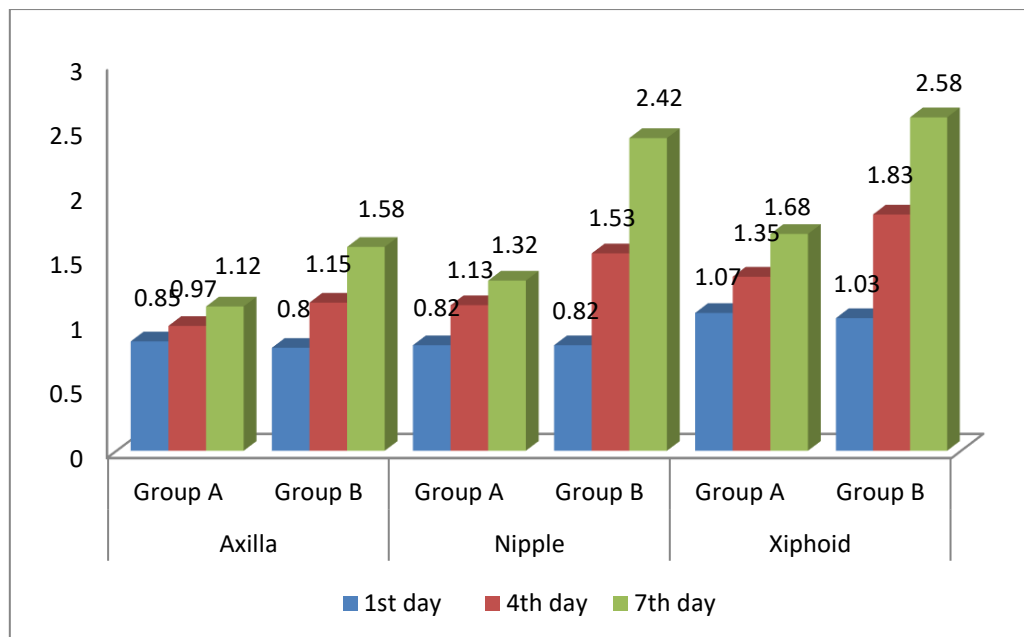


Table II: Between Groups^{4th}day

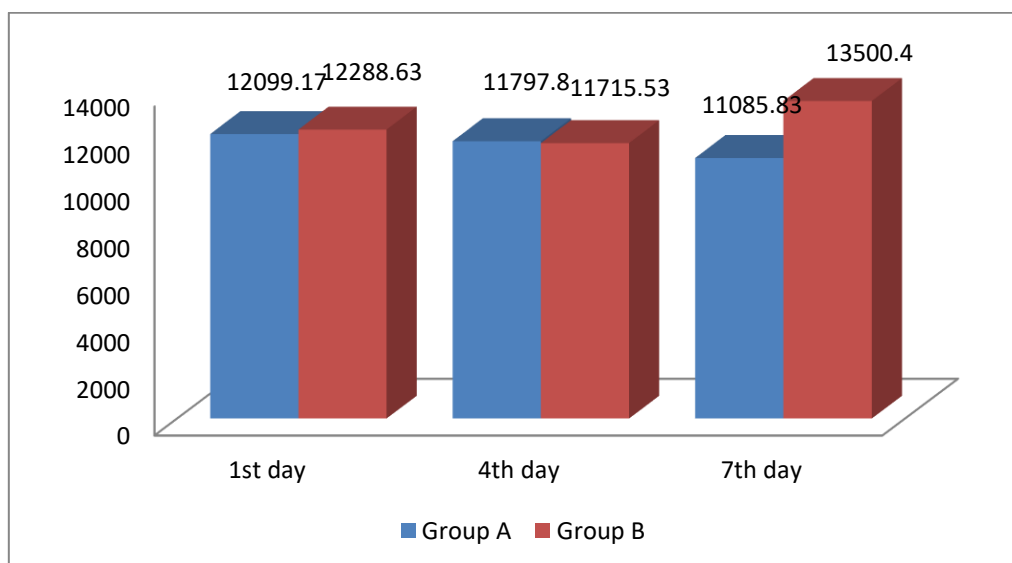
Sl. No:	Variable	Group A control	Group B Experimental	P-value
1	Pain	2.53±0.73	4.10±1.03	<0.0001
2	Chest Expansion Axilla	0.97±0.22	1.15±0.27	<0.006
3	Chest Expansion Nipple	1.13±0.29	1.53±0.45	<0.0001
4	Chest Expansion Xiphoid	1.35±0.40	1.83±0.51	<0.0001
5	RPP	11797.80±1424.44	11715.53±1204.69	>0.810

