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Surgical Diathermy versus Scalpel Incision in Elective Surgery: A Comparative Study

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Abstract **Original Research Article**

Background: Ancient scalpels were found in a Bronze age settlement older than 2100 BC in Turkey. Since that time it has been used in surgery. Surgical diathermy was introduced at the beginning of the 20th century. Since inception in 1929 it has been used in surgical practice (Lawrenson and Stephens, 1970). Surgical diathermy is used for tissue dissection, cutting and hemostasis. ***Aim of the study*:** The aim of the study was to observe the outcome between cutting diathermy and scalpel incision. ***Methodology*:** It was a comparative study carried out in the Department of Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), from February 2017 to January 2018. A total of 64 patients age >18yrs both sex of male and female meet the inclusion criteria undergoing elective surgery at general surgery ward of BSMMU were enrolled as study population. A purposive sampling methods were followed for respondent's selection. Total patients were divided in to two groups, Group I was diathermy and Group II was scalpel. ***Results*:** The mean age in Group I was 48.78±14.54, compared to the mean age in Group II which was 44.28±15.29. Most of the patients were 46-55 age groups. Minimum age of patient was 19 and maximum age was 70 in Group I, minimum age of patient was 22 in and maximum age was 76 in Group II. Male patients were 17(53.1%) and females were 15(46.9%) in Group I, in Group II males were 19(59.4%) and females were 13(40.6%). Mean BMI, in Group I was 21.03±2.45, compared to 20.42±2.90 in group II, statistically was not significant and thereby the two groups remain comparable. Minimum BMI was 16.94 kg/m^2 and maximum BMI was 27.59 kg/m^2 in Group I. Minimum BMI was 15.23 kg/m^2 and maximum BMI was 25.83 kg/m^2 in Group II. Mean Hb (gm/dl) was 11.46± 1.00 in group I and 11.51±0.98 in group II. The mean values of pain score of each day that is from day one to day five for Group I were 5.41, 4.78, 3.91, 3.00, 1.94 in comparison to 7.69, 6.88, 6.06, 5.19, 4.09 for Group II. Mean pain score in total five days was 3.81± 0.87 in Group I and 5.98±1.20 in Group II. ***Conclusion*:** Surgical diathermy is a safe and effective method to make skin incision in elective surgery and has significant advantages over scalpel skin incision in terms of shorter incision time, reduced postoperative pain and reduced duration of postoperative hospital stay but no significant difference in the rate of wound complications and assessment of scar cosmetically between two groups.

Keyword: Scalpels, Surgical diathermy, Tissue dissection, Hemostasis.

INTRODUCTION

Ancient scalpels were found in a Bronze age settlement older than 2100 BC in Turkey. Since that time it has been used in surgery. Surgical diathermy was introduced at the beginning of the 20th century. Since inception in 1929 it has been used in surgical practice [1]. There are some disadvantages of scalpel incision such as-lake of haemostasis leading to undesired blood loss, indistinct tissue planes, increased incision time, use of foreign material in the wound leading to infection risk, possibility of accidental injury in the operations theater and potential for tumour metastasis through lymphatic channels. By using surgical diathermy these problems might be overcome easily. Surgical diathermy is used for tissue dissection, cutting and hemostasis [2]. With advantages of modern electrosurgical units capable of

delivering pure sinusoidal current. The pure sinusoidal current allows tissue cleavage without damage to surrounding area and healing wound with minimal scarring [3]. Cutting diathermy used for skin incision now becoming extremely popular because of reduced incision time, rapid hemostasis, early wound-related post-operative pain relieve and lower analgesic requirements [4]. Diathermy incision is not a true cutting incision which acts by heating the cells within tissue so rapidly that they explode into steams, leaving a cavity. When electrode is moved forward, fresh tissue is contacted, new cells are exploded and an incision is made. This phenomenon may explain reduced incision time and healing with minimal tissue scarring [5]. The surgeon using cutting diathermy for skin incision must be properly trained and thoroughly familiar with electro-surgical techniques. Care should be taken to see that the patient is adequately grounded with a dispersive electrode to prevent postoperative complications. Postoperative complications increase the cost of treatment and is associated with lost work productivity, destruction of normal family life and great financial burden especially in developing country like ours. On the basis of this study it is suggested that there is no basic difference between the cutting diathermy groups and scalpel groups in clinical outcome. The hypothesis tested in this study was that the cutting diathermy incisions would be better than scalpel incisions in terms of incision time, wound -related postoperative pain, postoperative wound infections, length of postoperative hospital stay and cosmetic assessment of scar tissue but they excluded the patients who withdraw from the active participation during any step of study, who was lost during follow- up, patients with incomplete data, emergency operations, laparoscopic surgeries, patients on drugs (anticoagulants, corticosteroids) or alcohol abuse, patients with hepatic, renal or cardiovascular dysfunction, having previous surgery at same site,infected patients, immunocompromised patients, patients with diabetes, coagulopathy, malnourishement, cancer patients who received neo-adjuvant chemotherapy or radiotherapy.

