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Comparative study between scalpel versus electrocautery incisions in abdominal surgeries

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***Abstract*---**Aims: This study is to compare the outcome of diathermy incisions versus steel scalpel incisions in abdominal surgeries with regard to incision time, incision related blood loss, post-operative pain and post-operative wound infection / complication. Materials and methods: This is a prospective randomized comparative clinical study involving 116 patients. 58 patients were randomly assigned to undergo incision either with scalpel or electrocautery. Results were analysed based on the findings. Results: Incision time and incisional blood loss is lesser in electrocautery incisions when compared to scalpel incisions. This is an encouraging fact in view of routine use of electrocautery for taking abdominal incisions after observing all necessary aseptic precautions. There was no significant difference in terms of post-operative pain and wound complications according to the data. Conclusion: Electrosurgical instruments can be used as an alternate safer option for surgical incisions.

***Keywords*---**scalpel, electrocautery, diathermy, monopolar, bipolar, surgical incisions, incision time**.**

Introduction

The Greek words 'therma', which means heat, and 'dia,' which means through. Diathermy literally means "heating through." In 1909, a German physician named Carl France Nagelschmidt was the first to propose the term diathermy. There are two types of electro-surgeries: - Monopolar and Bipolar. Monopolar - owing to its versatility and clinical effectiveness is the most commonly used electrosurgical modality. In monopolar electrocautery, the active electrode is in the surgical site whereas the patient return electrode is on another site of the patient's body. This circuit starting from the electrosurgical generator

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to the patient and the current returning through the return electrode back to the generator completes the electrosurgical circuit.

Bipolar - where both the active and patient return electrode functions are performed at the site of the surgery by the two tines of the bipolar forceps. Tissue grasped between the two tines is only included in the electrical circuit. The patient return electrode is not needed because the return function is performed by one tine of the forceps. Hence it focuses only on the tissue which is in contact and prevents current flow through tissues of the body.

Monopolar electrocautery works on the principle of concentration of radiofrequency energy within the small surface area of the surgical instrument. Current will go through the patient's body to a conductive pad connected to the radio frequency generator, completing the electrical circuit. The energy density will be low enough that there would be no tissue damage at the pad site due to the larger surface area of the pad compared to the instrument tip. Compromising the electrical circuit will result in electrical shocks and burns to the patient or the operating surgeon.

Surgical incisions are generally made with scalpel. Usage of scalpel results in skin bleeding which obscure the operating time. Other alternative method in making skin incision is diathermy. Diathermy is mainly used for tissue destruction especially for hemostasis. Surgeons usually avoid diathermy for making skin incisions due to certain reasons like wound infection, delayed wound healing, and excessive scarring.

Diathermy incision has certain significant advantages compared with scalpel because of reduced incision time, less blood loss, reduced postoperative time. It is not a true cutting incision. Diathermy heat cell within tissues rapidly that they vaporize leaving the cavity within cell matrix, heat created disappears as steam instead of being spread to adjacent tissue. The moving electrode contracts and vaporizes the new cells and an incision is created.

Aims and Objectives

Aims

This study is to compare the outcome of diathermy incisions versus steel scalpel incisions in abdominal surgeries with regard to:

1. Incision time
2. Incision related blood loss
3. Post-operative pain
4. Post-operative wound infection / complication

Objectives

- To compare the outcome of diathermy incisions versus steel scalpel incisions in abdominal surgeries.

- To study the tissue changes and wound complications in diathermy and scalpel skin incisions.

Materials and Methods

This is a prospective randomized comparative clinical study. All patients fulfilling the inclusion criteria undergoing elective and emergency abdominal surgeries at Krishna Hospital & Medical Research Centre, Karad are included in the study from December 2019 to June 2021.

Inclusion Criteria

- Patients undergoing elective or emergency abdominal surgeries.
- Clean and clean-contaminated wounds (class 1 & 2).