**Table III Between Groups 7th day**

Sl. No:	Variable	Group A control	Group B Experimental	P-value
1	Pain	2.07±0.64	1.73±0.52	<0.038
2	Chest Expansion Axilla	1.12±0.25	1.58±0.37	<0.0001
3	Chest Expansion Nipple	1.32±0.36	2.42±0.54	<0.0001
4	Chest Expansion Xiphoid	1.68±0.55	2.58±0.60	<0.0001
5	RPP	11085.83±1290.11	13500.40±16378.16	>0.424

Table IV: Post within Group A control

Sl. No:	Variable	1 st day	4 th day	7 th day	P-value
1	Pain	5.57±0.90	2.53±0.73	2.07±0.64	<0.0001
2	Chest Expansion Axilla	0.85±0.33	0.97±0.22	1.12±0.25	<0.0001
3	Chest Expansion Nipple	0.82±0.28	1.13±0.29	1.32±0.36	<0.0001
4	Chest Expansion Xiphoid	1.07±0.47	1.35±0.40	1.68±0.55	<0.0001
5	RPP	12099.17±2125.20	11797.80±1424.44	11085.83±1290.11	<0.0001

**Table V:Pre-post within Group B experimental**

Sl. No:	Variable	1 st day	4 th day	7 th day	P-value
1	Pain	5.60±1.10	4.10±1.03	1.73±0.52	<0.0001
2	Chest Expansion Axilla	0.80±0.29	1.15±0.27	1.58±0.37	<0.0001
3	Chest Expansion Nipple	0.82±0.25	1.53±0.45	2.42±0.54	<0.0001
4	Chest Expansion Xiphoid	1.03±0.35	1.83±0.51	2.58±0.60	<0.0001
5	RPP	12288.63±1928.79	11715.53±1204.69	13500.40±16378.16	<0.0001

RESULTS:-

Data analysis was performed by SPSS (version 17) for windows. Alpha value was set as 0.05. Descriptive statistics was performed to find out mean, standard deviation for the demographic variable and outcome variables.

Unpaired t test was used to find out significant differences among demographic variable such as age. Mann whitney U test was used to find out difference in scores between groups for pain. Friedmanns test was used to find out significant difference with in group for pain. Unpaired t test was used to find out difference in scores between groups for chest expansion axilla, nipple, xiphoid and rate pressure product.

Repeated measures of ANOVA was used to find out significant difference with in group for is effective axilla, nipple, xiphoid and rate pressure product. Microsoft excel, word was used to generate graph and tables

POST OPERATIVE DAY 1





POST OPERATIVE DAY 7



DISCUSSION:-

Coronary artery bypass graft is a surgical procedure which has an adverse effect on respiratory muscles such as diaphragm and abdominal muscles, and an increased surgical site pain. Kinesiotaping technique designed to augment body's natural healing process by providing support and stability to muscles without limiting movement of the muscle. Diaphragmatic facilitation done improves autogenic inhibition, stress relaxation.