OBJECTIVES

General Objective

To observe the outcome between cutting diathermy and scalpel incision.

Specific Objective

- Incision time
- Wound related postoperative pain
- Postoperative wound infections
- Length of postoperative hospital stay
- Cosmetic assessment of scar tissue

Inclusion Criteria

- Patients selected for elective surgery
- Patients age above ≥ 18 years

Exclusion Criteria

- Patients who withdraw from the active participation during any step of study
- Patients who will be lost during follow-up
- Patients with incomplete data
- Emergency operations
- Laparoscopic surgeries
- Patients on drugs or alcohol abuse
- Hepatic, renal or cardiovascular dysfunction
- Previous surgery at same site
- Infected patients
- Immunocompromised patients
- Patients with diabetes, coagulopathy, malnourishement
- Cancer patients who will receive neo-adjuvant chemotherapy or radiotherapy

Data Analysis

Statistical analysis of the results was done by using computer based software SPSS version 23.0. Quantitative data was expressed as mean and standard deviation and qualitative data as frequency distribution and percentage. Statistical analysis was done by Student t-test for quantities variables, Chi square test(x^2) test for qualitative variables. Probability value <0.05 was considered as level of significance and 95% confidence interval was taken.

Study Procedure

Patients were randomized by using random number table. Even number is for Group I (diathermy group) and odd number is for Group II (scalpel group) in random number table. Then lottery was done for first patient. Next patients were sorted according to the number of row. According to random number table patients were selected and informed written consent was taken before the day of surgery. All incisions were given by surgeon who was associate professor as expertise. In diathermy group skin incisions were given with electrocautery needle in pure cutting mode was set at reading 30 and hemostasis was achieved with force of coagulation was set at 35. In scalpel group skin incisions was given with scalpel and bleeding was controlled by force of coagulation of diathermy. The incision time was considered as the time taken from initial skin incision to complete opening of the peritoneum with total hemostasis. All the procedures were carried under standardized suitable anesthesia. Valleylab Force FX™ electrocautery machine was used for all the cases. Incision time was recorded for both groups in data sheet. All the patients were operated under general anesthesia. Antibiotic prophylaxis was done by using intravenous ceftriaxone, cefuroxime or metronidazole half an hour prior to the procedure. Closure of the skin was done with skin stapler. Incision pain was measured by using NRS on the first 5 days after operation and recorded in data sheet. Analgesics ketorolac and pethidine were used for all cases post-operatively. Wound was checked at 4th POD and condition was recorded on data sheet. Wound condition was graded according to Southampton wound

scoring system: Normal healing (Grade 0), Normal healing with mild bruising and erythema (Grade I), erythema plus other signs of inflammation (Grade II), Pus (Grade III), deep or severe wound infection (Grade IV). It was checked earlier if the dressing of the patient became soaked or if the patient developed signs of wound infection. Wound infections within 30 days was recorded.

Ethical Clearance

Ethical clearance was taken from the Institutional Review Board authority of BSMMU. According to Helsinki Declaration for Medical Research involving Human Subjects 1964. Written informed consent was obtained from each patient.

RESULTS

Table 1: Distribution of the patients according to age by groups (N=64)

Age (Years)	Groups		p value
	Group I	Group II	
19-25 yrs.	3 (9.4)	4 (12.5)	
26-35 yrs.	2 (6.2)	7 (21.9)	
36-45 yrs.	8 (25.0)	5 (15.6)	
46-55 yrs.	9 (28.1)	8 (25.0)	
56-65 yrs.	6 (18.8)	7 (21.9)	
66-76 yrs.	4 (12.5)	1 (3.1)	
Mean ± SD	48.78 ± 14.54	44.28 ± 15.29	0.232
(Min-Max)	(19.0-70.0)	(22.0-76.0)	

Table 1 showed the mean age in Group I was 48.78±14.54), compared to the mean age in Group II which was 44.28±15.29. Most of the patients were 46-55 age groups. Minimum age of patient was 19 and maximum age was 70 in Group I, minimum age of patient was 22 in and maximum age was 76 in Group II.

