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Original Research Article

Is it safe to incise skin by monopolar electrocautery? A comparative study

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ABSTRACT

Background: The present study of evaluation of the use of electrocautery to incise the skin has been done to evaluate and assess basically. The advantages and disadvantages of the electrocautery to incise the skin when compared with that of scalpel. The results of the use of electrocautery on skin wound are then assessed to formulate the criteria for proper case selection for this procedure.
Methods: A total of 100 patients were taken for this study. 50 patients underwent electrocautry monopolar mode incision (group A) who were compared with 50 scalpel incision patients (group B). Study was done from 01 January 2016 to 30 September 2017. Variables used in this study were complication like pain, lack of apposition and skin infection at the site of incision, pain, sinus formation and induration. This method was also evaluated with respect to following parameters: days of hospitalization, cosmetic result, rate of infection, wound apposition and requirement of secondary suturing.
Results: As per our study, results are in favour of electrocautry by means of hemostasis. But we found that infection rate and complications are more with it. Moreover number of dressings required and hospital stay was also more with patient undergoing skin incision with electrocautry.
Conclusions: For locally overlying healthy skin with no compromise of vascularity or any oedema and there is less fat, electrocautery use for skin incision can still be recommended for better cosmetic result and shorter healing time with less complication and rapid surgery.

Keywords: Electrosurgery, Monopolar, Scalpel, Complications, Healing, Hospital stay, Wound infection

INTRODUCTION

The skin is the largest and among the most complex organs of the body. The idea of treating the disease by heating the tissues originate way back in 3000 B.C. when the Egyptians used heated stones to burn/cauterize the tissues for healing. As the development of human being progress with time, gradually led to the invention of electrocautery. After the invention of electricity in early 1800's, human being thought about the idea of heating the tissues by making the use of electricity and thus, was invented the electrocautery.

But still the progress was too slow in this area. It took almost 100 more years to develop a surgical diathermy that was then first experimented in its use in surgery (1926). This opened up a new arena for the surgeons to work with.[1] Things became much easier for the surgeons with the use of diathermy in the operative procedures. It basically tackled the most worrisome problem of heavy bleeding and time consumption during surgery and so proved to be a boon for the surgeons.[2] Later on many of the surgeons started exploring other uses of electrocautery during surgeons other than just coagulation.[3,4] Our work is a step in the same direction.

Some of the advantages of electrocautery during surgery can be stated as follows:

- Simple haemostasis and reduced loss of blood. Consequently, time is saved and the loss of blood reduced; often only few ligature need to be applied or none at all.
- Effective coagulation of the issue and, therefore, sealing of the tissue clefts and lymphatic vessels. No resorption of toxic substances which may develop immediately after the incision. Little after-pain due to the elimination of the pain receptors with reduced danger of metastasis.
- Effortless cutting with heavy or little coagulation, as desired.

Keeping these in mind we started the study with an idea to check them out practically and compare them with some other widely acceptable methods in surgery. But we wanted our study to draw out some conclusion which was not yet established firmly in literature. Hence we decided to compare and check the advantage of electrocautery over conventional steel scalpel for incising the skin only.

METHODS

Study was started after getting approval from scientific review committee and ethical committee (human research) of the institute & conducted at Department of Surgery, C. U. Shah Medical College and Hospital in Gujarat state.

Study duration

The study was carried out from 01-01-2016 to 30-09-2017.

Sample size

Sample size was 100 patients.

Inclusion criteria

All cases for elective open surgery were selected in this study. Patients selected were of any age.

Exclusion criteria

Exclusion criteria were cases where the skin was cut but not sutured back were not included e.g. amputation for gas gangrene, laprostomy, drainage of skin abscess, etc., special cases having respiratory, cardiac, diabetic, skin pathology or septic cases were excluded; emergency operations were excluded.

Ethical considerations

The study protocol, proforma and other documents like patient information sheet and informed consent were submitted and approved by Institutional Ethics Committee (IEC). The study was started after getting written approval from IEC and permission of superintendent.

Prior permission to conduct the study was obtained by Head of the Department of Surgery. Consent was obtained from patient and/or relatives before beginning of the study.

Case records of enrolled Patients, admitted for planned surgery was recorded in the pre-form containing demographic details, type of surgery, technical issues which were faced during operation and patients related issues.

Following data was collected and recorded for the study: Case serial number, Name and Age of the patient, Indoor and Outdoor case number, Date of admission, Types of surgery, Date of operation, Patient related issues like local site pain, post-operative hospital stay, availability and cost effectiveness in relation to socio-economic status of the patient, Date of Discharge, Follow up of the patient.

Haemostatic result were compared and rated as

Good: absolute and immediate haemostasis.

Average: Intermediate and early haemostasis.

