Turkish Journal of Thoracic and Cardiovascular Surgery 2019;27(2):173-177
http://dx.doi.org/doi: 10.5606/tgkdc.dergisi.2019.17517

Original Article / Özgün Makale

The relationship between chest pain intensity and physiological indicators after coronary artery bypass grafting: A correlational study

Koroner arter baypas greftleme sonrası göğüs ağrısının şiddeti ve fizyolojik belirteçler arasındaki ilişki: Korelasyon çalışması

Ali Fakhr-Movahedi[1], Afsaneh Zarei[2], Abbasali Ebrahimian[1]

[1]Nursing Care Research Center, Nursing and Midwifery School, Semnan University of Medical Sciences, Semnan, Iran
[2]Student Research Committee, Nursing and Midwifery School, Semnan University of Medical Sciences, Semnan, Iran

ABSTRACT

Background: This study aims to evaluate the relationship between chest pain intensity and physiological indicators in patients undergoing coronary artery bypass grafting.

Methods: In this correlational study, chest pain intensity and physiological responses of a total of 126 coronary artery bypass grafting patients (104 males, 22 females; mean age 62.3±8.5 years; range, 45 to 80 years) during respiratory exercise were evaluated in a referral hospital setting between December 2016 and March 2018. On the second day after surgery, pain intensity was measured by a numerical rating scale. Physiological indicators were collected using the Nihon Kohden (MU65) monitoring device.

Results: The mean pain intensity score was 7.8±1.9 (range, 1 to 10). There was no significant correlation between the pain intensity and physiological indicators (p>0.05). There was a negative correlation between the pain intensity and age of the patient (r=-0.183 and p=0.04). Pain intensity was not significantly different between male and female gender (p=0.064).

Conclusion: Our study results show no significant relationship between the chest pain intensity and physiological responses in patients undergoing coronary artery bypass grafting.

Keywords: Chest pain intensity, coronary artery bypass grafting, physiological indicator.

ÖZ

Amaç: Bu çalışmada koroner arter baypas greftleme yapılan hastalarda göğüs ağrısının şiddeti ve fizyolojik belirteçler arasındaki ilişki incelendi.

Çalışma planı: Bu korelasyon çalışmasına Aralık 2016 - Mart 2018 tarihleri arasında bir üniversite hastanesinde koroner arter baypas greftleme yapılan toplam 126 hastanın (104 erkek, 22 kadın; ort. yaş 62.3±8.5 yıl; dağılım, 45-80 yıl) göğüs ağrısı şiddeti ve fizyolojik yanıtları solunum egzersizi sırasında değerlendirildi. Ameliyatın ikinci gününde ağrı şiddeti sayısal bir değerlendirme ölçeği ile ölçüldü. Fizyolojik belirteçler, Nihon Kohden (MU65) takip cihazı ile belirlendi.

Bulgular: Ortalama ağrı şiddeti skoru 7.8±1.9 (dağılım 1-10) idi. Ağrı şiddeti ve fizyolojik belirteçler arasında anlamlı bir ilişki saptanmadı (p>0.05). Ağrı şiddeti ve hastanın yaşı arasında negatif bir ilişki izlendi (r=-0.183 ve p=0.04). Ağrı şiddeti erkek ve kadın cinsiyeti arasında anlamlı düzeyde farklı değildi (p=0.064).

Sonuç: Çalışma sonuçlarımız, koroner arter baypas greftleme yapılan hastalarda göğüs ağrısının şiddeti ve fizyolojik yanıtlar arasında anlamlı bir ilişki olmadığını göstermektedir.

Anahtar sözcükler: Göğüs ağrısı şiddeti, koroner arter baypas greftleme, fizyolojik belirteç.

