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Original Research Article

In Midline Abdominal Surgery, a Comparison of the Electrocautery and Scalpel Incision Methods

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Abstract:

Background: The incision is a "slit or cut" that allows access to the supporting tissues. Traditionally, a stainless-steel scalpel is used to make cuts. It is expected that these incisions will hurt more and be more bloody. In a surgeon's toolkit, electrosurgical devices are among the most valuable and often utilized items. In medicine, the process of burning a body part to remove or close it is referred to as cauterization. In order to produce a surgical incision, burn and seal blood arteries, and remove undesirable or hazardous tissue, electrocauterization, also known as electrocautery, is a common surgical technique. Additionally, its usage to lessen or cease bleeding is growing. The tissue is burned or destroyed using a tiny probe that has an electric current passing through it. Despite being accessible in every surgical theater, electrocautery is less commonly utilized for skin incisions because of concerns about tissue damage, inadequate wound healing, discomfort following surgery, and excessive scarring. The use of diathermy for skin incisions has decreased due to concerns about inadequate wound healing. The scalpel causes more blood loss but little injury to the surrounding tissue.

Aim: The aim of the study was to compare electrocautery incision with scalpel incision in terms of incision time, blood loss, postoperative pain, and wound infection.

Material and Method: In the Department of General Surgery, a prospective observational comparative study was carried out. Patients who were willing to take part in the trial and had midline abdominal surgery scheduled were randomly assigned to one of two groups: group B (scalpel group) or group A (electrocautery group). The type of technique utilized to produce the incision was kept a secret from both the patient and the lead investigator who noted the results. One of the operating surgeons' helpers documented the incision time and intraoperative blood loss; the lead investigator was informed of this information without disclosing the patient group. All patients who meet the inclusion criteria and are receiving mid-line abdominal surgery during the study period are included and randomly assigned to one of two groups: group B (scalpel group) or group A (electrocautery group).

Results: The study comprised 80 patients in total; 40 were divided into groups A and B. In both groups, the distribution of ages and genders was comparable. Group A consisted of 25 men and 15 women, while Group B had 22 men and 18 women. The number of elective and emergency patients in the two groups did not differ significantly. Between the two groups, there was no statistically significant variation in the length of the incisions. The difference between the incision depth and the wound area was statistically significant. The two groups' incision times and incision times per unit wound area differed statistically significantly. Significant variations were also observed in intraoperative blood loss between the two groups.

Conclusion: Compared to using a knife, electrocautery during skin incisions during midline abdominal surgery resulted in reduced intraoperative blood loss and shorter incision times. Between the two groups, there was no difference in wound complications or postoperative pain. Given the aforementioned benefits of electrocautery, we can therefore say that it is a safe and reliable substitute for a knife when creating skin incisions during a midline laparotomy.

Keywords: Electrocautery incision, Midline laparotomy and Scalpel incision.

Introduction

Historically, scalpels and disposable knives have been used frequently to make skin incisions during laparotomy procedures; these incisions are more painful and cause more blood loss. The use of this

technique has recently been replaced by electrosurgical skin incisions. [1] The disadvantages of surgical steel scalpels were avoided with the introduction of surgical diathermy at the start of the 20th century. "Electrosurgery" or "electrocautery" is the phrase that is typically used to refer to surgical diathermy. Because diathermy is convenient and hemostatic, it was thought to be an effective method of dissection. Because high-frequency alternating electric current is used, it is not regarded as a true cutting incision. The three main uses of diathermy are cutting, fulguration, and coagulation. [2] Potential benefits of electrosurgery include less blood loss, quick and dry tissue separation, and perhaps less chance of inadvertent harm from the scalpel to operating staff. [3,4]

Data from the Centers for Disease Control and Prevention indicate that operating rooms account for roughly 27% of all sharp injury cases. [5] According to records from the national surveillance system for healthcare professionals, needle injuries are the second most common cause of these types of injuries after cuts.

