Surgical Outcomes of Laparotomy Skin Incisions by Using Scalpel versus Cutting Diathermy during Elective Laparotomies - A Prospective Observational Study

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ABSTRACT

BACKGROUND
The aim of the present study is to compare surgical outcomes of cutting diathermy verses surgical scalpel for skin incisions from all elective laparotomies.

METHODS
This is a prospective observational study conducted among 30 patients undergoing elective laparotomy procedures admitted in the Department of General Surgery. Study was conducted over a period of 2 years. Patients undergoing elective laparotomy procedures who fulfilled the above inclusion criteria, after taking informed and written consent were enrolled in the study. Patients were randomized into two groups depending on whether the diathermy or scalpel was used in making the abdominal wall incision.

RESULTS
Incision time is less in diathermy group when compared to scalpel group. Incision related blood loss is less in diathermy group when compared to scalpel group. There is significant difference in the post-operative pain at 6, 12, and 24 hours between scalpel group and the diathermy group. There is significant difference in the incidence of wound infection at day 4 between scalpel group and diathermy group. The incidence of seroma is higher in scalpel group 40% as compared to diathermy group's 33.3%; but this result is not significant statistically. The POSAS total patient and total observer scale at 1st and 3rd month is higher in diathermy group. No difference in total patient score was found at 6th month follow up.

CONCLUSIONS
Cutting diathermy can be safely used to make abdominal wall incisions considering its efficacy in terms of shorter incision time, haemostasis, lesser post-operative pain, and relatively comparable scar cosmesis.

KEYWORDS
Diathermy, Scalpel, Observer Scale

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BACKGROUND

Incision is a cut or a slit to gain access to the deeper structures for repair of tissues damaged in trauma or for excision of a skin lesion.[1] Traditionally, surgical incisions are usually made with stainless steel scalpel and these incisions are bloody and painful, so use of scalpel results in bleeding which usually obscure the operating field which results in wastage of operating time. Various ideal methods of skin incisions which will provide quick and adequate exposure with minimal blood loss are still being researched by surgeons. Other alternative is diathermy which is mainly used for tissue dissection, cutting and coagulation of tissues. Skin incision by diathermy is avoided due to fear of deep burns, scarring, postoperative pain and poor wound healing when compared with scalpel, which creates a clean incised wound with minimal tissue destruction. But diathermy in skin incision decreases bleeding with less incision time.[2] Many advanced techniques like laser, plasma scalpel, Cavitron surgical aspirator etc have been used to minimise surgical blood loss but these are costly and relatively unavailable. Currently, most of the surgeons still use the scalpel for skin incisions and use coagulation diathermy to dissect deeper tissues. Now-a-days electrodes used in making cutting diathermy generate a pure sinusoidal current which produces cleavage in tissue planes without creating damage to the tissues leading to minimal scar formation compared to coagulation diathermy, which generates heat more slowly via an interrupted current. This study is undertaken to alleviate the fear of using diathermy for skin incisions, particularly to observe immediate post-operative pain, surgical site infections, duration of healing and wound scarring as compared to scalpel for skin incisions.

METHODS

This is a prospective observational study conducted among 30 patients undergoing elective laparotomy procedures admitted in the Department of General Surgery. Study was conducted over a period of 2 years.

Inclusion Criteria

1. Age: > 18 years and < 60 years.
2. Gender: males and females.
3. Patients who underwent elective laparotomy procedures.
4. Clean wounds.
5. All patients who gave valid written informed consent.

Exclusion Criteria

1. Clean contaminated and contaminated wounds.
2. Patients undergoing Re-laparotomies and Revision surgeries.
3. Patients undergoing emergency operative procedures.
4. Patients on anti-coagulant therapy.

Patients undergoing elective laparotomy procedures who fulfilled the above inclusion criteria, after taking informed and written consent are enrolled in the study. Patients were randomized into two groups according to whether the diathermy or scalpel was used in making abdominal wall incision-

- Scalpel group – 15 cases.
- Diathermy group – 15 cases.
- All procedures were carried out under spinal/ general anaesthesia. Premedication given was injection Ceftriaxone 1 gram intravenous 1 hour before surgery.
- The surgeon was informed of the type of incision to be used just before the start of the incision.

Scalpel Group

Abdominal wall was incised with scalpel and bleeding was controlled by diathermy coagulation.

