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ORIGINAL RESEARCH

Comparison of the Effects of 20 W and 40 W Electrocautery Power on Postoperative Pain Following Internal Thoracic Artery Harvesting in Coronary Bypass Surgery

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Purpose: After coronary artery bypass graft surgery (CABG), patients may experience pain and numbness in the anterior chest wall. These symptoms can negatively impact patients' quality of life and overall cardiac surgery satisfaction. This study investigates the effect of monopolar electrocautery output power, for hemostasis in the remaining internal thoracic wall after harvesting of the Internal Thoracic Artery (ITA), on postoperative pain in the anterior chest wall.

Patients and Methods: This paper examined 100 patients who had ITA harvesting during CABG in a Cardiovascular Surgery Clinic. Patients who were able to comply with postoperative pain tests and had sufficient mental and visual capacity were included in the study. In Group 1 (n: 50) patient, after the ITA was harvested, hemostasis was performed with 20 watt cautery power on the inner wall of the thorax. In Group 2 (n: 50) patients, hemostasis was performed with 40 watt electrocautery power. It was investigated whether there was a difference between these two groups in terms of postoperative drainage amounts and pain in the anterior chest wall with Behavioral Pain Scale (BPS) and Visual Analogue Scale (VAS).

Results: No statistically significant difference between Group 1 and Group 2 regarding demographic data and postoperative drainage amounts. However, in Group 1, in patients who hemostasis performed in the inner wall of the thorax with a low cautery power of 20 watts, postoperative pain was statistically significantly lower than in Group 2 in terms of BPS and VAS.

Conclusion: After harvesting of the ITA, hemostasis of the thoracic wall with 20 watt low cautery power does not affect the postoperative drainage. Additionally, these patients experience less postoperative pain due to less thermal damage after CABG. Furthermore, lower postoperative pain levels may reduce treatment costs by reducing analgesic requirements and intensive care duration.

Keywords: coronary artery bypass, electrocautery, internal thoracic artery

Introduction

Coronary artery bypass graft surgery (CABG) is a commonly preferred surgical intervention in the treatment of heart diseases. After CABG, patients may experience various complaints, such as pain and numbness, especially in the anterior chest wall. Such complaints may occur immediately after surgery or in the longer term. Although pain and numbness in the anterior chest wall after CABG are often temporary, the condition may become chronic for some patients. If left untreated, this postoperative pain reduces the quality of life and the patient's satisfaction with cardiac surgery.[1–7]

Pain and numbness in the anterior chest wall after CABG can be caused by several main reasons. The main reasons are sternotomy and stretching of the chest wall. Pain due to intercostal nerve damage in the thoracic wall where Internal Thoracic Artery (ITA) is harvested during CABG is also one of the essential causes of postoperative pain. Studies report that intercostal nerve damage occurs postoperatively in 75% of patients who had ITA harvested during CABG surgery.

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Along with pain, numbness can also be observed on the anterior chest wall, especially on the thorax where the ITA was removed.[7]

ITA is the standard and most preferred graft used for CABG because it can remain open for a long time.[8] After harvesting of the ITA, hemostasis of the remaining inner thorax wall is usually done with the help of electrocautery. However, no standard heat setting is defined for this electrocautery heat power. Generally, the electrocautery power used for hemostasis can be at least 40 watts, 70–80 degree Celsius. Postoperative complaints such as pain and numbness on the left side of the sternum that lasts for months as a result of sensory nerve damage due to thermal burn in this area as a result of this high degree.[9]

According to general trends, cauterization is performed with 40 watts and above cautery heat power for hemostasis on the remaining thoracic inner wall after ITA harvesting. After ITA, harvesting, electrocautery power used for hemostasis on the remaining ITA bed on the inner surface of the thorax may damage surrounding tissues due to excessive heat. High watts and temperatures may cause tissue burns or unwanted damage. The probability of developing intercostal nerve damage increases proportionately to the high heat value—in this case, postoperative pain and patient dissatisfaction increase. The length of intensive care unit stay may be extended due to respiratory distress due to pain. As a result, treatment costs may increase due to higher postoperative pain levels, increased analgesic requirements, and increased intensive care duration.

