ORIGINAL ARTICLE

Özgün Araştırma

Yazışma Adresi
Correspondence Address

Gurcan ALBENIZ
Department of General Surgery, Gebze Fatih State Hospital, Kocaeli, Türkiye
gurcanalbeniz@yahoo.com

Geliş Tarihi : 09 May 2022
Received
Kabul Tarihi : 28 July 2022
Accepted
E Yayın Tarihi : 01 January 2024
Online published

Bu makalede yapılacak atıf
Cite this article as

Albeniz G, Akıncı O, Tosun Y.
Comparison of the Results of Electrocautery and Scalpel Use in Abdominal Midline Incisions
Akd Med J 2024;10(1): 53-57

Gurcan ALBENIZ
Department of General Surgery, Gebze Fatih State Hospital, Kocaeli, Türkiye
ORCID ID: 0000-0002-2839-2507

Ozan AKINCI
Department of General Surgery, Kartal Lutfi Kirdar City Hospital, İstanbul, Türkiye
ORCID ID: 0000-0002-7149-6854

Yasin TOSUN
Department of General Surgery, Kartal Lutfi Kirdar City Hospital, İstanbul, Türkiye
ORCID ID: 0000-0001-9102-7900

DOI: 10.53394/akd.1114464

Comparison of the Results of Electrocautery and Scalpel Use in Abdominal Midline Incisions

Abdominal Orta Hat İnsizyonlarda Elektrokoter ile Bistüri Kullanım Sonuçlarının Karşılaştırılması

ABSTRACT

Objective:

Scalpel is the conventional instrument for laparotomy incisions. Electrocautery, on the other hand, can offer potential advantages such as blood loss, incision time, postoperative pain. In this study, we aimed to compare the clinical results of electrocautery and scalpel in abdominal midline surgical incisions.

Material and Methods:

One hundred forty-six cases who underwent elective abdominal midline incision between January 2020 – December 2021 were included in the study. The patients were divided into two randomized groups as electrocautery (n: 78) and scalpel (n: 68). The incision dimensions, incision time and blood loss during incision were noted intraoperatively. Postoperative pain and wound infection were recorded.

Results:

The age and sex distribution was similar in the two groups. Incision time (seconds) in the electrocautery group (35.4±18.1) (57.6±25.3) was significantly shorter compared with the time in the scalpel group ($p<0.001$).The amount of bleeding was lower in the electrocautery group ($p<0.001$). Postoperative day 1 VAS score was significantly higher in the scalpel group however, the day 5 VAS score was higher in the electrocautery group (respectively; $p<0.013$ and $p<0.001$). There was no difference between the two groups in terms of postoperative wound complications ($p>0.05$).

Conclusion:

Abdominal midline skin incisions performed by electrocautery are associated with faster and less blood loss compared with the incisions using scalpel. There was no difference between the two methods in terms of postoperative wound complications. The pain score of the scalpel on postoperative day 5 was lower than the pain score of the electrocautery.

Key Words:

Electrocautery, Scalpel, Midline laparotomy, Skin Incision

ÖZ

Amaç:

Laparotomi insizyonlarında geleneksel enstrüman bisturidir. Elektrokoter ise kan kaybı, insizyon süresi, postoperatif ağrı gibi potansiyel avantajlar sunabilmektedir. Bu çalışmada abdominal orta hat cerrahi insizyonlarda elektrokoter ile bisturinin klinik sonuçlarını karşılaştırmayı amaçladık.

Gereç ve Yöntemler:

Ocak 2020 – Aralık 2021 tarihleri arasında elektif karın orta hat cilt insizyonu yapılan 146 olgu çalışmaya dahil edildi. Hastalar elektrokoter (n:78) ve bistüri (n:68) olmak üzere iki randomize gruba ayrıldı. İnsizyon boyutları, kesi süresi ve kesi sırasındaki kan kaybı intraoperative olarak kaydedildi. Ameliyat sonrası ağrı ve yara enfeksiyonu kaydedildi.