Exclusion Criteria

- Immunocompromised patients.
- Contaminated and infected wounds (class 3 & 4).
- Patients on anticoagulants or corticosteroid therapy.
- Previous operated scar.

Incision time: - initial skin incision advancing through deeper tissues till opening of peritoneal cavity, including hemostasis. In scalpel group, skin incisions were made using scalpel with disposable blade of appropriate size. The incisions were made through skin and deeper tissues till peritoneum is opened. Bleeders were clamped, crushed or ligated using artery forceps and no electrocautery were used in the process. In electrocautery group, the process was carried out by incising through skin and deeper tissues till peritoneum is opened using standard diathermy pen electrode in cutting mode. Bleeders were cauterized or ligated in the process.

Incisional blood loss: - The gauze swabs used in making the incision and during hemostasis was weighed to calculate incisional blood loss. 1 ml of blood loss corresponds to 1 gm difference between dry and soaked gauze and blood loss per unit wound area was calculated as ml/cm^2. The point to be noted here is that suctioning of blood was not done in the entire process. Wound related pain was assessed using verbal rating scale (no pain, mild, moderate and severe pain) on 5 consecutive postoperative days.

Clinical assessment of the wound was done for 10 post-operative days for wound related complications. The duration of the incision was documented using a second's timer, which is the time taken from the initial skin incision to the end of opening of peritoneum completely. The incisional blood loss was measured by weighing the soakage pads. ASEPSIS score was used to assess wound infection.

Results

- Out of 116 patients in our study, 58 patients were randomly assigned to undergo incision either with scalpel or electrocautery. The mean age of

patients in the electrocautery group is 45.1 +/-13.0 and in the scalpel group are 44.8 +/- 12.9. The difference in age in the two groups studied was not statistically significant. (P value = 0.926)

- Total number of males outnumbered females in our study. 60% were males compared to the 40% of females in the study. Numbers of males were more than the females in both the incision groups. The number of males (35) and females (23) were equal in the two groups. P value was insignificant (1.000).
- Out of 58 patients who underwent electrocautery incision, the mean incision time was 8.07 +/- 0.35 minutes. The mean incision time in the other 58 patients with scalpel incision, the mean incision time was 9.1072+/- 0.34 minutes.
- Incision time was less in electrocautery group then in scalpel incision group with a statistically significant difference between the two. (P value <0.001)
- The mean value of incision related blood loss in electrocautery group 1.67+/- 0.15 was and scalpel group was 2.34+/- 0.34 ml/cm^2. The P value is found to be <0.001, hence there is a significant difference between electrocautery and scalpel group.

Verbal rating scale (VRS): was used to assess post-operative pain for 5 days. It was divided into no pain, mild, moderate and severe pain.

POD -1

- Most of the patients complained of moderate pain in the electrocautery incision group (42) and scalpel incision group (34) with no statistically significant difference seen between the groups. (P value = 0.295)

POD -2

- On post-operative day 2, most of the patients complained of mild pain in both electrocautery and scalpel incision groups and the difference between them were not statistically significant. (P value = 0.868)

POD -3

- On post-operative day 3, most of the patients complained of mild pain (101) and very few complained of moderate pain (15) .No statistically significant difference in pain between the two groups was noted. (P value = 0.406)

POD -4

- On post-operative day 4, most of the patients complained of mild pain (107) and very few complained of moderate pain (9) .No statistically significant difference in pain between the two groups was observed. (P value = 0.298)

POD -5

- On day 5, patients experienced more of mild pain (11) than moderate pain (5) with no statistically significant difference between the two groups as p

value is greater than 0.05. None of the patients complained of severe pain. (P value = 0.648)
ASEPSIS score: was used to assess wound complication from post-operative day 2 to post-operative day 10.