Diathermy Group

Abdominal wall was incised with electro-cautery needle (cutting) using pulse sine wave current and a power setting of 30 watts, haemostasis was achieved by diathermy coagulation.

Data Collection Method

The time from the start of the abdominal skin incision to completion of peritoneal incision was recorded. Blood loss during abdominal wall incision was calculated by weighing the swab used exclusively in making the incision and during haemostasis with each gram taken as equal to one mL of blood (1 gram = 1 mL). No suction evacuation of blood was done while making the incision. The length and depth of the incision was measured at the end of the procedure in centimetres using sterile measuring tape. Incisional area was calculated as a product of length and width of abdominal wall incision. The amount of blood was calculated as mL / cm^2.

Postoperative pain was measured using Visual Analogue Scale (VAS) after 6, 12, 24 and 48 hours of surgery

If pain score is more than 4, injection Diclofenac sodium 75 mg IM or Paracetamol 1 gram IV was given.

During the postoperative period (3rd POD to 7th POD) wound complications were reported as below –

1. Seroma – collection of serous discharge in suture site.
2. Haematoma – collection of blood clots.
3. Abscess – collection of purulent discharge.
4. Wound dehiscence.

Antibiotic prophylaxis was done using intravenous Ceftriaxone at about 1 hour prior to induction of anaesthesia. Rectus sheath was sutured using 1-0 loop Ethilon. Skin sutured using 2-0 Sutupak. Skin sutures were removed between 7 - 8 postoperative day and wound left open for secondary healing were kept on daily dressing.

At periods of 1, 3 and 6 months after surgery, patient surgical scars will be evaluated by using the Patient and Observer Scar Assessment Scale (POSAS), to evaluate the cosmesis of the surgical scar.

Statistical Analysis

The data on categorical variables is shown as n (% of cases) and the data on continuous variables is presented as mean and standard deviation (S.D.) across two study groups. The inter-group comparison of categorical variables is done using chi-square test or Fisher's exact probability test. The statistical significance of inter-group difference of means of continuous variables is tested using independent sample 't' test or unpaired 't' test. The underlying normality assumption was tested before subjecting the study variables to the 't' test. All the results are shown in tabular as well as graphical format to visualize any statistically significant difference clearly. In the entire study, p-values less than 0.05 are considered to be statistically significant. All hypotheses were formulated using two tailed alternatives against each null hypothesis (hypothesis of no difference).

RESULTS

Incision Time (sec/cm^2)	Scalpel Group	Diathermy Group
Mean ± SD	9.02 ± 0.523	8.10 ± 0.329
min, max	7.52, 9.48	7.48, 8.50
Incision related blood loss (mL/cm^2)		
Mean ± SD	2.33 ± 0.244	1.78 ± 0.11
Min, max	1.7, 2.6	1.6, 2.0

Table 1. Comparison of Mean Incision Time of Both Groups

The incision time is less in diathermy group when compared to scalpel group. P value is <0.0001, it denotes that there is a significant difference between two groups. The incision related blood loss is less in diathermy group when compared to scalpel group. P value is <0.0001, it denotes that there is significant difference between two groups.

Incidence of Postoperative Pain at 6 Hours			
	Scalpel	Diathermy	P-Value
Mild	5 (33.3%)	2 (13.3%)	
Moderate	5 (33.3%)	1 (6.6%)	
Severe	4 (26.6%)	1 (6.6%)	
Total	14 (93.3%)	14 (93.3%)	0.000194
Incidence of postoperative pain at 12 hours			
Mild	6 (40%)	1 (6.6%)	
Moderate	4 (26, 6%)	1 (6.6%)	
Severe	3 (20%)	1 (6.6%)	
Total	13 (86.6%)	3 (20%)	0.000253
Mild	6 (40%)	1 (6.6%)	
Moderate	3 (20%)	1 (6.6%)	
Severe	1 (6.6%)	0	
Total	10 (66.6%)	2 (13.3%)	0.002869
Incidence of postoperative pain at 24 hours			
Mild	6 (40%)	1 (6.6%)	
Moderate	3 (20%)	1 (6.6%)	
Severe	1 (6.6%)	0	
Total	**10 (66.6%)**	**2 (13.3%)**	**0.002869**
Incidence of postoperative pain at 48 hours			
Mild	5 (33, 33%)	1 (6.6%)	
Moderate	1 (6.6%)	0	
Severe	1 (6.6%)	0	
Total	7 (46.6%)	1 (6.6%)	0.013243

Table 2. Comparison of Incidence of Postoperative Pain

There is significant difference in the postoperative pain at 6, 12, 24 hours between scalpel group and diathermy group.

