

Diathermy versus Scalpel incision in elective midline laparotomy: A prospective randomized controlled clinical study

P.L. Chalya¹, M.D. Mchembe², J.B. Mabula¹, J.M. Gilyoma¹

¹Department of Surgery, Catholic University of Health and Allied Sciences- Bugando, Mwanza, Tanzania

²Department of Surgery, Muhimbili University of Health and Allied Sciences, Dar Es Salaam, Tanzania

Correspondence to: Dr Phillip Leo Chalya: drphillipoleo@yahoo.com

Background: Skin incisions have traditionally been made using a scalpel. Diathermy, a more recent alternative, is thought to increase the risk of infection, impair healing and decrease cosmesis. Recent studies suggest that diathermy may offer potential advantages with respect to blood loss, incision time and postoperative pain. The aim of this study was to compare the efficacy and safety of surgical diathermy incisions versus conventional scalpel incisions for midline laparotomy in our local setting with an aim to evaluate diathermy as an effective alternative to scalpel incision.

Methods: This was a prospective randomized clinical study which was conducted in the surgical wards of Bugando Medical Centre between January 2010 and December 2011. Patients were randomly assigned to two groups i.e. Group A (Scalpel group) and Group B (Diathermy group).

Results: A total of 214 patients were enrolled in the study. Of these, 108 patients were randomized to Group A (Scalpel group) and 106 patients to Group B (Diathermy group). The two groups did not differ significantly in relation to age and sex ($p > 0.001$). Laparotomy skin incisions using diathermy were significantly quicker than scalpel incisions ($p = 0.001$). There was significantly less blood loss in the diathermy group compared with the scalpel group ($P = 0.012$). The mean visual analogue scale was significantly reduced more in the diathermy group than in Group Scalpel group patients on postoperative day 1 ($p = 0.001$), day 2 ($p = 0.011$) and 3 ($p = 0.021$) respectively. The mean amount of intramuscular analgesic requirement was significantly less in the Diathermy group than in the Scalpel group ($p = 0.021$). Postoperative complication rates did not differ significantly between the Scalpel and Diathermy groups ($p = 0.243$). There was no significant difference between two groups with respect to the mean length of hospital stay ($p = 0.834$).

Conclusion: We conclude that diathermy incision in elective midline laparotomy has significant advantages compared with the scalpel because of reduced incision time, less blood loss, reduced early postoperative pain and analgesic requirements.

Introduction

Traditionally skin incisions are made by scalpels with disposable knives, these incision are more bloody and painful¹. Surgical diathermy was introduced at the beginning of the 20th century to obviate the inherent disadvantages of steel scalpel²⁻⁴. It is considered to be an efficient mode of dissection^{4,5}, being haemostatic and convenient^{4,6}. With the advent of modern electro-surgical units capable of delivering pure sinusoidal current, this technique is now becoming extremely popular because of rapid haemostasis, faster dissection and reduced overall operative blood loss⁷⁻⁹.

In diathermy, a potential gradient dependant current is passed through the tissue at high frequency (greater than 100000 Hz) to excite tissue molecules such as water resulting in controlled tissue lyses, which can be used for employed to coagulate (modulated mode) or to cut (sinusoidal mode) the tissue. This principle allows the use of diathermy electrode without causing surrounding tissue damage^{4,10}. Diathermy incision is not a true cutting incision⁹⁻¹¹. This method heats cell within tissues so rapidly that they vaporize, leaving cavity within cell matrix, heat created disappears as steam, rather than being transferred to adjacent tissues. As electrode is

moved forward new cells are contacted and vaporized with creation of incision. This explains absence of scarring and subsequent healing with less scarring^{9,11}.

Despite these findings and advantages, the idea of using diathermy as a 'cutting' instrument for skin and surgical incisions has been rejected by many surgeons for the fear of delay wound healing and the risk of infection and this have curtailed the widespread use of surgical diathermy for skin incisions^{4,9,11}. Midline laparotomy provides quick, easy and wide access to nearly all the structures of abdomen and retroperitoneum. However, it is associated with significant morbidity when compared to other abdominal incisions^{4,11}. The proper surgical technique has been a major concern among surgeons as it has been shown to affect healing following midline laparotomy^{4, 12}. However, diathermy has been reported to be used in midline laparotomy incisions as internationally carried out studies have shown it to have significant advantage over traditional scalpel incision on the basis of incision related blood loss, post operative pain. Moreover they also show that there was no difference between the two in terms of postoperative wound complications¹³.