Poor: Unsatisfactory and late haemostasis with persistent oozing.

Cosmetic results were compared and rated as

Good: linear scar with minimal or no puckering.

Average: linear scar with puckering of the surrounding skin, without depression.

Poor: severe puckering and depressed scar.

RESULTS

Here we started with the knowledge that haemostasis by electrocautery is much better than that with scalpel. Hence we compared the haemostasis in cases where skin was incised with electrocautery with that in control where skin was incised with Scalpel.

We found that 76% cases and 48% controls had good haemostasis while only 16% cases and 46% cases controls had average haemostasis (Table 1).

The time for achieving haemostasis is considerably different in between the incision put by a electrocautery when compared with that of scalpel ones. 76% of cases took less than 5 second for haemostasis while most of the control took more than 5 second for the same (Table 2).

Table 1: Hemostasis with scalpel versus electrocautry.

S. no	Haemostasis	No. of patients		Percentage of patients	
		Cases	Controls	Cases	Controls
1	Good	38	24	76	48
2	Average	8	23	16	46
3	Poor	4	3	8	6

Table 2: Time for hemostasis with scalpel versus electrocautry.

S. no	Time for haemostasis (in seconds)	No. of patients		Percentage of patients	
		Cases	Controls	Cases	Controls
1	<5	38	24	76	48
2	5-10	8	23	16	46
3	>10	4	3	8	6

Table 3: Age distribution.

S. no	Age groups (in years)	No. of patients		Percentage of patients	
		Cases	Controls	Cases	Controls
1	0-25	07	09	14	18
2	26-50	17	20	34	40
3	51-75	25	20	50	40
4	>75	01	01	02	02

Table 4: Sex distribution.

S. no	Sex	No. of patients		Percentage of patients	
		Cases	Controls	Cases	Controls
1	Male	30	35	60	70
2	Female	20	15	40	30

Table 5: Early complications.

S. no	Early complications	No. of patients		Percentage of patients	
		Cases	Controls	Cases	Controls
1	Pain	15	09	30	18
2	Lack of apposition	02	01	04	02
3	Stitch infection	10	03	20	06

Table 6: Number of dressings required.

S. no	Type of patient	No. of dressings required (Avg)		Percentage of patients	
		Cases	Controls	Cases	Controls
1	Uncomplicated cases (cases=35 & controls=41)	4	4	70	82
2	Complicated cases (cases=15 & controls=09)	28	31	30	18

In case the maximum patients were in the age group 51-75 yrs. The youngest patient was 1 yr old. The oldest patient was 78 yrs old. In controls the maximum patients were in the age group 26-50 yrs and 51-75 yrs. The oldest patient was 82 yrs old. Here in this study, since both the cases and control had equal age distribution between them. The analysis of the results became much easier due to removal of age the factor affecting the results (Table 3).

Here in this study since both the cases and control had equal sex distribution between them, the analysis of the results became much easier due to removal of sex as the factor affecting the results (Table 4).

Early complications observed during the hospital stay of initial 8 days up to stitch removal were as given in Table 5.

The patients were divided on the basis of healing into two groups: Healing with or without wound complications. In this study average number of dressings in both cases and controls was about 4 and 26 for uncomplicated and complicated patients respectively. So actually the average number of dressings required per patient did not vary much between the two groups. But the Patients requiring more number of dressings were definitely more in the cases (Table 6).

Table 7: Hospital stay.

S. no	Type of patient	Hospitalization in days (mean)		Percentage of patients	
		Cases	Controls	Cases	Controls
1	Uncomplicated cases (cases=34 & controls=41)	3.8	3.17	68	82
2	Complicated cases (case=16 & controls=9)	5.5	8.5	32	18

Table 8: Healing time.

S. no	Type of patient	Healing time (in days)		Percentage of patients	
		Cases	Controls	Cases	Controls
1	Uncomplicated cases (cases=40 & controls=47)	8	8	80	94
2	Complicated cases (case=10 & controls=03)	28	31	20	06

Table 9: Late complications.

Sr no	Late complications	No of patients		Percentage of patients	
		Cases	Controls	Cases	Controls
1	Pain	2	1	4	2
2	Sinus formation	1	Nil	2	0
3	Induration	2	Nil	4	0

Table 10: Power of electrocautry in monopolar mode.

Sr no.	Power of electrocautery kept for the skin incision	No. of patients	Percentage of patients	Percentage of patients developing wound gaping in the group (%)
1	1 (10 watts)	4	8	0 (0)
2	2 (20 watts)	19	38	1 (5.6)
3	3 (40 watts)	19	38	1 (5.6)
4	4 (60 watts)	8	16	0 (0)

Only those patients who could be dressed on outdoor basis were discharged. Here it can be seen that the days of hospitalization for both cases and control remained at about 3-4 days and 5-8 days respectively per patient in uncomplicated and complicated patient. But definitely the number of patients requiring more hospitalization due to complications was more among cases (Table 7). 1st dressing was done on the 2nd post-op day. Nearby patient were discharged after the 1st dressing. Patients from other states or living far away were discharged on the 7th post-op day after suture removal. Number of patients requiring secondary suturing were calculated.