	Scalpel	Diathermy	P-Value
Comparison of incidence of wound infection			
on day 4			
Yes	8 (53.3%)	1 (6.6%)	
No	7 (46.6%)	14 (93.3%)	0.005289
on day 5			
Yes	YES 6 (40%)	4 (26.6%)	
No	9 (60%)	11 (73.3%)	0.76738
on day 6			
Yes	10 (66.6%)	6 (40%)	
No	5 (33.3%)	9 (60%)	0.143235
on day 7			
Yes	N11 (73.3%)	7 (46.6%)	
No	4 (226.6%)	8 (53.3%)	0.136037

Table 3. Comparison of Incidence of Wound Infection

There is significant difference in the incidence of wound infection at day 4 between scalpel group and diathermy group. There is no significant difference in the incidence of wound infection at day 5, 6, 7 between scalpel group and diathermy group.

Complications	Scalpel (N = 15)	Diathermy (N =15)
Nil	4(26.6%)	7 (53.3%)
Seroma	6 (40%)	5 (33.3%)
Haematoma	1 (6.6%)	1 (6.6%)
Abscess	2 (13.3%)	1 (6.6%)
Dehiscence	2 (13.3%)	1 (6.6%)

Table 4. Comparison of Incidence of Other Complications

P Value is 0.813143. The result is not significant at P < 0.05. The incidence of seroma is higher in scalpel group 40% as compared to diathermy group 33.3%, but this result is not significant statistically.

Mean POSAS Patient Scale (Total)	Scalpel (N = 15)	Diathermy (N =15)	P-Value
Inter - group comparison of mean POSAS patient scale (Total Score Out of 60)			
1 - month	12.5 ± 2.02	14.4 ± 2.1	0.0182
3 - month	11.4 ± 1.2	13.3 ± 2.0	0.0101
6 - month	10.8 ± 1.02	10.8 ± 1.6	0.7031
Inter - group comparison of mean POSAS patient scale (Overall Score Out of 10)			
1 - month	3.6 ± 1.01	3.9 ± 1.23	0.443
3 - month	3.1 ± 1.23	3.3 ± 1.19	0.628
6 - month	2.8 ± 1.02	2.8 ± 0.74	0.845
Inter - group comparison of mean POSAS observer scale (Total Score Out of 60)			
1 - month	15.2 ± 1.90	18.4 ± 2.65	0.0008
3 - month	14.0 ± 2.43	14.9 ± 2.23	0.334
6 - month	13.5 ± 3.24	13.9 ± 4.43	- 0.787
Inter - group comparison of mean POSAS overall observer scale (Overall Score Out of 10)			
1 - month	3 2.93 ± 1.28	3.94 ± 1.23	0.0454
3 - month	2.87 ± 0.805	3.34 ± 1.19	0.2352
6 - month	MO 2.67 ± 1.01	2.80 ± 0.748	3 - 0.6947

Table 5. Inter Group Comparison of Mean POSAS Patient Scale (Total Score Out of 60)

The POSAS total patient scale at 1st and 3rd month is higher in diathermy group. No difference in total patient score was found at 6th month follow up.

The POSAS overall patient scale at 1st and 3rd month is higher in diathermy group. No difference in overall patient score was found at 6th month follow up.

The POSAS total Observer scale at 1st month is higher in diathermy group. No difference in total observer score was found at 3rd and 6th month follow up.

The POSAS overall observer scale at 1st month, 3rd month is higher in diathermy group. No difference in overall observer score was found at 6th month follow up.

DISCUSSION

Diathermy acts by vaporization of cells, producing plasma around the electrode and propagating its thermal effect. By this means, it produces a clean incision with haemostasis. Multiple studies have been undertaken to substantiate the efficacy of diathermy for skin incision. Many of them have proved efficient in terms of lesser blood loss, decreased operating time and haemostasis. Despite these advantages, its use by surgeons for skin incision in surgical units in developing countries including ours, is still minimal.