Table 2: Group wise gender distribution of patients (N=64)

Sex	Groups		p value
	Group I	Group II	
Male	17(53.1)	19(59.4)	0.614
Female	15(46.9)	13(40.6)	

Table 2 showed male patients were 17(53.1%) and females were 15(46.9%) in Group I, in Group II males were 19(59.4%) and females were 13(40.6%).

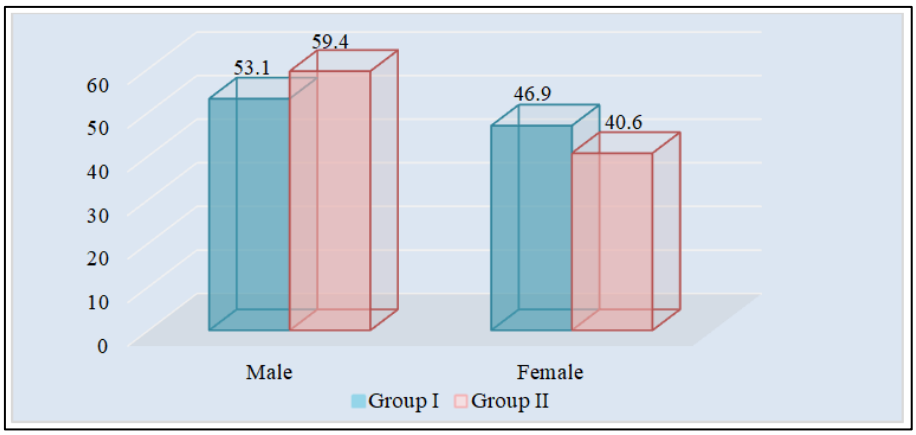

Figure I: Bar diagram showed group wise patients gender distribution. (N=64)

Table 3: Distribution of the patients according to BMI by groups (N=64)

BMI (kg/m^2)	Groups		p value
	Group I	Group II	
Under weight (<18.5)	5(15.6)	9(28.1)	
Normal (18.5-<25)	25(78.1)	22(68.8)	
Over weight (25-<30)	2(6.2)	1(3.1)	
Mean ± SD	21.03 ± 2.45	20.42 ± 2.90	0.368

(Min-Max)	(16.94-27.59)	(15.23-25.83)	

Table 3 showed the mean BMI, in Group I was 21.03±2.45), compared to 20.42 ±2.90 in group II, statistically was not significant (p=0.368) and thereby the two groups remain comparable. Minimum BMI was 16.94 kg/m^2 and maximum BMI was 27.59 kg/m^2 in Group I. Minimum BMI was 15.23 kg/m^2 and maximum BMI was 25.83 kg/m^2 in Group II.

Table 4: Mean of the patients according to Hb, incision time and hospital stay by groups (N=64)

Variables	Groups		p value
	Group I (n=32)	Group II (n=32)	
Level of Hb (gm/dl)	11.46 ± 1.00	11.51 ± 0.98	0.818
(Min-Max)	(10.10-14.10)	(10.00-14.10)	
Length of incision (cm)	17.84 ± 2.29	17.38 ± 1.83	0.369
(Min-Max)	(15.0-22.0)	(15.0-20.0)	
Time of incision (min)	4.70 ± 1.04	7.91 ± 1.09	<0.001
(Min-Max)	(3.0-8.0)	(4.0-10.0)	
Length of hospital stay (days)	11.06 ± 1.78	12.41 ± 1.66	0.003
(Min-Max)	(7.0-15.0)	(8.0-16.0)	

Table 4 showed the mean Hb (gm/dl) was 11.46± SD 1.00 in group I and 11.51±0.98 in group II. The length of incision was recorded in both the groups intra operatively. Minimum length was 15.0 and maximum length was 22.0 in group I, minimum length was 15.0 and maximum length was 20.0 in group II. Mean length of incision was 17.84 ±2.29) group I and 17.38±1.83 in group II. The time of incision was recorded in both the groups. Minimum duration was 3 minutes and maximum duration was 8 minutes in group I, minimum duration was 4 minutes and maximum duration was 10 minutes in group II. The mean incision time in group I was 4.70±1.04 and the mean incision time in group II was 7.91±1.09. Length of hospital stay ranged from 7 to 15 days in group I and 8 to 16 days in group II. The mean hospital stay time in group I was 11.06±1.78 and the mean incision time in group II was 12.41±1.66.

