ORIGINAL ARTICLE

Comparative study between electrocautery and scalpel in making midline abdominal incisions: An observational randomized controlled clinical study

Muqdad Fuad Abdulkareem[1], Mohammed Mohammud Habash[1], Badraddin Luay Badraddin[2]*

[1]Department of Surgery, College of Medicine, University of Diyala, Baqubah-32001, (Diyala) Iraq,

[2]Department of Surgery, Al-Yarmouk Teaching Hospital, Alkarkh Health Directorate, Al-Yarmouk 10015 (Baghdad), Iraq

Abstract

Background: Electrocautery has the advantages of making incisions with less blood loss, and dry and rapid dissection of tissue. Possible postoperative risks associated with electrocautery use are poor wound healing and surgical site infection. *Aim and Objectives:* To compare diathermy with scalpel in making midline incisions with regard to blood loss, time taken for incision, postoperative pain and wound infection. *Material and Methods:* Comparative observational study of 100 patients operated on through midline abdominal incision with 50 patients in Group A (the electrocautery group) and remaining 50 patients in Group B (the scalpel group). The dimension of the incision, time taken for making incisions and blood loss were reported. The postoperative pain and wound infection were also monitored. *Results:* Significant difference was revealed between Groups A and B concerning the mean time for incision per unit area of the wound, 8.26±1.46 and 10.96±1.59 s\cm^2 respectively ($p<0.0001$). An average blood loss per unit area of the wound was found to be significantly lower in the electrocautery group; 0.30±0.041 and 1.29±0.22 ml\cm^2 respectively (p-value<0.0001). Postoperative pain and surgical site infection were not significantly different between the two groups (p=0.1508 and 1, respectively). *Conclusion:* Electrocautery is safe in making abdominal incisions when compared to scalpel, and is associated with less blood loss and incision time with comparable postoperative pain and surgical site infection.

Keywords: Electrocautery incision, Diathermy incision, Scalpel incision, Midline incision

Introduction

Operating room presents a particular environment in which, all of the medical staff handle the sharp scalpel very closely. During emergencies, the risk of scalpel injury will increase. Around 28% of all injuries resulting from sharp scalpels happen in the theater [1]. The scalpel is addressed as being a common cause of injuries, second only to needles. Scalpel was considered for a long time as being the classic instrument for doing a skin incision as it rules out the possible tissue complications resulting from burn effect of the electrocautery. Also, using scalpel rather than electrocautery was thought to have the benefit of controlling the depth of the incision [2-3]. In the modern era of globalization, the emergence, and re-emergence of viral diseases is a continuous problem and is a serious concern for human health and economy [4]. The health care workers in the theater are at increased risk of seroconversion because of the use of the scalpels. This led to the alternative use of diathermy for making skin incisions. Also, reports of surgeons contracting the human immunodeficiency virus and even life threatening bacterial infection, particularly when dealing with

emergency conditions due to the use of scalpels were registered. As such, avoiding scalpel use can decrease the rate of infection transmission [2-3,5]. Surgical diathermy was evolved at the outset of the 20th century to obviate the problems associated with the use of scalpels. Diathermy was regarded to be effective method of dissection because of its hemostatic nature. It was not regarded primarily as cutting device, but was basically used for coagulation, and later on it was widely used for cutting [6]. Electrocautery has the advantages of decreasing blood loss along with rapid and dry dissection [7]. When using diathermy in the sinusoidal pattern (cutting mode), the tissue will lyse, as it is exposed to gradient dependent current that pass through it at high frequency (more than 100000Hz). This principle allows the use of diathermy electrode without resulting in injury to the adjacent tissue. In this way cells get heated inside the tissues very rapidly and vaporize leaving a hole and creating an incision with relatively less postoperative scarring. The generated heat evaporates as steam, rather than being borne by nearby tissues [8-9]. Due to the worry that electrocautery may cause burn with it's associated poor wound healing, infection and unintended damage to the deeper structures, electrocautery is yet not popularly applied in making incisions. Today's diathermy electrodes use pure sinusoidal current that cause a break in the tissues without injuring the nearby structures thus leading to minimal wound complications related to burn [10].

The current study aims to compare electrocautery (diathermy) made incisions with the conventional scalpel made incisions for midline abdominal laparotomies with regard to safety, mean blood loss, time taken for the incision, postoperative pain and wound infection.