We can observe sparsity of studies reporting cosmesis of scar and long-term effect on cosmetic outcome. In fact, in developing countries, use of diathermy, which is available in almost all surgical theatres is less due to the belief that diathermy causes electric burns, which leads to necrotic tissue accumulation causing delayed wound healing, infection and excessive scarring.[3,4]

The present tertiary-care-based trial was conducted to compare cosmetic outcome, postoperative pain and wound complications between abdominal wall incision taken by scalpel and cutting diathermy. In recent years after introduction of advanced electro-cautery units (pure sinusoidal current), there is an increasing trend in the use of cautery for making skin incision. Studies have shown that when compared with scalpel, use of electro cautery results in reduced operating time, minimal blood loss and early pain reduction and fewer analgesics in postoperative period. There was a significant difference in incision time between abdominal wall incisions made with scalpel and cutting diathermy. Our results suggested that, cutting diathermy resulted in a statistically significant shorter incision time than use of the scalpel. The shorter incision time is most likely explained by the fact that achieving haemostasis with a scalpel incision requires several instrument exchanges with coagulation diathermy, especially in subcutaneous tissue. Dixon et al [5] has shown that diathermy incision is more rapid than scalpel incision. There was a significant difference in incision related blood loss made with cutting diathermy and scalpel. Blood loss was significantly less following incisions made by cutting diathermy rather than scalpel. Present findings are comparable to findings reported by Talpur et al[6] who in their study reported statistically significant reduction in mean blood loss with diathermy when compared with scalpel. In present study there was a significant difference in postoperative pain (mild) at 6 hrs, 12 hrs, 24 hrs, 48 hrs between abdominal wall incisions made with cutting diathermy and scalpel. Our results suggested significantly reduced postoperative pain in diathermy group. This may be explained by the localised sensory nerve destruction with the subsequent disruption of transmission of nerve impulses resulting from diathermy ablation. Cell vaporisation caused by the application of pure sinusoidal current leads to immediate tissue and nerve necrosis without significantly affecting the nearby structures. Consequently, there is a total or partial injury to the cutaneous nerves in the area of the surgical wound with a reduced postoperative pain profile in patients who had diathermy skin incisions.

There was a significant difference in postoperative pain (moderate) at 6 hrs, 12 hrs, 24 hrs between skin incisions made with cutting diathermy and scalpel. At the end of 48 hrs there is no pain in diathermy group. Our +results suggested a significantly reduced postoperative pain in the diathermy group. There was a significant difference in postoperative pain (severe) at 6 hrs, 12 hrs, between abdominal wall incisions made with cutting diathermy and scalpel. At the end of 24 hours and 48 hours there is no pain in diathermy group. Our results suggested that postoperative pain is significantly reduced in the diathermy group. Lower pain scores in diathermy group was also supported by previously conducted studies. Chalya et al[7] revealed significantly reduced postoperative pain with diathermy incision as compared to scalpel incision on postoperative days 1 and 2. Analgesic requirements were also significantly lowered in diathermy incision group than scalpel group. These results were consistent with this study. The study conducted by Kearns [8] and colleagues stated that diathermy produces significantly less postoperative pain on the first and second postoperative day when compared to scalpel incisions. In this study, postoperative pain on the first and second days was higher in scalpel group. There was no significant difference in pain of both groups on subsequent days. One study done by LD Prakash and colleagues showed that there was no significant difference in postoperative pain between diathermy incision and scalpel incision group.[9] A study conducted in 2010 by Shivagouda P et al [10] revealed that there was significant difference between the two groups with respect to postoperative pain. Results of present study are consistent with this study. The use of thermal energy for abdominal wall incision raises concerns about collateral heat damage, impaired wound healing and a possible increased risk of wound infection, secondary to necrosis at wound edges. In the present study, occurrence of wound infection in scalpel group is higher compared to diathermy group. This incidence was statistically significant at POD 3, POD 4 and was not statistically significant at POD 5, POD 6, POD 7 and POD 8 ($p>0.05$). This outcome has been noted by previous studies.