POD -2

- Both groups were found to have similar wound complication rate with no statistically significant difference between the two groups. The wound infection rate in scalpel group was comparatively more (3). **(P value =0.648)**
  Haematoma was seen in 2 patients in electrocautery group. 3 patients in scalpel group developed complications, 2 patients developed haematoma and 1 patient developed seroma.

POD -4

- On day 2, wound infection was only found in 2 patients in scalpel group with no statistically significant difference between the groups. (P value=0.154)
  Only 2 patients in scalpel group developed seroma.

POD -6

- Out of the two groups, 6 patients in scalpel incision group and 3 patients in electrocautery group developed wound infection. The difference between them was not statistically significant. (P value =0.298)
  In the electrocautery group 3 patients developed superficial SSI and in scalpel group 4 patients developed superficial SSI and 2 patients developed seroma.

POD -8

- 17 patients developed wound complications out of 9 belonged to electrocautery group and 8 to scalpel group with no statistically significant difference between the two groups. (P value 0.793)
  2 patients developed seroma, 5 patients developed superficial SSI and 2 patients developed deep SSI in electrocautery group. In the scalpel group 1 patient developed seroma, 4 developed superficial SSI, 2 developed deep SSI and 1 patient developed wound dehiscence.

POD -10

- A total of 33 patients developed wound complications. Majority belonged to electrocautery group (19). The difference was not statistically significant. (P value = 0.303)
  In the electrocautery group majority of the patients (8) developed superficial SSI ,4 patients developed deep SSI, 3 patients developed seroma and wound dehiscence each and 1 patient developed haematoma. In the scalpel group,

6 patients were found to have superficial SSI, 4 had deep SSI and 2 patients developed seroma and wound dehiscence each.

Superficial SSI (30) was the most common complication followed by seroma (13), deep SSI (12), wound dehiscence (6) and haematoma (5).

Incision type	Mean (in mins)	Std. Deviation
Electrocautery	8.0778	.35685
Scalpel	9.1072	.37394
P Value	0.001	

Table 1: Incision Time

Incision related blood loss (ml/cm^2)	Mean	Std. Deviation
ELECTROCAUTERY (N=58)	1.672	0.1576
SCALPEL (N=58)	2.345	0.3409
P Value	0.000	

Table 2: Incision related blood loss

PAIN	POD1		POD2		POD3		POD4		POD5	
GROUP	E	S	E	S	E	S	E	S	E	S
MILD	8 (13.8%)	12 (20.7%)	42 (72.4%)	40 (69.0%)	52 (89.7%)	49 (84.5%)	55 (94.8%)	52 (89.7%)	55 (94.8%)	56 (96.6%)
MODERATE	42 (72.4%)	34 (58.6%)	14 (24.1%)	15 (25.9%)	6 (10.3%)	9 (15.5%)	3 (5.2%)	6 (10.3%)	3 (5.2%)	2 (3.4%)
SEVERE	8 (13.8%)	12 (20.7%)	2 (3.4%)	3 (5.2%)	-		-		-	
P VALUE	0.295		0.868		0.406		0.298		0.648	

E-Electrocautery, S-Scalpel

Table 3: Post-operative pain

Table 4: Post-operative wound complications

WOUND COMPLICATIONS	POD-2		POD-4		POD-6		POD-8		POD-10		TOTAL
GROUP	E	S	E	S	E	S	E	S	E	S	
HEMATOMA	2	2	-	-	-	-	-	-	1	-	5
SEROMA	-	1	-	2	-	2	2	1	3	2	13
SUPERFICIAL SSI	-	-	-	-	3	4	5	4	8	6	30
DEEP SSI	-	-	-	-	-	-	2	2	4	4	12
WOUND DEHISCENCE	-	-	-	-	-	-	-	1	3	2	6