Coronary artery bypass grafting (CABG) is one of the therapeutic modes in some cardiac disorders such as coronary artery diseases.[1] Despite therapeutic effects of open heart surgery, postoperative patients may experience many biological and psychological conditions.[2] Thoracotomy and post-sternotomy pain is an unpleasant feeling experienced by most of the patients after CABG.[3,4] Usually, %75 of patients suffer from pain postoperatively. In addition to discomfort, this pain affects the patient's physiological responses such as respiration, pulse, blood pressure, myocardial oxygen consumption, and cardiac output.[5]

Received: November 08, 2018 *Accepted:* December 19, 2018 *Published online:* April 24, 2019

Correspondence: Ebrahimian Abbasali, MD. Nursing Care Research Center, Nursing and Midwifery School, Semnan University of Medical Sciences, 35198-99951 Semnan, Iran. Tel: 00989123321418 e-mail: aa.ebrahimian@semums.ac.ir

Cite this article as:
Fakhr-Movahedi A, Zarei A, Ebrahimian A. The relationship between chest pain intensity and physiological indicators after coronary artery bypass grafting: A correlational study. Turk Gogus Kalp Dama 2019;27(2):173-177

Since pain management is an indicator of the quality of care,[6] pain evaluation is one of the important tasks of nurses and other health care personnel to tailor an appropriate caring program. Pain perception is a complex process and is related to various factors such as level of anxiety, previous experiences, and individuality of patients.[7] Using pain scales is a usual method for pain evaluation in the clinical setting. Most of the pain scales are self-report measures which evaluate pain severity according to patients' expressions. However, the methods of self-report may not be adequate due to lack of patients' collaboration or altered level of consciousness of the patient.[8] Also, self-report methods measure pain subjectively and mostly do not provide an exact and reliable assessment of pain.[6] Physiological responses indicate the threatening status of diseases.[9] Therefore, many clinicians and scientists have emphasized that an objective assessment of pain is more essential for pain management.[10] However, there is not enough evidence for a clear relationship between the severity of pain with physiological responses. In this regard, Block et al. found no relationship between vital signs and self-reported pain intensity.[11]

Despite the variety of pain evaluation methods, it seems that there is still no established consensus regarding the most optimal way to measure pain. Therefore, further researches are needed to specify how the patient responses to a painful condition in the clinical setting.[12] In the present study, we aimed to investigate the possible relationship between chest pain intensity and physiological indicators in patients undergoing CABG.

PATIENTS AND METHODS

In this correlational study, chest pain intensity and physiological responses of a total of 180 CABG patients during respiratory exercise were evaluated in a referral hospital setting in Iran between December 2016 and March 2018. However, 126 eligible patients (104 males, 22 females; mean age 62.3±8.5 years; range, 45 to 80 years) were enrolled.[13] *Inclusion criteria were as follows:* being cooperative, having an ability to establish verbal communication, and having the first experience of open heart surgery and not receiving analgesic medication within the last four hours. *Exclusion criteria were as follows:* being under mechanical ventilation, having delirium, hallucinations, severe depression, or surgery abscess, bleeding, and current or recent use of analgesic medications. A written informed consent was obtained from each patient. The study protocol was approved by the Ethics Committee of Semnan University of Medical Sciences, Semnan, Iran (No: IR.SEMUMS.REC.1395.96 /23.09.2016). The study was conducted in accordance with the principles of the Declaration of Helsinki.

All patients were operated by a single surgeon. The patients were hospitalized in the bed and their sternum stability were the same. In addition, a single sternal fixation technique was used in all patients. The fixation was performed by stainless steel wires of the same size (No. 7 USP; Dispomedica GmbH, Hamburg, Germany).

Data collection and measurements

On the second day after surgery, all patients received a non-steroidal anti-inflammatory drug (Gelofen® 400 mg capsule; Daana Pharmaceutical Company, Tabriz, Iran) at 05:00 am. Then, during respiratory exercise at 10:00 am, chest pain intensity and physiological indicators of systolic and diastolic blood pressure, heart rate, respiratory rate, oxygen saturation, and mean arterial pressure were measured. All measurements were performed at bedside. The chest pain severity was measured by a numerical rating scale (NRS) of pain which was validated by several studies.[14,15] The physiological indicators were measured using the Nihon Kohden (MU65) monitoring device (Nihon Kohden, Tokyo, Japan) which was calibrated for each measurement.