This study investigated the effects of two different cautery powers, 20 and 40 watts, applied to hemostasis in the remaining inner thoracic wall after ITA harvesting on postoperative pain in the anterior chest wall.

Materials and Methods

This is a single-center, retrospective observational study. The study was approved by the Kastamonu University Ethics Committee (2024 -KAEK-125), and written informed consent was obtained from all participants before their inclusion in the study. It was obtained by scanning the retrospective files of the patients and the data in the hospital information management system. The patients' demographic data (age, gender, additional diseases, etc) were scanned retrospectively from the hospital records. The two study groups consisted of equal numbers of patients. The same surgical team performed all surgeries.

This study examined 100 patients who underwent ITA harvesting for CABG between January 2022 and January 2025 in Cardiovascular Surgery clinic. Among the patients who underwent CABG surgery between these dates, patients with adequate vision and consciousness and who could comply with pain tests were included in the study. These patients were divided into two groups. Group 1 (n: 50 patients who coagulated with 20 watt to control bleeding in the remaining inner thoracic wall after ITA was removed) and Group 2 (n: 50 who coagulated with 40 watts to control bleeding in the remaining inner thoracic wall after ITA removed). The degree to which the ITA bed was cauterized with electrocautery during surgery was recorded during surgery for both patient groups.

After the surgery, the patients were observed in the cardiovascular surgery intensive care unit. As in routine, patients were followed up in terms of drainage. BPS was performed on the patients before extubation. After extubation, VAS tests were performed on the patients in the first 6 hours, 24 hours, and 7 days. In addition, all patients' total days of intensive care and total hospital stay were recorded. It was investigated whether there was a difference between the two groups in terms of postoperative drainage amount and postoperative left sternum pain. The drainage amounts within the first 24 hours after surgery were calculated retrospectively from the cardiovascular surgery intensive care unit follow-up charts. After surgery, BPS was applied to the patients before extubation in the intensive care unit. After extubation, VAS tests were applied to the patients at the first 6 hours, 24 hours, and 7 days. It was evaluated with Behavioral Pain Scale (BPS) and Visual Analogue Scale (VAS) (a worldwide standard test for pain management and clinical assessment).[10] Intensive care durations and total hospital stay days were recorded and compared for two groups.

Statistical Analysis

For statistical analysis, the SPSS version 25 program was applied. Mean and standard deviation values are used to present descriptive analyses. While normally distributed (parametric) variables were evaluated among the groups, the Student's *t*-test was used. The Mann–Whitney *U*-test was used to assess non-parametric variables. A p-value <0.05 was evaluated as a statistically significant result. A formal a priori power analysis was not performed prior to the study. However, based on similar studies in the literature and considering feasibility within the study period, a sample size of 100 patients was deemed sufficient to detect clinically meaningful differences.[7]

Results

Group 1 and Group 2 were compared statistically regarding demographic data, comorbid conditions, and the number of coronary arteries bypassed. After these comparisons, no statistically significant difference was found in demographic data, comorbid conditions, or the number of coronary arteries bypassed. These preoperative clinical characteristics are shown in Table 1.

In the postoperative follow-up, ıntubation times were longer in Group 2 in terms of median value (7.5), which was considered statistically significant (p<0.001). No statistically significant difference was found between the two groups regarding drainage amounts (p=0.790). BPS>3, the patient's pain was considered significant. Regarding BPS, the median value was found to be (1.7) in Group 1, and the median value was found to be (5.4) in Group 2. A statistically significant increase was found in Group 2 in BPS (p<0.001). VAS values taken 6, 24 hours after extubation, and 7 days after surgery were statistically significantly higher in Group 2 (p<0.001). Intensive care durations differed in both groups. Regarding days spent in intensive care, the median value was found to be (2.9) in Group 1, and the median value was found to be (3.4) in the 40-degree group. The 40-degree group was found to have a significantly longer intensive care stay (p=0.001). There was no significant difference between the groups regarding total hospital stay (p=0.439). Table 2 compares the two groups regarding postoperative intubated time, drainage, pain (BPS and VAS) and length of stay in the intensive care unit and hospital.