In tables within groups A & B there was significance seen <0.001 from day 1 to day 4,7. It depicts that there is progression in recovery from day 1-7 post-operatively. Although it is same with both the groups in experimental group there is increased stress relaxation, reduced hospitalization time and reduced cost to patients overall expenses. The present experimental study was done with the primary objective to observe the effect of kinesiotaping techniques on post operative CABG patients. It was done on 60 CABG patients (both males and females)

divided in to 2 groups i.e., control (30) and experimental (30). The study included CABG patients of age 45-55years. Kinesiotaping techniques and cardiac rehabilitation in phase I were given on post operative day 1 and 4 for experimental group and only cardiac rehabilitation to the control group.

In this study of seven days of combined kinesiotaping and cardiac rehabilitation protocol there is improved outcome measures of reduced pain and increased chest expansion. Moreover, there is an increased RPP which is not significant i.e., >0.810 on day 4 and >0.424 on day 7. Kinesiotaping techniques designed to augment body's natural healing process by providing support and stability to muscles without limiting movement of the muscle. Diaphragmatic facilitation done improves autogenic inhibition, stress relaxation. Kinesiotaping and cardiac rehabilitation protocol which includes spirometry, bed exercises and ambulation. We observed that there is no improvement seen on first day in terms of pain, chest expansion and RPP but by seventh day with exercise progression on day 4 and day 7 there is reduction in pain and increase in chest expansion particularly at xiphoid level is more significantly seen as it implied directly to increase in vertical length of thoracic cage. We also observed that there is reduction in slight swelling and stress relaxation at the surgical site. In contrast, control group exhibited less magnitude of improvement in terms of reducing pain and improving chest expansions. This supports the hypothesis of our study that use of kinesiotaping post-operatively day 1 on CABG patients.

Saniye Aydoyan Arshan et. Al., found that KT applied to diaphragm muscle improves aerobic performance and pulmonary functions in the short term and when compared to sham KT group. Hernandez et. al., found that no effect on exercise capacity. In our study, KT applied with both anteriorly and posteriorly, has shown good results in reducing pain and improved chest expansion measurements. Andrea Imperatori et. al., studied that KT after lung lobectomy is safe and effective technique for chest pain control. Marcin krajczyk et. al., studied that KT creates effective support for physiotherapy, providing post operative wound stabilizations, reduction of functional activity disorders within short duration in hospital treatment. Standard physiotherapy combined with KT might shorten hospitalization time for patients.

The results of the present study revealed that Kinesiotaping combined with conventional therapy is effective in reducing pain, and improving chest expansions within Phase I Rehabilitation. There was a statistical significance of <0.001 as reduction in pain and improving chest expansion when compared from day 1 to 7 post operatively with the use of kinesiotaping and conventional therapy as it indicates increase in VAS and decrease in chest expansion in group A than in group B.

Increased chest expansion and reduction of pain has shown better results because KT as a muscle facilitation technique applied to diaphragm stated to stimulate mechanoreceptors of skin which effect diaphragm through fascia and stimulate its fibres. In contrast, there is an altered result seen in RPP, may be due to short duration of treatment and there was no follow up after the study.

CONCLUSION:-

Kinesiotaping has shown a significant difference in reducing pain, improving thoracic mobility and breathing pattern of the patient.

This study has shown that there is significant difference when comparing the effectiveness of conventional physiotherapy and kinesiotaping techniques in terms of pain and thoracic mobility.

FURTHER STUDIES:-

Further studies with larger sample size and follow up would be better in knowing the effectiveness of kinesiotaping in improving cardiorespiratory functions.

Evaluation of diaphragmatic muscle strength can be done.

LIMITATIONS:-

Treatment duration was short.

Follow up and long treatment durations would help in better assessment of rate pressure product.