Statistical analysis

Statistical analysis was performed using the IBM SPSS for Windows version 23.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean ± standard deviation (SD) or number and frequency. The normality of data was analyzed using the Kolmogorov-Smirnov test. The chi-square test was used to describe demographic variables. Independent Student's t-test and Mann-Whitney U test were used to compare variables between two independent groups. The Pearson correlation analysis was used to evaluate possible relationship between the chest pain intensity and physiological indicators. A p value of <0.05 was considered statistically significant.

RESULTS

Of all patients, 51.6% were diabetics and 48.4% were non-diabetics. There was no significant difference between diabetic and non-diabetic patients in terms of pain intensity and physiological indicators.

The mean pain intensity score was 7.8±1.9 (range, 1 to 10). There was no significant correlation between the pain intensity and physiological indicators ($p>0.05$) (Table 1).

Table 1. Correlation between physiological indicators and pain intensity

Variable	Mean±SD	Min-Max	Correlation coefficient	*p*
Systolic blood pressure (mmHg)	119.9±11.3	90-149	0.002	0.97*
Diastolic blood pressure (mmHg)	71.6±10.6	45-96	-0.053	0.55**
Heart rate (beat/min)	73.6±8.6	54-94	0.17	0.056*
Respiratory rate	16.0±1.7	12-23	0.037	0.68*
O_2 saturation (%)	96.7±8.1	90-100	-0.027	0.76*
Mean arterial pressure	87.7±10.1	62.66-113.66	-0.42	0.64**

SD: Standard deviation; Min: Minimum; Max: Maximum; * Spearman's correlation coefficient; ** Pearson's correlation coefficient.

Table 2. Pain intensity and physiological indicators according to gender

	Gender		
	Male	Female	
Variable	Mean±SD	Mean±SD	*p*
Pain severity	7.3±2.00	8.2±1.4	0.064*
Systolic blood pressure (mmHg)	119.0±11.3	124.3±10.6	0.110*
Diastolic blood pressure (mmHg)	70.2±10.5	78.3±9.0	0.001**
Heart rate (beat/min)	72.7±8.3	77.7±8.9	0.006*
Respiratory rate	16.0±1.7	15.9±1.5	0.653*
O_2 saturation (%)	96.4±8.9	98.1±1.9	0.142*
Mean arterial pressure	86.4±9.8	93.9±9.3	0.001**

SD: Standard deviation; * Mann-Whitney U test; ** T-test.

However, the Pearson correlation analysis revealed a negative and significant correlation between the pain intensity scores and age of the patient (r=-0.183 and p=0.04), and older patients reported lower pain intensity. In addition, there was a negative and significant correlation between the age and oxygen saturation (p=0.001), and older patients had lower oxygen saturation levels.

Furthermore, diastolic blood pressure, heart rate, and mean arterial pressure were significantly higher in women than men. However, other physiological indicators and pain intensity were not significantly different between men and women (Table 2).

DISCUSSION

Post-sternotomy pain is a common problem in patients after CABG. Most patients experience various degrees of postoperative pain.[16] Evaluation of pain intensity is one of the important action of nurses and other health care personnel in the clinical setting. In the present study, we analyzed the possible relationship between chest pain intensity and physiological indicators. The results of the study showed that there was no significant relationship between the pain intensity and physiological indicators in CABG patients. Similarly, Ledowski et al.[8] found no relationship between the pain severity and hemodynamic and autonomic responses in patients after surgery. Daoust et al.[17] also concluded that vital signs should not be used as an estimation tool for pain intensity. In an observational study in the emergency setting, Marco et al.[18] reported no clinically significant relationship between the self-reported pain intensity and heart rate, blood pressure, and respiratory rate. On the other hand, in some studies, the pain was found to be correlated with physiological responses. Zamunér et al.[19] observed a correlation between the pain intensity and sympathetic activity in fibromyalgia patients. Helfer and McCubbin[20] also found an inverse