Many randomized clinical trials have been conducted to compare diathermy incision with scalpel incision over skin in midline laparotomy and many of them showed diathermy incision is better than scalpel incision in terms of time taken for incision, lesser pain, better wound healing and little blood loss^{4,9,13,14}. However, despite this evidence in many randomized clinical trials in support of diathermy use in skin incision, many surgeons in many centres including ours are still reluctant in using diathermy for making skin incisions^{9,11}. This prospective randomized clinical trial was conducted at our centre to compare the efficacy and safety of surgical diathermy incisions versus conventional scalpel incisions for midline laparotomy in our local setting with an aim to evaluate diathermy as an effective alternative to scalpel incision.

Patients and Methods

This was a prospective randomized clinical study which was conducted in the surgical wards of Bugando Medical Centre (BMC) between January 2010 and December 2011. BMC is located in Mwanza city along the shore of Lake Victoria in the northwestern part of Tanzania. It is a tertiary care and teaching hospital for the Catholic University of Health and Allied Sciences-Bugando (CUHAS-Bugando) and has 1000 beds. BMC is one of the four largest referral hospitals in the country and serves as a referral centre for tertiary specialist care for a catchment population of approximately 13 million people from neighboring regions in the northwestern Tanzania

All patients undergoing elective midline laparotomy during the period under study were eligible for the study. Only clean and clean contaminated cases were included. Patients who had previous midline laparotomy and those on concurrent anticoagulant or corticosteroid therapy were excluded from the study. All patients who met the inclusion criteria were, after informed written consent, consecutively enrolled in the study. The patients included in the study were randomized into two groups according to whether the diathermy or scalpel was used in making skin incision. A computer program (random number generator, Microsoft excel 5.0) was used to generate random number list, whereby patients were assigned to either of the two groups i.e. Group A consisting of patients receiving scalpel skin incision (scalpel group) and group B consisting of patients receiving diathermy skin incision (diathermy group). In the group of patients receiving scalpel incision (Group A), scalpel with disposable blade was used to incise skin till peritoneum whereas in group 'B' incision was made through skin and deeper tissues with diathermy using diathermy pen electrode. Electrosurgical unit (ESU), brand Sabre 2400 by Conmed Corporation, set at pure cutting mode and delivering 417 kHz sinusoidal current, was employed to incise skin and all the layers. In both groups diathermy was used in coagulation mode for hemostasis. The randomization was provided by a computer consultant. The surgeon was informed of the type of skin incision to be used just before the start of the skin incision.

Study variables analyzed were: incision time, incisional blood loss, postoperative pain, amount of intramuscular analgesic requirement, duration of hospital stay and postoperative complications. The length and depth of incision at the end of the procedure were measured in centimeters using a sterile flexible rule. Incision area" was calculated as the product of the length and width of skin incision. The time from the start of the skin incision to completion of the peritoneal incision with complete hemostasis was recorded. Blood loss during skin incision was calculated by weighing the swabs used exclusively in making the incision and during hemostasis with each gram taken as equal to one milliliter of blood (i.e. 1 g = 1 ml). No suction evacuation of blood was done while making the skin incision. The amount of blood was calculated as ml/cm². Postoperative pain was assessed according to a visual analogue scale (VAS) from 0 (no pain) to 10 (worst pain imaginable) on each postoperative morning.

Statistical data analysis was done using SPSS software version 15.0 (SPSS, Inc, Chicago, IL). Descriptive statistics were applied to calculate mean and standard deviation for age, and frequency for gender. The amount of wound related blood loss, incision time and the severity of wound related pain in both groups were compared using Student t-test, while post-op infection in two groups compared using Fisher's exact test.

Ethical consideration

Ethical approval to conduct the study was sought from the CUHAS-Bugando /BMC joint institutional ethic review committee before the commencement of the study. Informed consent was sought from each patient before being enrolled into the study.

Results

During the period under review, a total of 218 patients undergoing elective midline laparotomy were eligible for the study. Out of these, four patients were excluded from the study due to failure to meet the inclusion criteria. Thus, 214 patients were enrolled in the study. There were 118 (55.1%) males and 96(44.9%) females with a male to female ratio of 2.5:1. Their ages ranged from 16 to 76 years with a mean age of 45.4 ± 8.5 years. Patients were assigned to either of the two groups i.e. Group A (Scalpel group) and Group B (Diathermy group). One hundred and eight patients were eventually randomized to Scalpel group and 106 patients to Diathermy group (Figure 1).