Healing time is the duration from incision to healing for which patient no longer required dressing. Dressing was discontinued only when there was epithelialisation without discharge. Here it can be seen that the average healing time remains 8 and 30 days for uncomplicated and complicated patient respectively in both cases and controls but the percentage of uncomplicated patients is much more in controls than in cases and so most patient in controls heal faster than those in cases (Table 8).

The complications on long term that were of concern were pain, sinus and induration. Here is our study though the late complication were seen less, cases suffered from these more than the controls about 4% of cases developed them compared to nil amongst controls (Table 9).

Here, two patients where power 20 watts were set and one where power 40 watts was set were not included in the calculation of percentage of patients developing

wound gaping. Moreover the wound gaping correlation with power set for skin incision with electrocautery is also dependent on many other factors like the thickness of skin incised, the amount of fat at that site and the blood supply to the skin being incised. Moreover we can see that the wound gaping rate is the same with power 10, 20, and 40 watts. Though it is less with power 60 watts but we should also remember that none of the patients with power 60 watts were excluded from calculating the percentage of patients out of the group developing wound gaping (Table 10). So it would not be appropriate to comment on the optimum power required for skin incisions by electrocautery.

Figure 1: Skin incision by conventional scalpel.

Figure 2: Skin incision by monopolar electrocautry.

DISCUSSION

Tipton et al in 1975 showed that electrocautery can be used for incising the skin.[5] However; it takes a long time for a new method to supersede older established practice in medicine and surgery. A healthy skeptism is an essential part of the doctor's attitude to new ideas and new methods. New form of surgery must prove itself to be a superior one and safe when compared to the established methods before they gain general acceptance.

Since a long time the method of using electrocautery for making skin incisions has been under immense research after gaining some fruitful evidence from animal studies. The result of the present study are now evaluated and compared with the various studies by different authors under the following headings:

Haemostasis and time for haemostasis

In our study we found that in cases where the skin incised with electrocautery the haemostasis is good in 76% of patient while in control where the skin is incised with scalpel the haemostasis was good to average with equal distribution in each groups. Moreover it was found out that the time for haemostasis in skin incisions with electrocautery was <5 seconds in most (76%) patients while that in skin incisions with scalpel it was upto 10 seconds in most (94%) patients.

Kearns et al did a randomized clinical trial of diathermy versus scale incision in elective midline laparotomy. Their result showed that laparotomy incisions using diathermy were significantly quicker than scalpel incisions (mean (S.E.M) 6.1 (0.4) versus 7.5 (0.5) s/cm^2; p<0.04).There was significantly less blood loss in the diathermy group compared with the scalpel group (0.8 (0.1) versus 1.7 (0.3) ml/cm^2; p=0.002). Postoperative pain score were significantly lower in the diathermy group for the first 48 hrs after operation (p<0.05). Morphine requirement were also significantly lower over the first 5 postoperative days in the diathermy incision group (p<0.04). There was no difference between groups in wound complications before discharge and at the 1-month follow-up. They concluded that electrosurgical midline incision in elective surgery has significant advantages over scalpel use on the basis of incision time, blood loss, and early postoperative pain and analgesia requirements.

Age and sex distribution

In our study the age and sex have no effect on the final outcome of the results, and the same conclusion has been drawn by various other authors also. In our study both the case and the control group had almost similar age and sex composition still the complications differ between the two and hence it can be made out that age and sex did not affect the complication rate of our study. Mann W el did a controlled clinical study in pediatric patients which showed that there was little difference between skin incision made with a scalpel or by electrosurgical instruments.[6]

Early complications

In the present study, early complications that were studied were pain, lack of apposition and stitch infection. It was found that in cases the rate of all these three early complications was almost double (30%) as compared to that in controls (18%). In Pearlaman et al series, prospective randomized study of cholecystectomy incisions was done. Postoperative pain and wound

healing were the same for both the scalpel incised wound as well as the wound of skin incised with electrocautery.[7]

In Stolz et al series the comparison between electrocautery and scalpel was done to create anterolateral thoracotomy wounds and it was found that the early and late wound complications remained the same with both of them and so the choice of which method to use remains only a matter of surgeon preference.[7] Dixon et al showed that electrocautery use to create skin incisions showed better wound healing than the scalpel incisions with minimal complications.[8]