correlation between the resting blood pressure and pain intensity in healthy young adults. In addition, Hallman et al.[21] reported that patients with chronic neck and shoulder pain had heart rate variability than healthy individuals. According to the aforementioned studies, it seems there is no clear evidence indicating a relationship between post-sternotomy pain intensity and physiological responses among CABG patients. However, this can be attributed to several reasons. In the present study, we evaluated pain intensity on the second day after surgery, in which the patients were in a stable condition. Also, due to the acute nature of post-sternotomy pain, physiological responses might have not been affected, while chronic pain decreases the activity of the parasympathetic system, leading to an increase in the heart rate and blood pressure.[22] Therefore, further studies are warranted to clarify the relationship between the pain intensity and physiological responses in the clinical setting.

In our study, although the mean pain intensity in women was higher than men, the difference was not statistically significant. Similarly, Kállai et al.[23] found no significant difference in the intensity, threshold, and tolerance of pain between the male and female patients. However, Zeidan et al.[24] found higher pain scores and morphine consumption in women than men in the postoperative period. The results of Hussain et al.'s study[25] also showed an increase in the pain intensity of women than men. The lack of a significant difference in the pain intensity between male and female patients in our study can be explained by the lower number of female patients.

On the other hand, some physiological indicators such as heart rate, diastolic pressure, and mean arterial pressure were significantly higher in women than men in our study. However, Aslaksen and Flaten[26] reported that pain did not affect the heart rate. Hence, we recommend further studies to investigate and clarify the relationship of pain with gender and physiological responses.

Furthermore, we found a negative and significant correlation between the pain intensity and age of patient. In contrast, Moradi-Farsani et al.[27] concluded that the patients aged between 53 and 70 years had more intense pain than younger patients. In our study, the age ranges from 45 to 80 years, indicating that pain perception might have been influenced by advanced age. Also, type of medical conditions and pain perception might have affected pain response.

The main limitations of this study include a small sample size due to rigorous inclusion criteria and the lack of younger patients. Therefore, further large-scale studies including younger patients are needed to confirm our findings.

In conclusion, our study results show no significant relationship between the chest pain intensity and physiological responses in patients undergoing coronary artery bypass grafting. Although identification of perceived pain can play a role in screening patients, further studies are required to establish a definite conclusion on this topic.

Acknowledgements

We would like to thank the Nursing Care Research Center of Semnan University of Medical Sciences for providing facilities for this work and all patients that participated in this study and their sincere cooperation. This study was part of a Master's Thesis in critical care nursing, which was conducted at Semnan University of Medical Sciences, Semnan, Iran.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

REFERENCES

1. Adam S, Osborne S, Welch J, editors. Critical care nursing: science and practice. 3rd ed. Oxford: Oxford University Press; 2017.
2. Safaie N, Montazerghaem H, Jodati A, Maghamipour N. In-Hospital Complications of Coronary Artery Bypass Graft Surgery in Patients Older Than 70 Years. J Cardiovasc Thorac Res 2015;7:60-2.
3. Eti Aslan F, Korkmaz DF , Karabacak Ü. Pain in cardiac surgery and the nursing approach. Turk Gogus Kalp Dama 2012;20:172-6.
4. Cücü O, Karaca P, Enc Y, Yücel O, Aksoy T, Şenay Ş, Canik S. Comparison of thoracic paravertebral and epidural blocks for pain relief after thoracotomy. Turk Gogus Kalp Dama 2006;14:42-7.
5. Fayazi S, Shariati AAA, Momeni M. The efficacy of Benson's relaxation technique on postoperative pain in coronary artery bypass graft. Jundishapur Sci Med J 2010;8:479-89.
6. Kumar P, Tripathi L. Challenges in pain assessment: Pain intensity scales. Indian J Pain 2014;28:61-70.
7. Li Q, Wan X, Gu C, Yu Y, Huang W, Li S, et al. Pain assessment using the critical-care pain observation tool in Chinese critically ill ventilated adults. J Pain Symptom Manage 2014;48:975-82.
8. Ledowski T, Reimer M, Chavez V, Kapoor V, Wenk M. Effects of acute postoperative pain on catecholamine plasma levels, hemodynamic parameters, and cardiac autonomic control. Pain 2012;153:759-64.
9. Chanques G, Sebbane M, Barbotte E, Viel E, Eledjam JJ, Jaber S. A prospective study of pain at rest: incidence and