BPS Score Mean between Groups 1 and 2 shown in Figure 1. The average BPS score measured in the 40 watt group (Group 2) was around 5.2, while this value was around 1.5 in the 20 watt group. This difference suggests that Group 2

Table 1 Preoperative Clinical Characteristics

Variables	Group 1 (n=50)	Group 2 (n=50)	p-Value
Age (years)	64.7 ± 7.6	64.4 ± 8.1	0.717
Female gender, n (%)	10 (20)	14 (28)	0.482
Body mass index (kg/m²)	25.9 ± 2.3	27.2 ± 3.1	0.099
Diabetes mellitus, n (%)	27 (54)	32 (64)	0.416
Hypertension, n (%)	19 (38)	24 (48)	0.419
Smoking, n (%)	21 (42)	9 (18)	0.796
Chronic obstructive pulmonary disease, n (%)	10 (20)	6 (12)	0.413
Number of bypass graft	3.4 ± 1.1	3.5 ± 0.8	0.521

Notes: Mann–Whitney *U*-test, Chi-Square Test.

Table 2 Comparison Between the Two Groups Regarding Postoperative Drainage, Pain, and Length of Stay in the Intensive Care Unit and Hospital

	Group 1 (n=50)	Group 2 (n=50)	p
Intubated (hour)	6.2 ± 0.6	7.5 ± 1.2	<0.001
Drainage (cc)	584 ± 114.5	589 ± 101.2	0.790
BPS	1.7 ± 0.9	5.4 ± 2.2	<0.001
VAS (6 hours)	1.5 ± 0.7	4.4 ± 1.3	<0.001
VAS (24 hours)	1±0.7	3.1±1.3	<0.001
VAS (7 days)	0.3±0.5	0.7±0.6	<0.001
Intensive care unit day	2.9 ± 0.6	3.4 ± 0.9	0.001
Hospital stay day	6.4 ± 0.9	6.3 ± 1.8	0.439

Note: Mann–Whitney *U*-test.

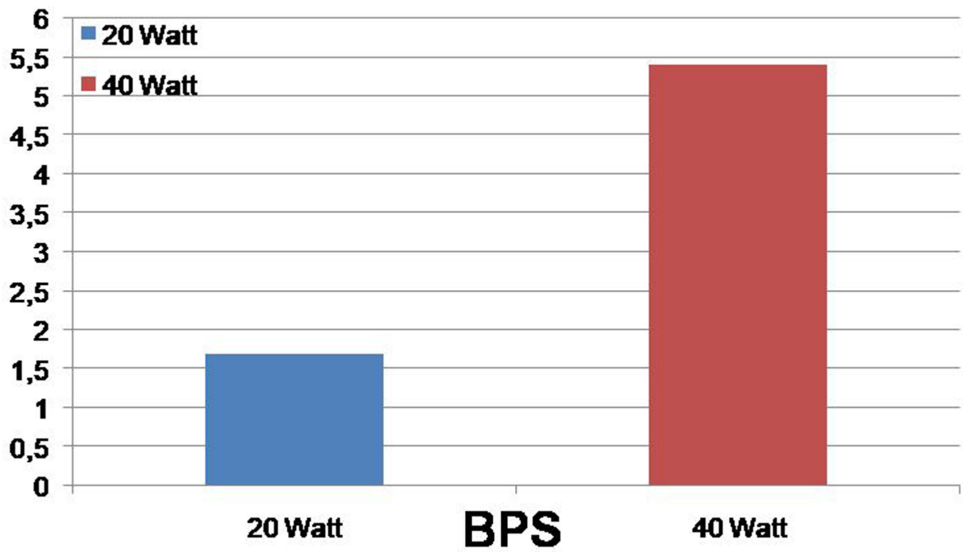

Figure 1 Postoperative Behavioral Pain Scale (BPS) scores in Group 1 (20 W) and Group 2 (40 W).
Note: Data are presented as mean ± standard deviation.