TOTAL	5 (4.3%)	2 (1.7%)	9 (7.8%)	17 (14.7%)	33 (28.4%)	66 (56.89%)
P VALUE	0.648	0.154	0.298	0.793	0.303	

E-Electrocautery, S-Scalpel

Discussion

- Electro surgery was first introduced in 1929, and it has been widely used since then. At present it is an indispensable tool in all operating rooms. Prior to the development of non-explosive anaesthetics, electrosurgical techniques had limited applications, such as underwater transurethral work, in basic skin procedures and in neurosurgery it was used while operating under regional anaesthesia or use of nitrous oxide anaesthesia. [1] Electro surgery was utilised to maintain haemostasis and control bleeding with the introduction of the anaesthetic halothane. [1]
- After the introduction of anaesthetic agent halothane, electro surgery was used to maintain haemostasis and control bleeding. Very few surgeons used electrocautery to make skin incisions. This version of using electrocautery to make skin incisions stemmed from the assumption that it increases devitalized tissue within the wound, potentially delaying wound healing, caused wound infection and resulted in scar formation. The use of electrocautery gained popularity as a result of the sinusoidal current produced by oscillator units.
- Preliminary research on electrosurgical techniques involving electrocautery revealed that it was only concerned with skin charring. [2] Additional animal investigations revealed that electrocautery was linked to a delay in wound healing, but no variations in wound strength were found. [3,4] The increased wound infection was thought to be caused by an increase in oxygen tension caused due to tissue heating. The fact that cell vaporisation generated by pure sinusoidal current induces tissue and nerve damage immediately explains the decreased verbal rating scale scores during the first 48 hours. Other studies have found that electro surgical incisions have substantial advantages, such as shorter incision times, less blood loss, less post-operative pain, and lymphatic sealing after the removal of malignant tumours.
- Siraj et al., in 2011, reported that incision time and incision related blood loss in the electrocautery group is significantly less in comparison with steel scalpel group which is similar to our study findings.[5]
- Dixon et al., has shown that incision with electrocautery is superior to scalpel incision.[6] He concluded that electrocautery incision was highly effective, consistently quicker, gave better cosmetic results with minimal complications.
- Kearns et al conducted a study in which the incisions were assessed in terms of incision time, blood loss from the incision, and postoperative pain. This study concluded that electrocautery incisions were significantly superior to scalpel incisions with respect to incision time and incision related blood loss. He also came to the conclusion that using electrocautery for skin incisions is associated with reduced postoperative discomfort and a lower need for analgesics. [1] In addition, Kearns discovered that

postoperative discomfort was greatly reduced in the electrocautery group for first 48 hours after operation.[1]

- In a study conducted by Shamim, he concluded that incision time was significantly longer for scalpel group which is similar to the results obtained in our study. Post operative pain perception was significantly reduced during the first 48 hours in patients in electrocautery group which is similar to the results of Kearns study but no such significance was found in our study. Post operative wound complication rate did not differ markedly between the two groups which is similar to the findings in our study. [7]
- Hussain and Hussain in his study observed that postoperative pain is substantially reduced in electrocautery group.[8]
- Ahmad et al. also noted similar findings and concluded that in the first 24 hours after surgery, electrocautery incisions resulted in much less postoperative pain. [9]
- In our study no such significant difference in post-operative pain was found between the two groups. The wound in the immediate postoperative period was assessed for 10 post-operative days. Presence of any haematoma, seroma, SSI and wound dehiscence was looked for and its presence or absence was recorded.
- In a study conducted by Siraj et al., between the scalpel and electrocautery groups, there were no statistically significant differences in wound infection rates. (The probability is 0.17). [5] Galal A N reported similar findings in 50 patients in 2007 and concluded that post-operative problems were insignificant in both groups. [10] Both the studies are consistent with the findings in our study.
- In a study by Adams et al, incisions done with a steel scalpel resulted in a lower percentage of surgical site infection (13.1%) than incisions produced with electrocautery.[11] No such difference was seen in our study.
- Groot et al. evaluated the electrocautery and steel scalpel in a study on wound infection rates in abdominal and thoracic surgery. They came to the conclusion that electrocautery does not increase the rate of wound infection. [12] Ahmad et al. also came to the same conclusion, that post-operative infections in electrocautery and scalpel groups are comparable.[9]
- Ali et al., in the year 2009, proposed that electrocautery was safe to make all types of skin incisions and stated that electrocautery group (12.5%) had lesser wound infection rate as compared to scalpel group (17.5%). However, this difference (P value = 0.378) was not statistically significant. [13]
- Electrocautery is safe in skin incisions, according to Patil Shivagouda's 2005 study, which found that the risk of post-operative wound infection was identical in both scalpel and electrocautery groups and was statistically insignificant.[14] In addition, the presence of blood-borne illnesses like hepatitis C and human immunodeficiency virus infection makes eliminating scalpel use from the operating room an appealing alternative. [1]