Table 5: Mean of the patients according to post-operative pain scale by groups in different follow up (N=64)

Post-operative pain (Scale from 0 to 10)	Groups		p value
	Group I	Group II	
Day one	5.41 ± 1.41	7.69 ± 1.79	<0.001
(Min-Max)	(2-8)	(2-10)	
Day two	4.78 ± 1.24	6.88 ± 1.88	<0.001
(Min-Max)	(2-8)	(1-10)	
Day three	3.91 ± 1.20	6.06 ± 1.22	<0.001
(Min-Max)	(1-8)	(3-8)	
Day four	3.00 ± 1.08	5.19 ± 1.15	<0.001
(Min-Max)	(1-7)	(1-7)	
Day five	1.94 ± 0.95	4.09 ± 1.06	<0.001
(Min-Max)	(1-6)	(1-5)	
Mean score	3.81 ± 0.87	5.98 ± 1.20	<0.001
(Min-Max)	(1.6-6.6)	(1.6-7.4)	

Table 5 showed the mean values of pain score of each day that is from day one to day five for Group I were 5.41, 4.78, 3.91, 3.00, 1.94 in comparison to 7.69, 6.88, 6.06, 5.19, 4.09 for Group II. Mean pain score in total five days was 3.81 ±0.87 in Group I and 5.98 ±1.20 in Group II. The NRS pain score was significantly reduced in Group I than in Group II patients on postoperative day 1(p=<0.001), day 2(p=<0.001), day 3(p= <0.001), day 4 (p=<0.001), day 5(p=< 0.001) respectively.

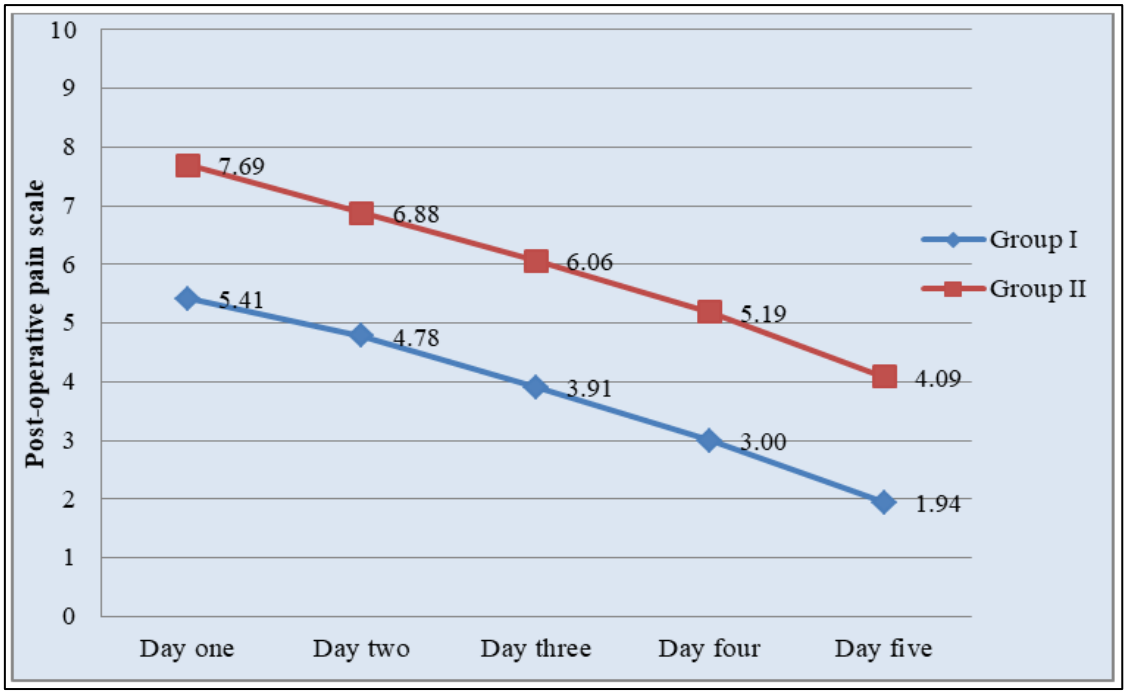

Figure II: Line chart of the patients according to post-operative pain scale by groups (N=64)

Table 6: Distribution of the patients according to wound conditions by groups (N=64)

Wound conditions	Groups		p value
	Group I	Group II	
Grade 0	24(75.0)	19(59.4)	0.663
Grade I	2(6.3)	5(15.6)	
Grade II	3(9.4)	3(9.4)	
Grade III	2(6.3)	3(9.4)	
Grade IV	1(3.1)	2(6.3)	