characteristics of an unrecognized symptom in surgical and trauma versus medical intensive care unit patients. Anesthesiology 2007;107:858-60.
10. Cowen R, Stasiowska MK, Laycock H, Bantel C. Assessing pain objectively: the use of physiological markers. Anaesthesia 2015;70:828-47.
11. Samartzis D, Borthakur A, Belfer I, Bow C, Lotz JC, Wang HQ, et al. Novel diagnostic and prognostic methods for disc degeneration and low back pain. Spine J 2015;15:1919-32.
12. Gélinas C, Johnston C. Pain assessment in the critically ill ventilated adult: validation of the Critical-Care Pain Observation Tool and physiologic indicators. Clin J Pain 2007;23:497-505.
13. Krejcie RV, Morgan DW. Determining sample size for research activities. Educ Psychol Meas 1970;30:607-10.
14. Ferreira-Valente MA, Pais-Ribeiro JL, Jensen MP. Validity of four pain intensity rating scales. Pain 2011;152:2399-404.
15. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). Arthritis Care Res (Hoboken) 2011;63:240-52.
16. Tokgöz ST, Yılmaz D, Tokgöz Y, Çelik B, Bulut Y. The evaluation of arterial stiffness of essential hypertension and white coat hypertension in children: a case-control study. Cardiol Young 2018;28:403-8.
17. Daoust R, Paquet J, Bailey B, Lavigne G, Piette É, Sanogo K, et al. Vital Signs Are Not Associated with Self-Reported Acute Pain Intensity in the Emergency Department. CJEM 2016;18:19-27.
18. Marco CA, Plewa MC, Buderer N, Hymel G, Cooper J. Self-reported pain scores in the emergency department: lack of association with vital signs. Acad Emerg Med 2006;13:974-9.
19. Zamunér AR, Barbic F, Dipaola F, Bulgheroni M, Diana A, Atzeni F, et al. Relationship between sympathetic activity and pain intensity in fibromyalgia. Clin Exp Rheumatol 2015;33(1 Suppl 88):S53-7.
20. Helfer SG, McCubbin JA. Does gender affect the relation between blood pressure and pain sensitivity? Int J Behav Med 2001;8:220-9.
21. Hallman DM, Ekman AH, Lyskov E. Changes in physical activity and heart rate variability in chronic neck-shoulder pain: monitoring during work and leisure time. Int Arch Occup Environ Health 2014;87:735-44.
22. Tracy LM, Ioannou L, Baker KS, Gibson SJ, Georgiou-Karistianis N, Giummarra MJ. Meta-analytic evidence for decreased heart rate variability in chronic pain implicating parasympathetic nervous system dysregulation. Pain 2016;157:7-29.
23. Kállai I, Barke A, Voss U. The effects of experimenter characteristics on pain reports in women and men. Pain 2004;112:142-7.
24. Zeidan A, Al-Temyatt S, Mowafi H, Ghattas T. Gender-related difference in postoperative pain after laparoscopic Roux-En-Y gastric bypass in morbidly obese patients. Obes Surg 2013;23:1880-4.
25. Hussain AM, Khan FA, Ahmed A, Chawla T, Azam SI. Effect of gender on pain perception and analgesic consumption in laparoscopic cholecystectomy: An observational study. J Anaesthesiol Clin Pharmacol 2013;29:337-41.
26. Aslaksen PM, Flaten MA. The roles of physiological and subjective stress in the effectiveness of a placebo on experimentally induced pain. Psychosom Med 2008;70:811-8.
27. Moradi-Farsani D, Akrami F, Naghibi K, Alikiaii B, Nazemorroaya B. The effect of age and sex on postoperative pain after deep vitrectomy. J Isfahan Med Sch 2017;34:1660-5.