In the operating room, healthcare personnel come into close contact with sharp objects, which raises the risk of injury in an emergency. Before diathermy was discovered, the scalpel was the preferred tool for making skin incisions. By eliminating the potential for burn injuries, a scalpel lowers the likelihood of severe scarring and inadequate wound healing. However, the use of sharp instruments during work resulted in higher rates of seroconversion among healthcare personnel, which prompted the creation of a Sharpless substitute for skin incisions. According to Perry et al., 8% of all injuries that happened in a hospital setting were caused by a scalpel, and there have been cases of surgeons getting HIV infection as a result of a scalpel injury. [6,7]

The scalpel was long thought to be the gold standard for creating skin incisions since it eliminates the chance of electrical burns and has the benefit of regulated incision depth. Due to the higher seroconversion risk among healthcare personnel who handle sharp objects, "Sharpless" alternatives to skin incision techniques, such as electrocautery, have been used. According to Perry J et al., 8% of all injuries that happened in a hospital setting were caused by a scalpel, and there have been cases of surgeons getting HIV infection as a result of a scalpel injury. [8,9]

Reducing the usage of scalpels not only lowers the risk of infection transmission but also lowers the number of man-hours lost as a result of serious mechanical injuries. Although electrocautery is widely used for dividing muscle, fascial layers, subcutaneous tissue, and intraoperative hemostasis, its use as a scalpel substitute for skin incisions has not yet gained widespread acceptance due to concerns that electrocautery may cause burn-related wound complications and unintentional damage to deeper structures. [10] Despite its many benefits, most surgeons are skeptical of using surgical diathermy as a cutting tool in place of a traditional scalpel when making a skin incision due to the procedure's needless scarring, increased risk of wound infection, and decreased rate of wound healing. As a result, surgical diathermy is used less frequently for skin incisions. [11,12] Therefore, the purpose of this study was to assess the safety and efficacy of electrocautery vs scalpels while making skin incisions for midline abdominal surgery. The study compared the incision time, blood loss, postoperative pain, and wound infection between electrocautery and scalpel techniques. The purpose of the study was to assess the safety and efficacy of electrocautery against scalpels for skin incisions during midline abdominal surgery.

Material and Methods

In the Department of General Surgery, a prospective observational comparative study was carried out. Patients who were willing to take part in the trial and had midline abdominal surgery scheduled were randomly assigned to one of two groups: group B (scalpel group) or group A (electrocautery group). The type of technique utilized to produce the incision was kept a secret from both the patient and the lead investigator who noted the results. One of the operating surgeons' helpers documented the incision time and intraoperative blood loss; the lead investigator was informed of this information without disclosing the patient group. During the study period, all patients who meet the inclusion criteria and are undergoing mid-line abdominal surgery are included and randomly assigned to one of two groups: group B (scalpel group) or group A (electrocautery group).

Inclusion criteria: Patients scheduled for midline abdominal surgery and willing to participate in the study were included in the study.

Exclusion criteria: Patients with previous midline laparotomy, patients on concurrent anticoagulant or corticosteroid therapy, patients with chronic medical illnesses like diabetes mellitus, anemia, and tuberculosis, and patients with active wound infection elsewhere in the body were excluded from the study.

Methods

A skin incision was made in the scalpel group using a scalpel equipped with a disposable blade that was the right size. Using a typical diathermy pen electrode, an electrocautery group incision was produced through the skin and deeper tissues. To incise the skin and all of its layers, an electrosurgical unit (ESU) with the Erbe Vio 300 D

brand from Erbe Medical India Pvt Ltd was used. It was configured for pure cutting mode and delivered 350 kHz sinusoidal current. For the purpose of stopping bleeding in the subcutaneous plane in both groups, diathermy in conjunction with coagulation mode was employed. Once the peritoneum was opened, the entire surgical process was performed using diathermy in the preferred mode as needed. All of the patients had general or spinal anesthesia during their operations. One gram of ceftriaxone was given to each patient thirty minutes prior to surgery, and this dosage was repeated every twelve hours for three days. For two days, 100 mg of tramadol injection was administered every eight hours. Vicryl was used to seal the subcutaneous layers, and 2-0 ethilion was used on the skin. On day 10, following surgery, skin sutures were taken out after the tensile strength was examined.