Group A (Scalpel group) consisted of 62 males and 27 females (M: F = 2.3: 1) whereas Group B (Diathermy group) comprised of 57 males and 21 females (M: F= 2.7: 1). There was no statistically significant difference in the gender between the two groups ($p = 0.653$). The mean age in Scalpel group was 45.4 ± 12.4, while it was 43.3 ± 11.2 in Diathermy group. There was no significant difference between two groups with respect to age ($p = 0.345$). The mean time taken for incision in scalpel group was 9.21 ± 1.40sec/ cm² whereas in diathermy group, the mean incision time was 7.84 ± 0.82 sec/cm². The difference between the two groups with respect to the mean incision time was statistically significant ($p = 0.001$). The mean incisional blood loss was 1.62 ± 0.14 ml/cm² in scalpel group, while it was 1.12 ± 0.20 ml/cm² in diathermy group. Diathermy incision group had significantly less bleeding than the scalpel group ($p = 0.012$). The mean VAS was significantly reduced more in Group B (diathermy group) than in Group A (Scalpel group) patients on postoperative day 1 ($p = 0.001$), day 2 ($p = 0.011$) and 3 ($p = 0.021$) respectively.

The mean amount of intramuscular analgesic requirement was significantly less in the Diathermy group than in the Scalpel group ($p = 0.021$)

Postoperative wound infection was recorded in 28 patients giving an overall postoperative wound infection rate of 13.1%. The postoperative wound infection rates in the Scalpel group and Diathermy group were 14.8% (16/108) and 13.2% (14/106) respectively.

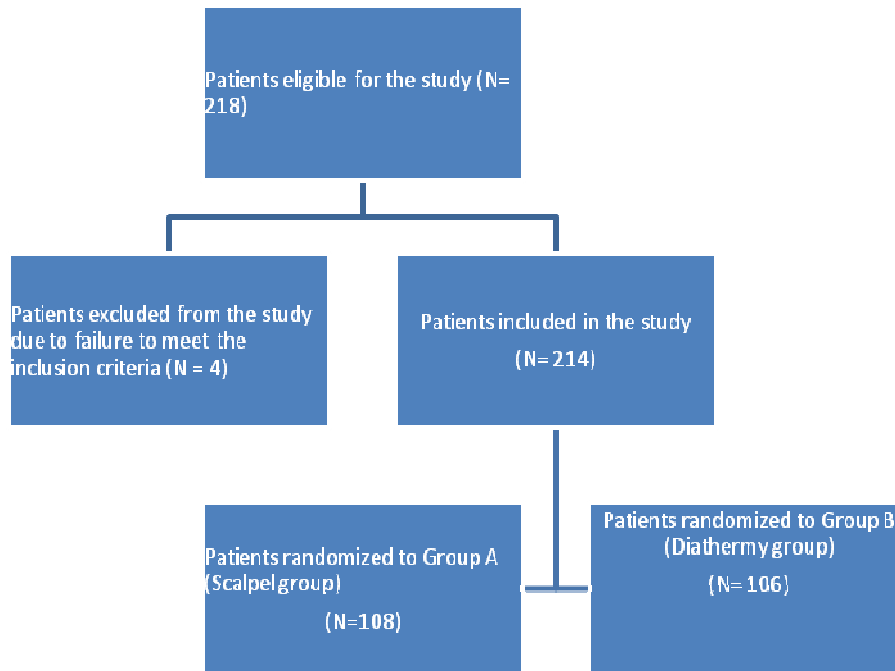


Figure 1. Flow chart of patients

Table 1. Patient characteristics in the two groups (N= 214)

Patient Characteristics	Group A (Scalpel Group)	Group B (Diathermy Group)	P-value
Number of patients	108	106	
Mean age (in years)	45.42 ±12.40	43.34± 11.20	0.345
Sex (male: female ratio)	2.3: 1	2.7: 1	0.653
Mean incision time (sec/cm²)	9.21 ± 1.40	7.84 ± 0.82	0.001
The mean incisional blood loss (ml/cm²)	1.62 ± 0.14	1.12 ± 0.20	0.012
Mean Visual Analogue Score (VAS)			
Day 1	3.92 ± 1.24	2.42 ± 0.40	0.001
Day 2	3.10 ± 1.04	1.22 ± 0.18	0.011
Day 3	2.40 ± 0.20	1.01 ± 0.11	0.021
Mean amount of intramuscular analgesic requirement (doses) in 48 hrs	8.2 ± 0.66	4.63± 0.4±8	0.021
Postoperative wound infection rate (%)	14.8	13.2	0.243
Mean length of hospital stay (in days)	12.34 ± 8.22	11.78± 6.40	0.834

The difference between the two groups was not statistically significant ($p = 0.243$). The mean length hospital stay (LOS) for the entire group was 14.63 ± 6.36 . The mean LOS in the Scalpel group and Diathermy group were 12.34 ± 34 and 11.78 ± 6.48 days respectively. The mean LOS did not differ significantly between the two groups ($p = 0.834$). Table 1 shows distribution of patients according to patient's characteristics.