REFERENCES:

1. Michael diodato and Edgar G. Chedrawy “coronary Artery Bypass Graft surgery” CT 06102-5037, Hartford. Published on 2 January 2014.
2. Stuart J. Head, Teresa M. Keiser, Volkman Falk et al “coronary artery bypass grafting : Part I- the evolution over the first 50 years”. European heart journal, 2862-2872 2013
3. Solange guizilini, Walter J. GOMES, Sonia M. FARESIN, Antonio Carlos c. carvalho, Jaime i. jaramillo, Francisco a. Alves, Roberto CATANI, Enio buffolo Effects of the pleural drain site on the pulmonary function after coronary artery bypass grafting Rev Bras Cir Cardiovasc 2004; 19(1): 47-54
4. Rochelle Wynne, and Mari, postoperative pulmonary dysfunction in adults after cardiac surgery with cardiopulmonary bypass: clinical significance and implications for practice american journal of critical care, september 2004, volume 13, no. 5
5. Isabel Yanez - Brage et.al Respiratory Physiotherapy and incidence of Pulmonary complications in off-pump CABG an observational follow up study 2009
6. Charles weissmann, Pulmonary complications after cardiac surgeries September 1, 2004
7. Neshat Hasan Niyayeh Saffari,¹ Ebrahim Nasiri,² Seyed Nouraddin Mousavinasab,² Rahman Ghafari,² Aria Soleimani,² and Ravanbakhsh Esmaeili³ Frequency Rate of Atelectasis in Patients Following Coronary Artery Bypass Graft and Its Associated Factors at Mazandaran Heart Center in 2013-2014 Published online 2015 Mar 26. doi: [10.5539/gjhs.v7n7p97](https://doi.org/10.5539/gjhs.v7n7p97)
8. Christopher Noel MD Postoperative pulmonary complications of cardiac surgery February 6, 2018
9. Jan Heerman Effects of off-pump coronary surgery on the mechanics of the respiratory system, lung, and chest wall: Comparison with extracorporeal circulation 30(11):2430-7 · December 2002

10. Isabel Yáñez-Brage,¹ Salvador Pita-Fernández,² Alberto Juffé-Stein,³ Ursicino Martínez-González,³ Sonia Pértega-Díaz,² and Ángeles Mauleón-García Respiratory physiotherapy and incidence of pulmonary complications in off-pump coronary artery bypass graft surgery: an observational follow-up study *BMC Pulm Med.* 2009; 9: 36. Published online 2009 Jul 28. doi: 10.1186/1471-2466-9-36
11. Danuta Lietz-Kijak, Edward Kijak, Marcin Krajczyk, Katarzyna Bogacz, Jacek Łuniewski, and Jan Szczegielniak The Impact of the Use of Kinesio Taping Method on the Reduction of Swelling in Patients After Orthognathic Surgery: A Pilot Study *Med Sci Monit.* 2018; 24: 3736–3743. Published online 2018 Jun 4. doi: 10.12659/MSM.909915
12. <https://kinesiotaping.com/about/what-is-the-kinesio-taping-method/>
13. Dérriek Patrick Artioli , Gladson Ricardo Flor Bertolini Kinesio taping: application and results on pain: systematic review DOI: 10.1590/1809-2950/553210114
- 14 Cheng hu jung The Effects of Scapular Taping on Electromyography Muscle Activity and Proprioception Feedback in Healthy Shoulders *Journal of Orthopaedic Research* 29(1):53-January 2011 DOI: 10.1002/jor.21146 .
- 15 C. Koradia 1, M. Jiandani can diaphragmatic taping improve Pulmonary function post open heart surgery <https://doi.org/10.1016/j.physio.2015.03.3662>
16. Joseph Tessler; Bruno Bordoni Cardiac Rehabilitation : May 4, 2019.
- 17.Margo simon et. al., Cardiac rehabilitation: A class 1 recommendation, doi:10.3949/ccjm.85a.17037 July 2018
- 18 Chung-Han Ho, PhD, Yi-Chen Chen, MS, Chin-Chen Chu, MD, PhD, Jhi-Joung Wang, MD, PhD, and Kuang-Ming Liao, MD, MS Postoperative Complications After Coronary Artery Bypass Grafting in Patients With Chronic Obstructive Pulmonary Disease 2016 Feb;95(8): e2926. Published online 2016 Mar 3.
19. Ronaldo Vegni¹; Gustavo Ferreira de Almeida¹; Fabricio Braga¹; Marcia Freitas¹; Luis Eduardo Drumond¹; Guilherme Penna¹; José Kezen¹; Gustavo Freitas Nobre¹; Marcelo Kalichshtein¹; André Miguel Japiassú Postoperative cardiac artery bypass graft complications in elderly patients Accepted on July 31, 2008
- 20 Joong-San Wang, PT, PhD1), Kyun-Hee Cho, PT2), Shin-Jun Park, PT, The immediate effect of diaphragm taping with breathing exercise on muscle tone and stiffness of respiratory muscles and SpO2 in stroke patient *J. Phys. Ther. Sci.* 29: 970–973, 2017
21. Hae-Yong Lee, PhD, Song-Hee Cheon, PhD, Min-Sik Yong, Effect of diaphragm breathing exercise applied on the basis of overload principle *J. Phys. Ther. Sci.* 29: 1054–1056, 2017
22. Mohammadreza Sattari, Mohammad Ebrahim Baghdadchi, Marzieh Kheyri, Hassan Khakzadi, Simin Ozar Mashayekhi “Study of Patient Pain Management after Heart Surgery” *Advanced Pharmaceutical Bulletin*, 2013, 3(2), 373-377
23. Sarah Henderson The Clinical Effectiveness of Using Kinesio Tape Following Wisdom Teeth Extraction *Physiother Rehabil* 1:103. doi:10.4172/2573-0312.1000103
- 24 .Kindal malehorn, jodi hiniker, theresa mackey, kristin j. heumann, steven ross murray, and robert w. pettitt kinesio tape® applied to the thorax augments ventilatory efficiency during heavy exercise *international journal of exercise science* 6(2) : 157-163, 2013
- 25.Jan Szczegieniak et al The possibilities of using Kinesiotaping in patients after cardiac surgery. *MEDSPORTPRESS*, 2007; 4(4); Vol 7, 465-471