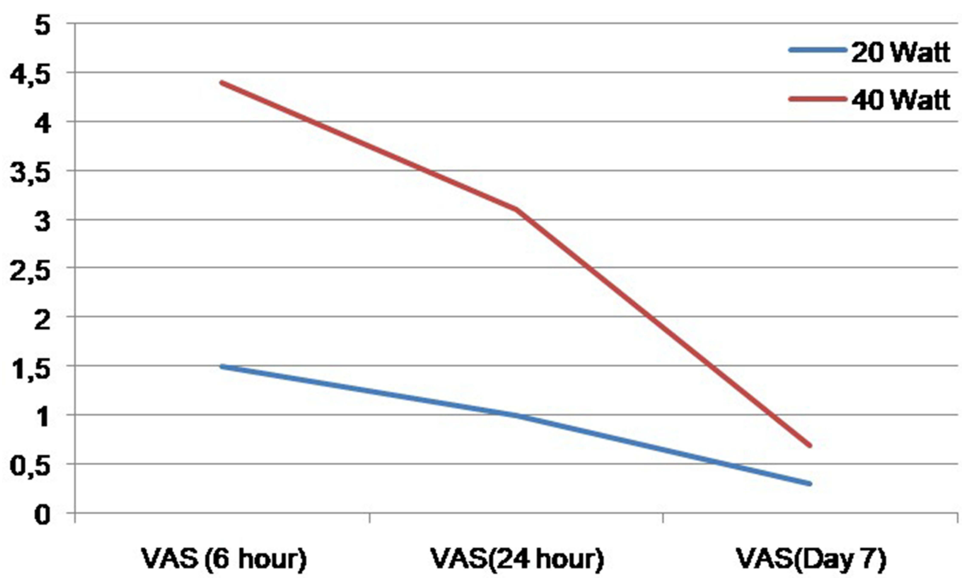

Figure 2 Postoperative visual analog scale (VAS) scores at 6 hours, 24 hours, and 7 days in Group 1 (20 W) and Group 2 (40 W).
Note: *Data are presented as mean ± standard deviation.*

caused higher behavioral pain symptoms. In addition, the lower BPS score in the 20 watt group indicates that this method is less uncomfortable in the postoperative period and provides more effective pain control.

VAS Score Mean between Groups 1 and 2 shown in Figure 2. The average VAS score was approximately 4.5 in Group 2 at the 6th hour, while it was 1.5 in Group 1. Similarly, at the 24th hour, Group 2 had an average score of approximately 3.5, while Group 1 was below 1. On the 7th day, pain levels had decreased significantly in both groups, and the difference between the groups had decreased. However, the pain level in Group 2 was still higher than in Group 1.

Discussion

One of the most important causes of pain after CABG is sternotomy. Cutting the sternum during CABG can cause pain and tenderness for the patient during the healing process. In some patients, the pain process may be prolonged due to improper union of the cut bone or infection. Due to the intercostal nerves that are cut or stretched during sternotomy, there may be numbness and tingling in the anterior chest wall along with pain.[7]

In most patients, pain and numbness in the anterior chest wall after CABG improves within a few weeks. Although pain and numbness in the anterior chest wall after CABG usually improve on their own or with treatment, the condition can become chronic for some patients.[1,2,9,11,12] In some cases, persistent pain, especially in the early postoperative period, can also cause respiratory distress. In this case, an unwanted respiratory failure may develop.[13]

Although the most common cause of pain after CABG surgery is sternotomy and chest wall stretching, nerve damage in the inner thorax where the ITA for CABG is removed may also cause pain. In the study conducted by Mailis et al, the rate of anterior intercostal nerve injury after coronary artery bypass graft surgery using ITA was determined as 73%. In this study, definite nerve damage was detected in 73% of the subjects, and possible nerve damage was found in another 11% at the site of internal thoracic artery harvesting.[7]