Incision Dimension Measurement: A sterile, flexible ruler was used to measure the dimensions of the incision in millimeters. The depth of the incision was determined by measuring its length and taking the thickness of the abdominal wall into account. Next, the wound area was determined by multiplying the length and depth of the incision. Incision time (from the start of skin incision till the complete opening of the peritoneal cavity including hemostasis) was noted in seconds and then the time taken per unit wound area (s\cm2) was calculated.

Blood Loss Measurement: Weighing the gauze swabs used during the incision allowed for the measurement of blood loss. The gauze was weighed using an electronic weighing scale both before and after the surgery. The dry and soaked gauze were weighed differently, with each gram representing one milliliter of blood. The incision was made without the use of suction. Then, the amount of blood loss was calculated in ml and blood loss per unit wound area as ml\cm2.

Pain Intensity Measurement: On the second postoperative day following surgery, patients' pain was clinically assessed using a visual analog scale, with 0 denoting no discomfort and 10 denoting the greatest possible pain. Up until the patient's release, a clinical evaluation of the wound was performed for surgical site infections every postoperative day and during the initial hospital follow-up appointment. Any irregularity was recorded. Grade 1 wound infections were defined as having erythema, induration, and pain; grade 2 wound infections included serous fluid discharge; grade 3 wound infections included contaminated fluid in less than half of the wound; and grade 4 wound infections included contaminated fluid in more than half of the wound. [13,14]

Statistical Analysis: Categorical variables such as gender, co-morbid conditions, and type of surgery (elective or emergency) were presented as frequencies or percentages and compared between the two groups using Fisher's exact test. Continuous variables such as age, incision time, blood loss, and incision size were represented as mean or standard deviation and compared between the two groups using an independent student's t-test.

Result

The study comprised 80 patients in total; 40 were divided into groups A and B. In both groups, the distribution of ages and genders was comparable. Group A consisted of 25 men and 15 women, while Group B had 22 men and 18 women. The number of elective and emergency patients in the two groups did not differ significantly.

Table 1: Demographic profile and case distribution

	Group A	Group B
Age	39.42±13.52	34.75±13.10
Male	25	22
Female	15	18
Type-elective	29	26
Emergency	11	14

Table 2: Comparison of incision time and blood loss

Parameters	Group A (mean±SD)	Group B (mean±SD)
Length (cm)	11.60±1.02	11.18±1.22
Depth (cm)	1.4±0.26	1.51±0.19
Wound area (cm^2)	32.44±5.51	32.72±5.24
Incision time (s)	295.55±50.20	348.33±38.65
Incision time\wound area (s\cm^2)	7.13±1.43	10.01±1.66
Blood loss (ml)	10.63±1.79	30.88±2.76
Blood loss\wound area (ml\cm^2)	0.21±0.02	1.16±0.18

Between the two groups, there was no statistically significant variation in the length of the incisions. The difference between the incision depth and the wound area was statistically significant. The two groups' incision times and incision times per unit wound area differed statistically significantly. Significant variations were also

observed in intraoperative blood loss between the two groups. In comparison to group B, group A saw a much lower mean blood loss per unit incision area.

Table 3: Comparison of pain score and wound infection

	Group A	Group B
Pain score	3.53±0.77	3.73±0.44
Wound Infection		
Yes	3	4
No	37	36

Pain score was calculated in both the groups on postoperative day 2 which was found to be statistically insignificant between the two groups.

Discussion

Diathermy was developed at the start of the 20th century to address the inherent drawbacks of scalpels, which included the potential for tumor metastasis, indistinct tissue planes, increased operative time, and the use of suture material in the wound, which increased the risk of infection. Due to its quick hemostasis, speedy dissection, and decreased overall operative blood loss, this approach is currently gaining a lot of popularity with the introduction of contemporary electrosurgical machines that can generate pure sinusoidal current. [15,16]

Regardless of the surgical treatment being performed, electrocautery has become a vital part of the operating room since Dr. Harvey Cushing carried out the first surgery employing an electrosurgical tool in 1926. Studies have demonstrated that electrocautery is safe and effective for splitting muscle and subcutaneous tissue layers, and it can also be used safely for bowel resection. It is still up for debate, though, whether or not to initially make the skin incision using electrocautery.