Material and Methods

This was a comparative observational study of 100 patients carried out between August 2021 and September 2022 at Baquba Teaching Hospital, Diyala Province, Iraq and Al-Yarmouk Teaching Hospital, Baghdad Province, Iraq. One hundred patients operated through midline incision were assigned into 2 equal groups – Group A (the electrocautery group) and Group B (the scalpel group).

Inclusion criteria

Patients with surgeries requiring midline incision and willing to provide written informed consent were enrolled in this study.

Exclusion criteria

Patients with history of midline laparotomy, receiving anticoagulants and/or corticosteroids, having chronic diseases such as tuberculosis, anemia, diabetes mellitus, and those having wound infection at any site in the body, were excluded from the study.

The study was initiated after obtaining ethical approval from the Institutional Ethical Committee (Letter no 187/ Baquba Teaching Hospital, 134/ Al-Yarmouk teaching Hospital- Ethics Committee for Research on Human Subjects /2021, Date-25/7/2021).

Sampling technique

One hundred patients matching our selection criteria were operated on through midline incision. The patients were assigned into 2 equal groups; Group A (the electrocautery group) and Group B (the scalpel group); each with 50 patients.

The distribution of patients between the two groups was random based upon the date of admission to the hospital, such that, electrocautery group included patients who were admitted on odd dates, while scalpel group included those admitted on even dates.

Sample size calculation

The sample size was calculated at 95% confidence interval with an 80% power of 0.05 α- error. The sample size was calculated as 50 patients in each group to confirm an anticipated minimum difference of 0.34 with a standard deviation of 0.63 required to make the comparison between two groups.

Methodology

Patients from both groups were operated on through midline abdominal incision under spinal or general anaesthesia. Prophylactic antibiotic in the form of 1 gram ceftriaxone was given for all patients in both groups at the time of induction and repeated 12 hourly for three days. Paracetamol infusion 1000 mg was given eight hourly for two days. The abdomen was closed in 3 layers using looped (double line) nylon for the fascial plane, 2-0 polyglactin 910 subcutaneously and 2-0 silk for closure of the skin. Skin sutures were removed on day10 postoperatively.

The dimensions of the incision were measured in centimeters using sterile ruler. The length of the incision and the depth (abdominal wall thickness) were reported. After that, the resultant wound area was calculated using these variables (length and depth of the incision). The time taken for making the full thickness incision till entering the abdominal cavity, together with the time spent for maintaining hemostasis was reported in seconds, then, the time taken per unit area of the wound ($s\backslash cm^2$) was calculated.

During making the incision, the blood loss was measured through weighing the gauze used, both before and after completing the incision, by subtracting the weight of the gauze before use from that after use (soaked gauze) with the result being the amount of blood loss (each 1 gram equal to 1 milliliter). After that, the amount of blood loss per unit area of the wound was measured as ml/cm^2. Suction of blood was avoided during incision making.

On postoperative day 2, pain was evaluated using Visual Analogue Scale (VAS) score of 0-10, with score zero meaning no pain and10 meaning the worst pain. Further, daily clinical wound assessment was performed for the presence of wound infection till the day of discharge and subsequently on the first follow up visit. The presence of wound infection was reported, if any of the following signs and symptoms were present; erythema, pain induration, serous discharge, or pus [11-12].

Statistical analysis

Categorical variables as sex, type of surgery (emergency versus elective) and comorbid conditions, were expressed as frequencies and percentages and the comparison was done using the Fisher's exact test. Continuous variables as the age, time taken for making the incision, blood loss and size of incision were presented as Mean±SD and the comparison made by applying independent student's t test. The cutoff 5% was taken as a level of significance with p-value of <0.05 considered significant.

Results

One hundred patients recruited in our study were equally distributed between two groups; 50 patients in the electrocautery group and 50 patients in the scalpel group.

Both groups were matched for age and gender. Electrocautery group included 28 males and 22 females, while the scalpel group included 27 males and 23 females. No statistical difference was noted with respect to age and gender between the two groups. (p-Value 0.2376 and 1 respectively) (Table 1).

Elective and emergency cases was nearly equally distributed between the two groups. There were 38 elective and 12 emergency cases in Group A, with 35 elective and 15 emergency cases in Group B. No statistical difference was noticed considering the type of procedure between the two groups (p=0.6529). This helped eliminating the type of surgery as an influencing factor on the outcome of the study. Our study showed no statistically significant difference between the electrocautery group and the scalpel groups with regard to hypertension and diabetes mellitus type 2 ($p > 0.05$ for both) (Table 1). We also did not find any statistically significant difference between the two groups with regard to the incision length, it was 13.69±2.05 in Group A and 13.26±2.31 in Group B with p=0.3273.