Discussion

Since it was first introduced at the beginning of the 20th century²⁻⁴, surgical diathermy has increasingly been used for tissue dissection, being haemostatic and convenient^{4, 6}. The surgeons, however, continue to be reluctant when it comes to the use of diathermy for making an incision of skin and fascia^{4, 9, 11}. This reluctance, which stems partly from previous studies that the use of diathermy causes devitalization of tissue within the wound which consequently lead to wound infection, delayed wound healing and excessive scarring has been seriously challenged by recent randomized clinical trials, which suggests diathermy to be safe option with definitive advantages and no added risk profile^{4, 9, 13,14}. Despite this evidence in these randomized clinical trials in support of diathermy use in making skin incisions, many surgeons in many centres including our centre still advocate the use of scalpel in making skin incisions^{9, 11}. So this study was aimed at investigating this alternative method of incision with comparison to the scalpel incision with regards to advantages, like time and bleeding, as well as alleged complications i.e. postoperative pain and wound infection.

Studies conducted in humans provided conflicting results. Soballe *et al*¹⁵ reported that electric coagulation increases the incidence of indurated margins, infections, and weakness of the wound cut in comparison with the knife. Conversely, Groot *et al*¹⁶ reported that use of surgical diathermy to create surgical wounds in patients undergoing abdominal or thoracic operations carries a wound infection rate similar to that of scalpel.

Several randomized clinical studies have been conducted to compare diathermy incision with scalpel incision over skin and many of them showed diathermy incision is better than scalpel incision in terms of time taken for incision, lesser pain, better wound healing and little blood loss^{1, 6, 9, 12, 13, 17, 18, 19}. In agreement with other studies^{1, 4, 13}, the present study has shown that diathermy incision in elective midline laparotomy has significant advantages compared with the scalpel because of reduced incision time, less blood loss, reduced early postoperative pain and analgesic requirements. In addition, our study showed no significant difference between the two groups in post operative complication rate and length of hospital stay.

The fear of tissue injury in diathermy incision was first unfolded when this technique was used by Peterson²⁰ in reconstructive and cosmetic faciomaxillary surgery, Mann and Klippel²¹ in paediatric surgery, Kamer²² in rhinoplasty, Tabin²³ in blepharoplasty, with minimum scarring and excellent results. Kearns *et al*¹³ who compared electrosurgical and scalpel methods in hundred patients undergoing elective midline incision have indicated that the diathermy incision has significant advantages over scalpel incision based on incision time, blood loss, early postoperative pain and analgesia requirements. Their study found that diathermy was associated with significantly lesser incision related blood loss and was quicker. Similarly, there was no significant difference in terms of wound complications, including wound infection, as reported by the present study.

The results of this study are also in agreement with that of Telfer *et al*²⁴ which compared 101 patients undergoing midline laparotomy, by either diathermy or scalpel, for intestinal resection. Diathermy was associated with significantly less blood loss and an insignificant difference in postoperative pain. Contrary to present study, however, their study showed that there was no advantage with diathermy in relation to the incision related time. In keeping with other randomized clinical trials^{4, 9, 13, 14}.

Our study showed no advantages of scalpel incision over diathermy incision in midline laparotomy diathermy and can be used as an effective alternative to scalpel incision. The present study showed no statistically significant differences in the rate of postoperative complications and postoperative hospital stay between the two groups which is in consistent with other trials^{1, 4, 13}. On the basis of this study, it is suggested that in elective midline laparotomy the skin may be safely incised using

diathermy as this has shown to be associated with short incision time, less blood loss, reduced postoperative pain and analgesic requirements in the postoperative period.

Conclusion

The study has demonstrated that surgical diathermy is a safe and effective method to make skin incision in elective midline laparotomy and has significant advantages over scalpel skin incision in that it is associated with short incision time, less blood loss, reduced postoperative pain and analgesic requirements in the postoperative period.

Acknowledgements

We are grateful to all those who participated in the preparation of this manuscript. Special thanks go to our Senior House Officers (SHO) in the department of Surgery for their support in data collection. We also like to thank all members of staff in surgical department for their cordial support and criticisms.