Of course, ITA is the standard and most preferred graft for CABG due to its long-term patency. ITA is the most frequently preferred artery graft in CABG surgery due to its prolonged patency, suitability for coronary artery anastomosis, and non-requirement of proximal anastomosis. The ITA harvesting technique has always been debated for postoperative drainage. In addition to excellent long-term patency, pedicled ITA is preferred because it is easier and faster to prepare.[9] In the clinic where the study was conducted, pedicled ITA procurement is preferred due to the ease of providing long-term patency. Especially after pedicled ITA harvesting, coagulating the remaining ITA bed on the thoracic wall with electrocautery and careful hemostasis is essential for less postoperative drainage.

The electrocautery powers used in surgery are known as follows. Low power (20–30 watts) generally targets a temperature range of 60–70°C, which is ideal for bleeding control. Medium power (40 watts) provides stronger coagulation by providing temperatures between 70°C and 80°C. However, more heat can cause damage to surrounding tissues. High power (60 watts and above) can create higher temperatures (80°C and above), which can cause tissue burns or unwanted damage.[14]

After ITA harvesting, hemostasis of the ITA bed remaining on the inner surface of the thorax is significant for postoperative drainage. Electrocautery is usually used for this bleeding control. However, there are differences in the heat power of the electrocautery used from clinic to clinic, and a standard heat degree is not specified. When the general approaches for the electrocautery power used for this purpose are considered as at least 40 watts, ie, 70–80 degrees, it can be said that complaints such as pain and numbness that last for months on the left side of the sternum in patients after surgery develop as a result of sensory nerve damage due to thermal burn in this region.

Since Albrecht Theodor Middeldorpf performed the first electrical surgical procedure using a galvanometer in 1854, electrocautery has been developed and plays a vital role in surgery. Middeldorpf was among the first to integrate the galvanocauteri (electrical coagulation) method into surgery. The term galvanocauteri is derived from the combination of the words “Galvano-” (electrical current) and “-cauter” (cauterization). Since then, electrocautery has become essential for hemostasis in surgical operations.[15,16] Electrocautery, an integral part of modern surgery, is based on an alternating current that causes division/coagulation without damaging nearby tissues.[17] The coagulation mode feature present in electrocautery significantly reduces blood loss by providing hemostasis.[18] In addition to providing almost perfect hemostasis, the widespread use of electrocautery (or galvanometer) devices in surgeries offers many advantages. However, due to incorrect use or excessive heat application, thermal damage and related undesirable effects such as pain and loss of sensation may also occur. The high-frequency electrical current applied with electrocautery generates heat in the tissues, damaging the surrounding tissues while coagulating the vessels. This damage can affect the nerves and cause pain or loss of sensation.[19] It is suggested in the literature that the pain caused by electrocautery can be explained by thermal damage to the cutaneous nerve endings, just like in full-thickness burns.[14]

Studies on reducing pain due to ITA harvesting have been found in the literature. In the research conducted by Boodhwani et al it was stated that skeleton IMA harvesting reduces postoperative pain and numbness. However, in this article, it was interpreted that harvesting IMA to skeleton may prolong the duration of surgery.[20] With the same logic, we prefer pedicled ITA harvesting due to its ease of harvest and long-term patency.

All cardiovascular surgeons know that after ITA harvesting, coagulation of the remaining ITA bed on the thoracic wall with electrocautery for hemostasis is essential for less postoperative drainage. However, while electrocautery procedures using high temperatures for hemostasis provide effective bleeding control, they can also cause severe postoperative pain due to thermal nerve damage in the inner surface of the thorax. No article has been found in the literature regarding what this electrocautery temperature should be. However, in general practice, 40 watts and above electrocauterization is preferred for hemostasis of the ITA bed remaining on the inner surface of the thorax after ITA harvesting. When the electrocautery power used for hemostasis of the ITA bed remaining on the inner surface of the thorax after ITA harvesting is considered as at least 40 watts, ie, 70–80 degrees, it can be said that complaints such as pain and numbness on the left side of the sternum that lasts for months in patients after surgery develop as a result of sensory nerve damage due to thermal burn in this region. This study was planned with this logic. This study was planned considering that patients who underwent hemorrhage control of the inner surface of the thorax with a low electrocautery value of 20 watts after ITA harvesting may have fewer postoperative pain complaints due to less thermal damage than those who used 40 watts. For this purpose, 100 patients who underwent ITA harvesting for CABG and bypass grafting between January 2022 and January 2025 in a cardiovascular surgery clinic were examined.