Bulgular:

Yaş ve cinsiyet dağılımı iki grupta benzerdi. İnsizyon süresi(sn) elektrokoter grubunda (35,4±18,1) bistüri grubuna (57,6±25,3) göre anlamlı ölçüde daha kısaydı ($p<0,001$).
Kanama miktarı elektrokoter grubunda daha düşüktü ($p<0,001$). Postoperatif birinci gün VAS skoru, bistüri grubunda anlamlı ölçüde daha yüksek iken beşinci gün VAS skoru elektrokoter grubunda daha yüksekti (sırasıyla; $p<0,013$ ve $p<0,001$). Postoperatif yara komplikasyonları açısından iki grup arasında fark yoktu ($p>0.05$).

Sonuç:

Elektrokoter ile uygulanan abdominal orta cilt insizyonları bisturiye göre daha hızlı ve daha az kan kaybı ile ilişkilidir. Postoperatif yara komplikasyonları açısından iki metod arasında fark yoktur. Bistürinin postoperatif beşinci gün ağrı skoru elektrokotere göre daha düşüktür.

Anahtar Kelimeler:

Elektrokoter, Bistüri, Orta hat insizyon, Cilt insizyon

INTRODUCTION

Surgical skin incisions are conventionally performed mostly using a scalpel. Diathermy provides an important alternative to scalpel with the advantage of hemostasis for skin incisions. There is no consensus in the literature regarding the safety and efficacy of the electrocautery versus scalpel in skin incisions (1). Electrocoagulation, the ability to provide intraoperative hemostasis, is widely used by surgeons in the separation of subcutaneous tissue, fascia and muscle layers. Despite this, it has currently not been preferred for skin incisions due to the concern of electric burns that it can cause on the skin.

On the other hand, scalpel was the standard method for surgical incisions until electrosurgical instruments were discovered because it had the advantage of reaching a controlled incision depth and with no possibility of electric burns. In experimental studies, it has been shown that the use of cautery has consequences such as high wound site infection rates and low wound tension force (2). Soballe et al. found that there was an increase in induration in the wound incision lips and infection in the wound site, and poor tissue healing due to the use of electrocautery (3). In contrast, in various other studies, it has been observed that the complication rates of the use of scalpel with electrocautery are similar, there is less bleeding, shorter incision time and lower postoperative pain with electrocautery (4-6).
This study aimed to compare the results of the use of electrocautery with scalpel, which are conventionally used in midline incisions in abdominal surgery.

MATERIALS and METHODS

The present prospective study was performed on 146 patients who underwent midline incision for abdominal surgery between January 2020 and December 2021. This study was approved by the Ethics Committee of the Istanbul Kartal Lütfi Kirdar City Hospital (approval number: 2022/514/221/5). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/ organizational research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed written consents were obtained from the patients. Patients over 18 years who underwent elective abdominal surgery (such as gastrointestinal surgery, hepatobiliary surgery, and umbilical surgery) were included in the study. Cases with a previous history of abdominal midline incision (such as incisional hernia, recurrent cancer surgery), cases with emergent abdominal surgery, cases under the age of 18, cases with an immunocompromised, cardiac pacemaker, and cases who did not agree to participate in the study were excluded from the study.

The patients were divided into two randomized groups; the Cautery group and the Scalpel group. The patients were randomized as electrocautery for one week and scalpel for one week in sequential order. The age, sex, incision length (cm), incision depth (cm), wound area (cm2), incision time (seconds), actual incision time (sec/cm2), the amount of bleeding from the incision (ml), postoperative wound complications, and the postoperative day 1 and day 5 Visual Analog Scale (VAS), (0-10) scores of the patients were recorded. The wound area was calculated according to the formula = incision length (cm) / incision depth (cm). Actual incision time was calculated according to the formula = incision time (sec) / wound area (cm2). The amount of bleeding that occurred during the incision was calculated by measuring the weight of gauze swabs. In all cases, 4x4 cm gauze swabs were used, and each 1 g weight gain in gauze on a sensitive digital scale was considered 1 ml of blood.

All cases were operated under general anesthesia. The abdominal region was washed and dried with 7.5% povidone-iodine before surgical intervention. Prophylactic intravenous administration of 1 g of cefazolin was performed in all cases. The operations were performed by two specialized general surgeons.
In the scalpel group, the incision of all layers of the skin and subcutaneous tissue was made using a disposable scalpel of the appropriate size. In the cautery group, incisions were made with a standard diathermy pen electrode (Beybi, Turkey). In both groups, hemostasis was achieved with the help of electrocautery after opening the peritoneum. Abdominal fascia was closed with

looppolyglyconate (Maxon; DavisandGeck, Gosport, UK) and the skin incision was closed with a 3-0 polypropylene (Prolene; Ethicon, USA) suture.