Our study revealed significant difference between the two groups regarding the incision depth, it was 2.79±0.31 for Group A and 2.59±0.27 for Group B with p=0.00086. Also, there was significant

Table 1: Distribution of demographic factors, type of surgery & co-morbidities

	Group A Electrocautery group (N=50)	Group B Scalpel group (N=50)	p
Age	41.34±14.59	37.81±15.11	0.2376^{NS}
Gender			
Male	28 (56%)	27 (54%)	1^{NS}
Female	22 (44%)	23 (46%)	
Surgery Type			
Elective	38 (76%)	35 (70%)	0.6529^{NS}
Emergency	12 (24%)	15 (30%)	
Hypertension	13 (26%)	11 (22%)	0.8388^{NS}
Diabetes Mellitus Type 2	16 (32%)	14 (28%)	0.8555^{NS}

NS- Not significant, significant at $p < 0.05$

difference with regard to the wound area between the two groups, it was 37.95±7.43 cm^2 for Group A and 34.62±7.21 cm^2 for Group B with p=0.02513. (Table 2).A statistical difference was found with regard to incision time between the two groups, it was 307.44±59.29 for Group A and 370.23±40.64 for Group B with p <0.0001. Also there was statistical difference concerning the incision time per unit area of the wound (8.26±1.46 in Group A and 10.96±1.59 in Group B; p <0.0001) (Table 2).

With regard to the intraoperative blood loss, the study showed significant difference between the studied groups (10.58±1.71 ml in electrocautery group vs 39.83±4.74 ml in scalpel group; p <0.0001). Mean blood loss per unit area of the wound was significantly lower in electrocautery group than in the scalpel group, 0.30±0.041 ml\$cm^2$ and 1.29±0.22ml\$cm^2$ respectively; p <0.0001 (Table 2).

The pain score calculated in both Groups A and B on postoperative day two was statistically insignificant (4.72±0.54 in electrocautery group versus 4.51±0.87 in scalpel group); p=0.1508 (Table 3). Also no statistical significant difference was seen concerning the development of Surgical Site Infection (SSI) between the two groups, with only 3 patients in the electrocautery group and 2 patients in the scalpel group developing SSI (p=1).

Table 2: Incision time, dimensions and blood loss in the two groups

Parameters	Group A (Mean±SD) N =50	Group B (Mean±SD) N =50	p	CI
Length (cm)	13.69±2.05	13.26±2.31	0.3273^{NS}	-0.4368, 1.2968
Depth (cm)	2.79±0.31	2.59±0.27	0.00086**	0.0846, 0.3154
Wound area (cm^2)	37.95±7.43	34.62±7.21	0.02513	0.4244, 6.2356
Incision time (s)	307.44±59.29	370.23±40.64	<0.0001**	42.6168, 82.9632
Incision time \ wound area (s\cm^2)	8.26±1.46	10.96±1.59	<0.0001**	2.0942, 3.3058
Blood loss (ml)	10.58±1.71	39.83±4.74	<0.0001**	27.8358, 30.6642
Blood loss \ wound area (ml\cm^2)	0.30±0.041	1.29±0.22	<0.0001**	0.9272, 1.0528

*NS: Not significant, significant at p < 0.05, very significant**at p< 0.001*

Table 3: The reported pain score and surgical site infection in the electrocautery group and scalpel group

	Electrocautery group N=50	Scalpel group N=50	P value
Pain score	4.72±0.54	4.51±0.87	0.1508^{NS}
SSI			
Present	3	2	1^{NS}
Not present	47	48	

SSI: Surgical Site Infection; NS: Not significant

Discussion

The first surgery performed using electrosurgical instrument was by Dr. Harvey Cushing in 1926, and since that time, electrocautery became an essential component in the surgical theatre regardless of the type of surgical procedure performed. It has been well established as an alternative to scalpel in terms of safety and efficacy, while making a cut in the skin, subcutaneous tissue and muscle layers. Some authors have also found electrocautery to be safe for intestinal surgery. Despite that, using thermal energy for making incisions is still a matter of debate because of the fear that such thermal energy may cause poor wound healing and excessive scar formation [13].