Tipton et al in his study on healing of electrosurgical and scalpel wounds in rabbits found out that tensile tests showed the electrosurgical wound being initially stronger, but at four days there was no difference. Thereafter the scalpel wounds were stronger and their healing progress much faster. Histological preparations showed more extensive inflammation and necrosis in the electrosurgical wounds. Dixon et al showed that electrocautery use to make skin incisions showed better wound healing than the scalpel incision with minimal complications.[9]

Number of dressings required

In our study the average number of dressings in patients without complications was 4 while in patients with complication the average number of dressings was 28. On comparing these result with the control. Where the average requirement of number of dressings was 4 and 31 respectively, It can be seen that the average number of dressings required between cases and controls did not differ much but the number of patients requiring more dressings (because of complications) almost double. In our study 30% cases got complicated and had increased number of dressings as compared to 18% of controls requiring increased number of dressings.

The lesser the number of dressings more is the dressing material and the man power saved and the work load reduced. The less number of dressings are also favorable to the patients, as they are exposed to agony of dressing less frequently and fewer hospital visits, which saves patients time and money.

Duration of hospitalization

In previous studies, authors have not considered hospitalization in their study. In present study all the patients were admitted and allowed to go home only when their wound required only minor dressings. In the present study, average days of hospitalization in Patients with sound healing was 3-4 days while in patients with complications the hospitalization days differed markedly between cases and controls. It was found that in cases the average duration of hospitalization in complicated cases was 5-6 days whereas that in complicated controls was 8-9 days.

Though the confounding patient, whose hospitalization periods was prolonged due to either the associated general condition or due to some associated diseases, were not included in the counting of the days of hospitalization in both cases and controls, there are many other factors which affect the duration of hospitalization like: Residence of the patients, Mode of conveyance available to the patient for follow up and Economic condition of the patient and capacity to spend on conveyance to hospital for dressing purpose.

Hence it can be seen that the duration of hospitalization is very difficult to be counted on the basis of such limited criteria's only. Still from the diagram 7 it can be said that more patients remained hospitalizes for a longer time due to complications associated with the wound. No such study is yet available which comments on the effect of skin incision on the duration of hospitalization.

Healing time

In our study the average healing time in uncomplicated cases was 8 days while that in complicated cases was 5-6 days. Similarly the average healing time in uncomplicated controls was 8-9 days. Hence it can be commented that the healing time did not vary much between the cases and controls-both complicated and uncomplicated. But the point which comes to a highlight is that since the complication rate gets double in cases the number of wound getting healed up is reduced and more and more wounds require secondary suturing when the skin is incised with electrocautery. Wang et al showed that high-frequency electric knife remarkably delays the healing of abdominal incision in his experimental and clinical studies. Its application should be minimized so as to reduce the possibility of postoperative complications.[10]

Cosmetic results

In most of the series, it has been found to have confounding results with the cosmetic appearance of the scar resulting from both types of skin incisions. In the present study it was very clearly found out that at 3 months the wounds created on incising the skin with scalpel had better cosmetic appearance than those made by incising the skin with electrocautery. Though the duration of follow up of the patient with respect to the analysis of the cosmetic results is not adequate but still at 3 months the wound's have been well compared for their cosmetic appearance because it carriers much importance for the patients at large.

The number of wounds with average and poor cosmetic results was significant in those patients where skin was incised with electrocautery. This might be because of certain reasons: wound infection, requirement of secondary suturing, burning out of the margins produced in skin incised with electrocautery, less blood supply to the margins with hemostasis produced by electrocautery at the skin margins while incision.

Late complications

Here the late complications that were studied were pain, sinus formation and induration of the scar. It can be seen that the late complications of pain doesn't very much between the cases and the control group as the size of the study patients is quite small. But none of the controls did develop sinus or induration of the scar.

Stoltz et al showed that scalpel and electrosurgical thoracotomy incision in elective surgery were similar in terms of early and late wound complications when used to perform anterolateral thoracotomy. Therefore, the choice of which methods to use remains only a matter of surgeon preference. Study by Arashiro et al on porcine skin showed that the scalpel incisions produced more defined borders, healed more rapidly, and resulted in less collateral tissue damage than those produced by electrosurgery.[11]

CONCLUSION

Those cases, where, locally overlying skin as healthy, there is no compromise of vascularity or any oedema and there is less fat, electrocautery use for skin incision can still be recommended for better cosmetic result and shorter healing time with less complication and rapid surgery. While those cases where overlying skin is oedematous, with compromised vascularity, with sign of infection, with more fat and more mobility of the area the use of electrocautery to create skin incisions is bound to fail and it may prolong the course of healing and may worsen the patient's conditions. Here is such cases, the use of scalpel remain the methods of choice to create skin incisions.

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