A study conducted by Franchi et al, in multicentre collaborative trials on midline laparotomy patients found no increase in the early or late wound in diathermy skin incisions.[11] K.V. Ragesh and colleagues in their study on use of scalpel versus diathermy in hernia surgery calculated postoperative infection rate using Southampton score. They found that diathermy did not increase postoperative infection rate as compared to scalpel.[12] Due to minimal charring and necrosis when using diathermy, rate of infection is not higher in diathermy incision as compared to scalpel. However, few studies conducted in the past showed increase rate of wound infection in diathermy group. These reported effects appear to be related with use of coagulation diathermy.[9] Seromas were observed in 40% patients in scalpel group and 33.3% patients in diathermy group. Haematoma, Abscess, and Dehiscence in both groups were not statistically significant. It could be that cutting diathermy produces heat quickly and causes tissue vaporization, as opposed to the charring and necrosis associated with coagulation diathermy which predisposes to wound complications. Only 2 patients in scalpel group and only one patient in diathermy group developed wound dehiscence.

Occurrence of these all complications were comparable with the study conducted by Mannali AR et al,[61] and they were not statistically significant (p>0.05). The impact of surgical scar on the quality of life of the patient can be considerable. Studies show that scar can be a significant source of stress for the patient and may impair patients' self-esteem.[13] Considering this fact, POSAS which contains patient's opinion was also taken into a count for assessment of cosmesis of scar. The major concern for the use of diathermy on the skin is the belief of inferior cosmetic results. In our study, mean total patient score was found to be significantly higher in diathermy group at 1st month (p = 0.018) and 3rd month (p= 0.010). No difference in total patient score was found at 6 months follow up (p= 0.703). However, there was no significant difference noted in overall patient score in either group at 1st month (p = 0.443), 3rd month (p=0.628) and 6th month (p=0.845). Mean total score of POSAS observer scale at 1st month was found to higher in diathermy group (p=0.0008) as compared to scalpel group. No significant difference was found at 3rd month (p=0.334) and 6th month (p=0.787). Overall observer score was also found to follow the trend of total score being higher in diathermy group at 1st month (p=0.0454) and 3rd month (p=0.2352). No difference was found at 6th month follow up in either of the groups (p=0.6947).

In their study, Mannali AR et al [13] compared scalpel and diathermy skin incision cosmesis by Vancouver Scar Scale (VSS) and Patient and Observer Scar Assessment Score (POSAS). They found no significant difference in the quality of wound cosmesis between scalpel and diathermy skin incision. Both the groups were comparable with respect to VSS (p=0.05) and POSAS (p = 0.07). L.N.F Aird and colleagues found that there was no significant difference in diathermy skin incision and scalpel skin incision in terms of VSS (P=0.837), POSAS total score (p=0.684) and POSAS overall score (p=0.728).[14] Janson K.M. Chau and colleagues conducted a study which assessed 19 patients undergoing bilateral neck dissection, showed no significant difference in patient component of the POSAS or patients overall satisfaction score (p=0.518). Similarly, no significant differences in objective assessment were noted between scalpel and diathermy incision group at 6 months post operatively (p=0.732).[15]

Yamamoto et al, also compared cosmetic outcome after breast surgery when using diathermy against scalpel and scissors to perform surgery. They found relatively worse cosmetic results in diathermy group, but only in patients who underwent radiotherapy.[16] In one meta-analysis**,** Aird LN et al performed systemic electronic literature search on Medline and PubMed and evaluated methodological quality of included publications. They found six RCTs comparing diathermy and scalpel for skin incisions. No significant difference was noted in scar cosmesis or wound infection rates between the two groups.[14]

Altogether the published data and results from the present study support the assertion that diathermy produces scar with a cosmetic outcome equivalent to that produced by scalpel at power setting of 30 watts. In this setting, there won't be any tissue damage that affects the wound healing.

CONCLUSIONS

Diathermy is the most common surgical equipment used for coagulation during surgery in our theatres. When used for abdominal wall incisions, it coagulates dermal capillaries and prevents unnecessary blood loss and enables early access to the peritoneal cavity. Time required for incision time and incision related blood loss was less in cutting diathermy compared to surgical scalpel. Postoperative pain at 6 hours, 12 hours, 24 hours and 48 hours was significantly lower in cutting diathermy compared to surgical scalpel. Superficial surgical site infections were lowered in cutting diathermy compared to surgical scalpel, while incidence of seroma was same in both scalpel and cutting diathermy groups.

Hypertrophic scar formation was similar in both the groups at the end of 1st month and 3rd month whereas at the end of 6th month no difference was noted between scalpel and cutting diathermy groups. Cutting diathermy can be safely used to make abdominal wall incisions considering its efficacy in terms of shorter incision time, haemostasis, lesser postoperative pain and relatively comparable scar cosmesis.

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