Statistical Analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 25.0 program. The suitability of the variables for normal distribution was examined by histogram graphs and using the Kolmogorov-Smirnov test. The mean, standard deviation and median values were used in presentation of the descriptive analyses. Categorical variables were compared with the Pearson Chi-Square Test. Kolmogorov-Smirnov test assessed normality of quantitative data distribution. Quantitative data, not normally distributed, were compared with the Mann-Whitney U test. If data is normally distributed, independent samples t-test were used. Cases where the P-value was below 0.05 were evaluated as statistically significant results.

RESULTS

A total of 146 patients, including 77 men and 69 women with a mean age of 50.65 years were enrolled in the study. There were 78 patients in the cautery group, and 68 patients in the Scalpel group. The mean incision time was 45.8±24.4 sec, incision length was 11.8±3.5 cm, incision depth was 4.9±1.4 cm, wound area was 2.6±1.0 cm2, actual incision time was 20.3±12.2 sec/cm2 and bleeding amount was 9.4±7.6 ml in all patients included in the study. The postoperative wound site infection developed in 12 patients and postoperative seroma developed in 39 patients (Table I). No electrocautery or scalpel-related organ injury occurred in any of the cases in our study.

Table I: The demographic, surgical and clinical features of all cases.

		Mean±s.d / n (%)
Age(year)		50.65±14.9
Sex	Male	77
	Female	69
Incision method	Cautery	78
	Scalpel	68
Incision time (sec)		45.8±24.4
Incision length (cm)		11.8±3.5
Incision depth (cm)		4.9±1.4
Wound site (cm²)		2.6±1.0
Real incision time (sec/cm²)		20.3±12.2
Bleeding amount (ml)		9.4±7.6
Postoperative wound site infection		12 (8.2)
Postoperative seroma		39 (26.7)
Postoperative VAS score (Day 1)		6.7±1.5
Postoperative VAS score (Day 5)		4.2±1.1

There was no difference between cautery and scalpel groups in terms of age, sex, incision length and incision depth (p>0.05). The incision time and the actual incision time were significantly shorter in the Cautery group (p<0,001). The amount of bleeding was significantly lower in the Cautery group (p<0.001).Postoperative day 1 VAS score was significantly higher in the scalpel group however the day 5 VAS score was higher in the Cautery group (respectively; p<0.013 and p<0.001), (Table II).

Table II: Comparison of the electrocautery and scalpel groups.

	Electrocautery group Mean±s.d / n (%)	**Scalpel group** Mean±s.d / n (%)	**P**
Age(year)	52.6±13.7	51.8±15.6	0.849
Sex (F/M)	38/40	31/37	0.706
Incision time (sec)	35.4±18.1	57.6±25.3	**<0.001**[a]
Incision length (cm)	11.5±3.4	12.1±3.6	0.217[a]
Incision depth (cm)	4.8±1.4	5.0±1.5	0.270[a]
Wound site (cm²)	2.6±0.98	2.6±1.1	0.761[a]
Real incision time (sn/cm²)	15.8±9.2	25.6±13.1	**<0.001**[a]
Bleeding amount (ml)	5.9±1.9	13.4±9.5	**<0.001**[a]
Postoperative VAS score (Day 1)	6.4±1.4	7.0±1.6	**0.013**[a]
Postoperative VAS score (Day 5)	4.5±0.95	3.8±1.3	**0.001**[a]
Postoperative wound site infection	4 (5.1)	8 (11.7)	0.145[b]
Postoperative seroma	25 (32.0)	14 (20.6)	0.118[b]

[a]Mann Whitney U Test; [b]Chi-square test

The rate of change in the postoperative VAS score between the incision techniques was compared with the analysis of repeated measurements. Accordingly, there was a significantly higher decrease in the VAS from day 1 to day 5 in the scalpel group (p:0.001). There was no significant difference between the two groups in terms of postoperative wound site infection and seroma (p>0.05).