While a small number of randomized studies have demonstrated the effectiveness of electrocautery in skin incisions, other research have revealed increased wound infection and healing issues in the electrocautery group. [17,18] Franchi et al.2001 [19] reported that scalpel and diathermy were similar in terms of early and late wound complications when used to perform midline abdominal incisions in gynecologic oncologic patients. However, Papay et al.1998 [20] and Ozdogan et al.2008 [21] have shown contradictory results.

Chrysos et al.2005 [22] while performing prosthetic mesh inguinal hernioplasties found no change in wound complication rates with the use of electrocautery, declaring it as safe as the scalpel in terms of wound healing. Stoltz et al.2004 [23] stated that scalpel and electrosurgical thoracotomy incisions were similar in terms of early and late wound healing rates. Kumar et al.2011 [24] studied 80 patients undergoing head and neck surgery and found that electrocautery had significantly lower blood loss during incision. Coagulation and cutting mode property of electrocautery lead to less blood loss to cause coagulation. Aird LN et al.2012 [17] in their meta-analysis confirmed a significant decrease in the required volume and days of patient-controlled analgesia in the electrocautery group. Kearns et al. [25] and Rappaport et al.1990 [26] showed significantly less blood loss during incision in patients undergoing midline laparotomy in the electrocautery group.

Hemostasis, seroma, purulent collection, and wound dehiscence are the most common problems observed during the healing phase of wounds. Yilmaz et al. 2011 [27] compared scalpel and electrocautery and reported that seroma incidence was higher in the electrocautery group than the other groups and there was no difference between groups with respect to hematoma. Similarly, we found that the incidence of seroma was higher in the scalpel group than in the diathermy group.

Previous research on electrocautery skin incisions raised serious concerns about wound healing and found that the procedure increased the risk of wound complications. [28,29] But during the past ten years, research has thoroughly examined this matter and proven that electrocautery is safe to use when creating skin incisions. Franchi et al.2001 [19] in a multi-center collaborative trial on midline laparotomy patients found no increase in early or late wound complications using electrocautery.

Electrocautery is safe in skin incisions, according to Patil Shivagouda's 2005 [30] study, which found that the risk of post-operative wound infection was identical in both scalpel and electrocautery groups and was statistically insignificant. Eradicating the usage of scalpels in the operating room is also a desirable option because to the prevalence of blood-borne infections such as hepatitis C and HIV infection. [1] Compared to skin incisions done with a knife, those made by cutting diathermy result in less blood loss and are faster. Cutting diathermy is a method for abdominal skin incisions that is satisfactory visually. Diathermy has no higher risk of wound infection, and it may have advantages such as reduced postoperative wound discomfort. The results of this study demonstrate that, as compared to using a scalpel, diathermy offers clear safety benefits to the surgical team and may offer

some benefits in terms of postoperative wound pain. When operating time and blood loss are critical in high-risk patients, the best technique for making an incision is diathermy. In terms of inflammation, wound strength, and scarring, cauterization wounds heal similarly to those made with a knife. According to these findings, diathermy is a safe, effective surgical technique with a wide range of applications, including abdominal laparotomy procedures.

A smaller sample size was the study's primary limitation. The outcomes of this investigation, however, are consistent with findings from other countries and lend credence to the application of electrocautery in skin incision procedures.

Conclusion

Compared to using a knife, electrocautery during skin incisions during midline abdominal surgery resulted in reduced intraoperative blood loss and shorter incision times. Between the two groups, there was no difference in wound complications or postoperative pain. Given the aforementioned benefits of electrocautery, we can therefore say that it is a safe and reliable substitute for a knife when creating skin incisions during a midline laparotomy. When comparing electrocautery vs scalpel incisions for skin incisions during midline laparotomy, the former can be deemed safe and successful due to its same wound infection rate, postoperative incision site pain, and much reduced blood loss during the same amount of time required for the incision.

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