References

1. Shivagouda P, Gogeri B.V., Godhi A.S., Metgud S.C. Prospective randomized control trial comparing the efficacy of diathermy incision versus scalpel incision over skin in patients undergoing inguinal hernia repair. *Recent Research in Science and Technology* 2010, 2(8): 44-47
2. Cushing H. Electrosurgery as an aid to the removal of intracranial tumors with a preliminary note on a new surgical current generator. *Surg Gynecol Obstet* 1989, 64:47:751-84.
3. Leaper DJ. Basic surgical skills and anastomosis. In: Russell RC, Williams NS, Bulstrode CJ. Editors. *Bailey and Love's Short Practice of Surgery*. 24th ed. London. Arnold; 2004, 95-106.
4. Siraj A, Farooq-Dar M, Gilani AB, Raziq S. Elective midline laparotomy: Comparison of diathermy and scalpel incisions *Professional Med J*. 2011, 18(1): 106-111
5. Duxbury MS, Blake SM, Dashfield A, Lambert AW. A randomized trial of knife versus diathermy in pilonidal disease. *Ann R Coll Surg Eng* 2003, 85: 405-7
6. Sheikh B: Safety and efficacy of electrocautery scalpel utilization for skin opening in neurosurgery. *Neurosurg* 2004, 18:268-72.
7. Laughlin SA, Dudley DK. Electrosurgery. *Clin Dermatol* 1992, 10:285-90
8. Sigel B, Dunn MR. The mechanism of blood vessel closure by high-frequency electrocoagulation. *Surg Gynecol Obstet* 1965, 121:823-31
9. Kumar V, Tewari M, Shukla HS. A comparative study of scalpel and surgical diathermy incision in elective operations of head and neck cancer. *Indian J Cancer* 2011, 48:216-9
10. Cuschieri A, Steele RJ. Surgical craft and technology. In: Cuschieri A, Steele RJ, Moossa AR. editors. *Essential Surgical Practice Vol 1*. 4th ed. Oxford: Butterworth- Heinemann 2000, 37-68.
11. Lodhi FB, Asrar R, Akram M, Hussain R. Incidence of Abdominal Wound Dehiscence (Midline Vs Paramedian Incision Closed With Vicryl No.1). *King Edward med Coll* 2001, 7:38-40
12. Dixon AR, Watkin DFL. Electrosurgical skin incision versus conventional scalpel: A prospective trial. *J R Coll Surg Edinb* 1990, 35:299-301
13. Kearns SR, Connolly EM, McNally S, McNamara DA, Deasy J. Randomized clinical trial of diathermy versus Scalpel incision in elective midline laparotomy. *Br J Surg* 2001, 88:41-4.

14. Ly J, Mittal A, Windsor J. Systematic review and meta-analysis of cutting diathermy *versus* scalpel for skin incision. *Br J Surg*, 2012, 99: 613–620.
15. Soballe PW, Nimbkar NV, Hayward I. Electric cautery lowers the contamination threshold for infection of laparotomies. *Am J Surg* 1998, 175:263-6
16. Groot G, Chappell EW. Electrocautery used to create incisions does not increase wound infection rates. *Am J Surg* 1994, 167:601-603
17. Chowdri NA, WaniNA, Ganai AA, Naqash. SH, Peer.GQ, Wani.QA. Comparative study of electro-surgical and scalpel incision in general surgery. *IJS*. 2002, 63: 308-310.
18. Chrysos E, Athanasakis E, Antnakakis S, Xynos E, Zoros O. A prospective study comparing diathermy and scalpel incision in tension free inguinal hernioplasty. *Am Surg* 2005, 71(4):326-329.
19. Pollinger HS, Mostafa G, Horold KL, Austin CE, Kercher KW, Matthews BD. Comparison of wound healing characteristics with feed back circuit electro-surgical generators in a porcine model. *Am Surg*. 2003, 12:1054-1060.
20. Peterson A. The use of electro-surgery in reconstructive and cosmetic maxillofacial surgery. *Dental Clin North Am* .1982, 20:799-823.
21. Mann W, Klippel CH. Electro-surgical skin incisions. *J Paediatric Surg* 1977, 12: 725-726.
22. Kamer FM, Cohen A. High frequency needle dissection rhinotomy. *Laryngoscope* 1985, 95: 1118-1120.
23. Tobin HA. Electro-surgical blepharoplasty: A technique that questions conventional concepts of fat compartmentisation. *Ann Plastic Surg* 1985, 14: 59-63.