With regards to age and gender of patients, our study did not find any significant difference between the electrocautery group and the scalpel group (p-0.2376 and 1 respectively). Similar results were found by Lalgudi *et al*. with the median age being 47.76±12.32 for the electrocautery group and 47.27±12.43 for the scalpel group (p=0.86); and for gender the p-value was 0.63 [14]. Our study did not find significant difference between the electrocautery group and the scalpel group with regard to the type of surgery (elective, emergency) (p=0.6529).This corresponds with findings by Yadav *et al*. [15]. We also did not find significant difference between the two groups concerning the presence of associated comorbid conditions (hypertension and diabetes mellitus type 2) (p=0.8388 and 0.8555 respectively) which is in accordance with the findings by Guru *et al*. [13].

Although few studies have found electrocautery to be efficient for performing skin incision, others have raised concern regarding wound healing and found an increased incidence of SSI in the electrocautery group [16-19]. We did not find significant difference between the two groups with regard to the postoperative wound infection. This finding is supported by Franchi *et al*. who found no difference in rates of wound infection among the 2 groups in oncologic gynaecological patients [20]. Ismail *et al*. also did not find any statistically significant difference between both techniques with regard to postoperative wound complications, length of hospital stay, and wound

cosmetic characteristics [21]. In contrast, Huang *et al*. reported that diathermy incision resulted in slower wound healing and higher infection rate than scalpel incision [22].

Our study found the time needed to accomplish the incision was significantly lower in the electro-cautery group. This is in concordance with findings by Mittal and Windsor whose analysis showed that using cutting diathermy is associated with significantly shorter incision time when compared to scalpel: mean difference was 36.19s ($p < 0{\cdot}001$) [23]. Thakare *et al*. also showed shorter incision time for neck dissection in the electrocautery group, (3.14±0.25 in electrocautery group versus 5.20±0.23 in scalpel group with $p < 0.001$) [24].

In our study, the incision time\wound area ($s\backslash cm^2$) was lower in the electrocautery group. This is supported by Shamim and Siraj *et al*. which found that using electrocautery was associated with significantly quicker incision times\wound area: mean difference 1.73 (0.19 to 3.27) s/cm^2 ($p= 0.03$) [25-26].

We also found electrocautery to be associated with significantly lower mean blood loss when compared to scalpel made incisions. This may be explained by its property of 2 modes: cutting and coagulation. Parallel outcomes were documented by Siraj *et al*. and Talpur *et al*. In the latter study, the mean blood loss during incision making was 1.83 mL/cm^2 and 1.14 mL/cm^2 for the electro-cautery group and the scalpel group respectively [26-27]. Similarly Lee *et al*. and Lalgudi *et al*. also showed significant differences in the mean blood loss in the electrocautery group in comparison to the scalpel group: mean 0.7±1.7 mL *versus* 3.0±4.3 mL ($p < .0001$) in the study by Lee *et al.* and 6.46±3.94 mL *versus* 23.40±15.28 Ml ($p<0.0001$) in the study by Lalgudi *et al*. [28, 14].

Our study showed no significant difference with regard to pain score between the two groups on postoperative day two. This is in contrast to Chrysos *et al*. who found that patients in the electrocautery group needed only half dose of analgesia postoperatively [29]. Similarly Kearns *et al*. also reported significantly less pain both on day one and two postoperatively when using diathermy for making skin incisions [30].

Conclusion

Electrocautery is safe in making abdominal incisions when compared to scalpel, and is associated with less blood loss and incision time and comparable postoperative pain and surgical site infection.

Acknowledgments

The authors are thankful to Baqubah Teaching Hospital and Al-Yarmouk Teaching Hospital where we conducted our study. We are also thankful to the patients for extending their full cooperation to the study.

Source of funding: The current study was self-funded.

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Author for Correspondence:

Muqdad Fuad Abdulkareem, Department of Surgery, College of Medicine, University of Diyala, Baqubah-32001, (Diyala) Iraq Email: muqdad@uodiyala.edu.iq Telephone: +9647711040358

How to cite this article:

Abdulkareem MF, Habash MM, Badraddin BL. Comparative study between electrocautery and scalpel in making midline abdominal incisions: An observational randomized controlled clinical study. *J Krishna Inst Med Sci Univ* 2022; 11(4):46-54

Submitted: *27-June-2022* ***Accepted:*** *27-Aug-2022* ***Published:*** *01-Oct-2022*