The patients were divided into two groups: Group 1 (n: 50 patients whose anterior thoracic wall was coagulated with 20 watts) and Group 2 (n: 50 patients whose anterior thoracic wall was coagulated with 40 watts).

According to the results of this study, there was no statistically significant difference between Group 1 and Group 2 in terms of demographic data and comorbid conditions. According to the results of BPS and VAS evaluations, a statistically significant difference was observed in patients who used 20 watts of cautery power (Group 1) compared to the patient group who used 40 watts (Group 2) regarding less postoperative pain in the anterior chest wall. It was statistically significant that postoperative pain was less in those who underwent thoracic internal hemostasis with 20 watts in Group 1. No statistically significant difference was found between these two groups regarding postoperative drainage amounts according to 2 different cautery degrees. Length of stay in the intensive care unit differed in both groups. Regarding length of stay in the intensive care unit, in Group 2 was found to have a statistically significantly longer length of stay in intensive care unit. There was no significant difference between the groups regarding total hospital stay.

Of course, individual pain perception can of course affect the results. Therefore, patients who were able to adapt to the pain tests performed after surgery and who had sufficient mental and visual capacity were included in the study.

There are studies in the literature indicating that skeletal ITA harvesting reduces postoperative pain and numbness.[20] However, in this study, as pedicled ITA harvesting was performed on all patients in accordance with the clinic's routine surgical practice and preference, a direct comparison with the skeletonized ITA technique in terms of postoperative pain could not be conducted.

The retrospective nature of this study and the lack of long-term follow-up are limitations that may affect the generalizability of the findings; however, when the literature on the subject was reviewed, no study was found investigating a possible relationship between the degree of cauterization of the remaining ITA bed on the inner chest wall after ITA harvesting for hemostasis and postoperative pain.

As highlighted in studies, pain is a condition that contributes significantly to increased hospital costs.[21,22] As noted in this study, shorter length of stay in the intensive care unit is particularly important in reducing hospital costs.

The study is about early chest wall pain after CABG, and it is obvious that more comprehensive studies are needed in the future regarding chronic pain. Although the study demonstrates a significant reduction in pain at day 7, the long-term implications of this finding, including its impact on the risk of chronic postoperative pain, remain unclear. Future prospective and longitudinal studies are warranted to further investigate these outcomes.

Conclusion

This study is based on the logic that lower electrocautery power, such as 20 watts, for hemostasis of the remaining inner thoracic wall after ITA harvest may reduce tissue and nerve damage. Using 20 watts instead of 40 watts in the study did not increase postoperative drainage and was associated with less pain and sensory loss, and increased patient comfort. Reduced pain also facilitated better respiratory function, potentially shortened ICU stay, and reduced treatment costs. These findings support the use of lower cautery power as a safe and cost-effective alternative for CABG surgery. These findings suggest that a simple intraoperative adjustment in electrocautery power may contribute to postoperative recovery and may contribute to surgical practice.

There are not many articles similar to this study in the literature. In this sense, this study is original. These results may be further validated and strengthened by larger, multi-center studies in the future.

Data Sharing Statement

https://doi.org/10.5281/zenodo.14589729.

Ethics Committee Approval

Ethics committee approval was received from Kastamonu University Faculty of Medicine ethics committee (2024-KAEK -125). The study was conducted by the principles of the Declaration of Helsinki.

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Disclosure

The author declares no conflicts of interest concerning the authorship and publication of this article.

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