Table 6 showed normal healing (Grade 0) was found 24(75.0%) in Group I and 19(59.4%) in Group II, Normal healing with mild bruising and erythema (Grade I) was found 2(6.3%) in Group I and 5(15.6%) in Group II, erythema plus other signs of inflammation (Grade II) was found 3(9.4 %) in both Group I and Group II, Pus (Grade III) was found 2(6.3%) in Group I and 3(9.4%) in Group II, deep or severe wound infection (Grade IV) was found 1(3.1%) in Group I and 2(6.3%) in Group II

Table 7: Distribution of the patients according to wound infection by groups (N=64)

Wound infection	Groups		p value
	Group I	Group II	
Present	3(9.4)	5(15.6)	0.708
Absent	29(90.6)	27(84.4)	

Table 7 showed out of 64 patients, wound infections were found in 3 patients (9.4 %) in Group I and 5 patients (15.6 %) in Group II.

Table 8: Distribution of the patients according to cosmetic assessment of scar tissue by groups (N=64)

Cosmetic assessment of scar tissue	Groups		p value
	Group I	Group II	
Linear scar	27(84.4)	24(75.0)	0.608
Hypertrophic scar	4(12.5)	7(21.9)	
Keloid	1(3.1)	1(3.1)	

Table 8 showed out of 64 patients**,** in cosmetic assessment of scar we have found linear scar in 27 patients in Group I and 24 patients in Group II, hypertrophic scar in 4 patients in Group I and 7 patients in Group II, keloid in 1 patient in both Group I and Group II.