- 26 Jaspreet kaur, manoj kumar, mounika rani a systematic review on efficacy of kinesiotaping in pain management int j physiotherapy. vol 3(3), 355-361, june (2016)
- 27 Mehran Mostafavifar , Jess Wertz , DO & james borchers , A Systematic Review of the Effectiveness of Kinesio Taping for Musculoskeletal Injury Journal The Physician and Sportsmedicine Volume 40, 2012 - Issue 4
- 28 Saniye Aydogan Arslan, Arzu Daskapan, Nihan Ozunlu Pekyavas, Elif Sakizli Effects of Kinesio Taping Applied to Diaphragm Muscle on Aerobic Exercise Capacity and Pulmonary Function in Sedentary Individuals DOI: 10.21673/anadoluklin.385414
29. E. WESTERDAHL Optimal technique for deep breathing exercises after cardiac surgery (Minerva Anestesiol 2015;81:678-83)
30. Ghada E El-Refaye PhD , Engy M El Nahas¹, Hassan O Ghareeb² Effect of kinesio taping therapy combined with breathing exercises on childbirth duration and labor pain: a randomized controlled trial Year : 2016 Volume : 21 Issue : 1 Page : 23-31
31. Sean Williams , Chris Whatman, Patria A Hume, Kelly Sheerin Kinesio taping in treatment and prevention of sports injuries: a meta-analysis of the evidence for its effectiveness Sports Med 2012 Feb 1;42(2):153-64. doi: 10.2165/11594960-000000000-00000
32. Burcu Metin Ökmen , Korgün Ökmen Effectiveness of kinesiotaping on diaphragm thickness, diaphragmatic thickening fraction, and intercostal muscle thickness in patients undergoing mechanical ventilation: a pilot study published on April 5, 2018 as 10.18621/eurj.373465
33. L R Fisher , M I Cawley, S T Holgate Relation between chest expansion, pulmonary function, and exercise tolerance in patients with ankylosing spondylitis PMID: 2256739