Conclusion

- Incision time and incisional blood loss is lesser in electrocautery incisions when compared to scalpel incisions. This is an encouraging fact in view of

routine use of electrocautery for taking abdominal incisions after observing all necessary aseptic precautions.

- Hence, we conclude that electrosurgical instruments can be used as an alternate safer option for surgical incisions.
- Based on the observations made in our study we conclude that diathermy incisions are just as likely to become infected as scalpel incisions. Also post-operative wound pain in patients was quite similar in incisions made with electrocautery and scalpel. The rate of wound complication and post-operative pain was insignificant among both the incision techniques.

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References

1. Kearns SR, Connoly EM, McNally S, McNamara DA, Deasy J. Randomized clinical trial of diathermy versus scalpel incision in elective midline laparotomy. Br J Surg 2001;88:41-43.
2. Glover JL, Bendick PJ, Link WJ. The use of thermal knives in surgery: Electrosurgery, lasers, plasma scalpel. CurrProblSurg1978;15:1-78.
3. Arnaud JP, Adloff M. Electrosurgery and wound healing: An experimental study in rats. EurSurg Res 1980;12:439
4. Hall RR. The healing of tissues incised by a carbon-dioxide laser. Br J Surg 1971;58:22-25.
5. Siraj A, Dar MF, Gilani AAS, Raziq S. Elective midline laparotomy: Comparison of diathermy and scalpel incision. Prof Med J 2011;18:106-11.
6. Dixon AR, Watkin DF. Electrosurgical skin incision versus conventional scalpel: A Prospective trial. J R CollSurgEdinb 1990;35:299-301
7. Shamim M. Diathermy vs. Scalpel skin incisions in general surgery: Double-blind, randomized, clinical trial. World J Surg 2009;33:1594-9.
8. Hussain SA, Hussain S. Incision with knife or diathermy and postoperative pain. Br J Surg 1988;75:1179-80.
9. Ahmad NZ, Ahmed A. Meta-analysis of the effectiveness of surgical scalpel or diathermy in making abdominal skin incisions. Ann Surg 2011;253:8-13.
10. AbulNagah G, Tarek EF, Lotfy H, Shehab W, Tarek A. Comparative study between using harmonic scalpel and electrocautery in modified radical mastectomy. Egyptian Journal of Surgery 2007;26:176-80.
11. Adams KF, Schatzkin A, Harris TB, Kipnis V, Mouw T, BallardBarbash R, et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. N Engl J Med 2006; 355:763-78.
12. Groot G, Chappell EW. Electrocautery used to create incisions does not increase wound infection rates. Am J Surg 1994;167:601-3.
13. Ali Q, Siddique K, Mirza S, Malik AZ. Comparison of superficial surgical site infection following use of diathermy and scalpel for making skin incision in inguinal hernioplasty. Niger J ClinPract 2009;12:371-4.
14. Patil S, Gogeri BV, Goudhi AS, Metgud SC. Prospective randomized controlled trial comparing the efficacy of diathermy incision versus scalpel incision over skin in patients undergoing inguinal hernia repair. Rec

Res Sci Tech 2010;2:44-7.