DISCUSSION

Surgical diathermy is used increasingly for homeostasis and tissue dissection. Some surgeons were reluctant in using cutting diathermy for making skin incision. Their thinking is it leaves devitalized tissue within the wound which consequently lead to wound infection, delayed wound healing and ugly scar formation. However, these concerns have not been substantiated by recent several randomized clinical trials of skin incision which have shown faster incision time, reduced wound-related postoperative pain and lower analgesic requirement with cutting diathermy incision compared with scalpel incision. Similarly, there was no significant difference in terms of postoperative wound infection and cosmetic outcome of scar between two groups as reported by the present study. It was a comparative study. Patients were randomized into two groups as mentioned earlier. Groups were well matched for age, sex, body mass index, incision time, postoperative pain score (NRS), postoperative hospital stay. Major end point was to detect any differences between the two groups in terms of incision time, wound-related postoperative pain, duration of postoperative hospital stay, postoperative wound infections and cosmetic outcome of scar. The mean age in Group I was 48.78±14.54, compared to the mean age in Group II which was 44.28±15.29. Most of the patients were 46-55 age groups. Minimum age of patient was 19 and maximum age was 70 in Group I, minimum age of patient was 22 in and maximum age was 76 in Group II. Statistically the two groups were comparable and p value was not significant (p=0.232). In this study 17 patients were male and 15 patients were female in Group I. 19 patients were male and 13 patients were female in Group II. Males were predominant than females. Male patients were 53.1 % and females were 46.9% in Group I, in Group II males were 59.4% and females were 40.6%. The mean BMI, in Group I was 21.03±2.45, compared to 20.42±2.90 in group II, statistically not significant (p=0.368) and thereby the two groups remain comparable. Minimum BMI was 16.94 kg/m^2 and maximum BMI was 27.59 kg/m^2 in Group I. Minimum BMI was 15.23 kg/m^2 and maximum BMI was 25.83 kg/m^2 in Group II. Mean Hb (gm/dl) was 11.46±1.00 in group I and 11.51±0.98 in group II. Chhabda *et al.*, (2015) [6], the length of incision was recorded in both the groups intra operatively. The mean length (cm) of incision in Group I is 8.15±3.75 and Group II is 9.04±4.44. The time of incision was recorded in both the groups and analyzed. The mean time of incision in Group I is 6.45±3.36 and in Group II is 8.83±5.55. This differences are statistically significant. In our study minimum duration was 3 minutes and maximum duration was 8 minutes in group I, minimum duration was 4 minutes and maximum duration was 10 minutes in group II. The mean incision time in group I was 4.70±1.04 and the mean incision time in group II was 7.91±1.09. The difference between the two groups in terms of mean incision time was statistically significant (p=<0.001). Jamali *et al.*, (2015) [7]**,** hospital stay of patients, with mean value of hospital stay in diathermy group (Group I) was 8.24±4.96 and in Scalpel (Group II) 10.54±9.56. The difference between the two groups in terms of mean incision time was not significant (p=0.43). In our study the leanth of hospital stay ranged from 7 to 15 days in group I and 8 to 16 days in group II. The mean hospital stay time in group I was 11.06±1.78 and the mean incision time in group II was 12.41±1.66. The difference between the two groups in terms of mean incision time was significant (p=0.003). Mirza *et al.*, (2018) [8], mean pain score in diathermy group was 4.10±0.71 while in scalpel group 6.86±0.62. Student's t-test was applied which showed statistically significant (p- value <0.001) difference among two groups. L.N.F. Aird *et al.*, (2015) [9], pain scores on day 1 after operation were significantly lower in the diathermy group (mean 1·68 versus 3·13; P = 0·018), but were not significantly different on days 2-5. Chalya *et al.*, (2013) [10], revealed significantly reduced mean NRS with diathermy incisions as compared to scalpel incisions on postoperative day one (P=0.001), two (P=0.011) and three (P=0.021). In our study, mean pain score was 3.81±0.87 in Group I and 5.98±1.20 in Group II. This showed that the NRS pain score was significantly reduced in Group I than in Group II patients on postoperative day 1(p=< 0.001), day 2(p=< 0.001), day 3(p= <0.001), day 4(p=<0.001), day 5(p=<0.001) respectively which is statistically significant. Jamali *et al.*, (2015) [7], wound infection rate was almost equal in both groups; (n=3, 6%) in Diathermy group (A), while (n=4, 8%) in Scalpel group (B) which is similar to what has been reported in international literature. Talpur *et al.*, (2015) [11], among wound complications, 22(15.71%) patients from Group I developed wound infections and in Group II 26 (18.18%) patients developed wound complications. Erythema of wound margin was found four (2.9%) patients for Group I and in eight (5.6%) patients of Group II. Overall no statistically significant differences were seen regarding wound complications for the two groups. L.N.F. Aird *et al.*, (2015) [9]. Neither were there significant differences in wound infection rates between the groups (5 of 30 versus 5 of 32; P= 1·000). In our study wound infections were found in 3 patients (9.4%) in Group I and 5 patients (15.6%) in Group II. The difference between the two groups in terms of wound infection was not significant (p=0.708). Normal healing with mild bruising and erythema (Grade I) was found 2(6.3%) in Group I and 5(15.6%) in Group II, erythema plus other signs of inflammation (Grade II) was found 3(9.4 %) in both Group I and Group II. Kumar *et al.*, (2011) [12], reviewed the respective cosmetic grading of wounds between the two groups. Linear scar was found 86.67% in diathermy group and 69.23% in scalpel group, hypertrophic scar was found 0% in diathermy group and 15.38% in scalpel group, keloid was found 6.67% in diathermy group and 7.69% in scalpel group. Comparable trends were seen in both the groups and the difference between these groups was not statistically significant. L.N.F. Aird *et al.*, (2015) [9], total of 66 patients were randomized to cutting diathermy

(31) or scalpel (35). At 6 months, there was no significant difference between the diathermy and scalpel groups. In our study the respective cosmetic grading of scar between two groups. Linear scar was found 84.40 % in diathermy group and 75.0 % in scalpel group, hypertrophic scar was found 12.5% in diathermy group and 21.90 % in scalpel group, keloid was found 3.1% in diathermy group and 3.1 in scalpel group. Comparable trends were seen in both the groups and the difference between these groups was not statistically significant. It is to be understood that there is no significant difference in postoperative wound infection and cosmetic assessment of scar in between the diathermy and scalpel groups but efficacy of cutting diathermy by less incision time, less postoperative pain, less duration of postoperative hospital stays in making skin incision in elective surgery compared to scalpel.

CONCLUSION

Our study showed that surgical diathermy is a safe and effective method to make skin incision in elective surgery and has significant advantages over scalpel skin incision in terms of shorter incision time, reduced postoperative pain and reduced duration of postoperative hospital stay but no significant difference in the rate of wound complications and assessment of scar cosmetically between two groups.

Limitation of the Study

The sample size was relatively small. Duration of the study was short. The long term result could not be assessed. Only limited number of postoperative complications were observed

RECOMMENDATION

A multicenter randomized control trial study with larger sample size and long term follow-ups is needed to justify the outcome of surgical diathermy versus scalpel for making skin incision in elective surgery in preventing wound complications**.**

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