DISCUSSION

Since Albrecht Theodor Middeldorpf performed the first electrical surgical procedure using galvanocautery in 1854, the electrocautery developed and plays an important role in surgical hemostasis has become an important instrument in the operating room, regardless of the procedure performed (7). The electrocautery which has become an integral part of modern surgery, depends on an alternating current that causes cleavage/coagulation without damaging nearby tissues (8). The safety and efficacy of the electrocautery in separating the subcutaneous tissue

and muscle layers is well known. However, the use of electrocautery in skin incision is still a matter of debate.
Surgeons detect postoperative wound site infection in abdominal surgery with a frequency of 15-25% (9). In our study, there was no significant difference between electrocautery and scalpel groups in terms of wound site infection. In a study with 240 patients conducted by Johnson et al., the rate of postoperative wound site infection was found to be similar in both methods (10). Similarly, Groot et al., also reported that electrocautery did not increase the risk of wound site infection (5). Researchers reported in a meta-analysis involving 6422 participants that the postoperative wound complication rate of electrocautery was similar to the rate of scalpel (11). However, inguinal hernioplasty, head, neck, breast, hemiarthroplasty surgeries were also included in addition to abdominal incision cases in the study. On the other hand, in order to reduce possible biases, our study was conducted in a homogeneous patient population in which only abdominal midline incisions were used.

We foundin our study that the time required to complete the incision was shorter in the use of electrocautery than the time required in scalpel. Chrysos et al., in cases of elective hernioplasty; Johnson et al., in their studies conducted in elective laparotomy cases, came to the same conclusion with our study (10,12). In contrast, in a double-blinded randomized controlled trial, it was reported that the incision time of scalpel and electrocautery use was similar (13). However, in a systematic review conducted by Charoenkwan et al. in 2012, it was concluded that there is inadequate reliable evidence for suggesting that electrocautery reduces the incision time (14).

The coagulation mode feature present in the electrocautery significantly reduces blood loss by ensuring hemostasis. In the present study, we found that the average blood loss was lower in the electrocautery group compared to the blood loss in the scalpel group. Kearns et al. reported that blood loss during the incision time was significantly lower in cases of elective midline laparotomy (15). Kumar et al., examined 80 patients who had undergone head and neck surgery and found that electrocautery significantly reduced blood loss during incision (16). In our study, the postoperative day 1 pain score was similar in both groups. However, the day 5 pain score was higher in the electrocautery group. Chrysos et al., stated that the use of scalpel increased the pain more in the postoperative period compared to the use of electrocautery and that more analgesic drugs were needed (12). Prakash et al., reported that the use of scalpel or electrocautery caused no significant difference in terms of pain in any postoperative period (13). It has been suggested in the literature that the lower pain score of electrocautery can be explained by the thermal destruction of cutaneous nerve endings, just like in full-layer burns (11, 17).

Limitations

The limitations of our study were that it was a single-center study, there was need for postoperative analgesics, the force of wound tension and the cosmetic satisfaction of the patients were not evaluated. We also accept that comparing the two methods in terms of incisional hernia development by making patient follow-ups longer is the other limitation.

CONCLUSION

In the light of the increasing clinical evidence, as a conclusion, electrocautery, which is an effective instrument in hemostasis, is a safe and effective surgical instrument as scalpel in abdominal midline incisions. With the data obtained from this study, we observed that electrocautery does not increase the risk of early wound complications, has the advantages of shorter incision time and less blood loss.

Ethics Committee Approval:
This research complies with all the relevant national regulations, institutional policies and is in accordance the tenets of the Helsinki Declaration, and has been approved by the Ethics Committee of the Istanbul Kartal Lütfi Kirdar City Hospital (approval number: 2022/514/221/5).

Informed Consent:
All the participants' rights were protected and written informed consents were obtained before the procedures according tothe Helsinki Declaration.

Author Contributions:
Concept - G.A..; Design - G.A.; Supervision - G.A; Resources - O.A.; Materials - O.A; Data Collection and/or Processing - Y.T.; Analysis and/ or Interpretation – Y.T.; Literature Search - G.A.; Writing Manuscript - G.A., O.A.; Critical Review - G.A., O.A., Y.T.

Conflict of Interest:
The authors declared that this study has received no financial support.

Financial Disclosure:
The authors declared that this study has received no financial support.

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