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A Comparative Study between Cautery and Scalpel Incisions in Surgery: Clinical Outcomes and Patient-Centered Impacts

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Abstract: ***Background**: Abdominal surgeries such as cholecystectomy, appendicectomy, laparotomy, and hernioplasty require precise incisions. The method of incision-scalpel versus electrocautery-significantly influences intraoperative blood loss, healing time, post-operative pain, infection rates, and cosmetic outcomes. This study aimed to compare the outcomes of these two common incision techniques to guide evidence-based surgical practice and patient-centered care. **Materials and Methods**: A prospective interventional clinical study was conducted at Rama Medical College and Hospital over 1.5 years (May 2023 – September 2024). Eighty patients were included and divided equally into two groups: Group A (Scalpel) – 40 patients, Group B (Electrocautery/Diathermy)-40 patients. Parameters measured included incision time, intraoperative blood loss, need for additional hemostasis, post-operative pain (VAS scale), infection rates, healing time, and cosmetic satisfaction. Patients were followed for 30 days post-operatively. **Results**: Incision Time: Scalpel group was faster (6.8 ± 1.5 min) compared to cautery (8.3 ± 1.8 min), $p < 0.05$. Blood Loss: Significantly lower in cautery group (110 ± 20 mL) vs. scalpel (180 ± 25 mL), $p < 0.01$. Hemostasis Requirement: Cautery group required fewer additional hemostatic measures (10%) compared to scalpel (35%), $p < 0.01$. Pain: Lower VAS scores in the scalpel group on all follow-up days, $p < 0.05$. Healing Time: Faster in scalpel group (12.5 ± 2.0 days) vs. cautery (14.3 ± 2.5 days), $p < 0.01$. Cosmetic Satisfaction: Higher in scalpel group (87% vs. 65%), $p < 0.05$. Infection Rates: No significant difference (Scalpel: 7.5%, Cautery: 5%). **Conclusion**: Both scalpel and electrocautery have unique advantages. Scalpel incisions offer better healing, lower pain, and superior cosmetic outcomes, making them ideal for elective and cosmetically sensitive surgeries. Electrocautery is beneficial in vascular or emergency procedures due to superior hemostasis and reduced blood loss. A hybrid approach—scalpel for skin and cautery for deeper dissection—may provide optimal results.*

Keywords: Scalpel, Electrocautery, Incision Techniques, Abdominal Surgery, Wound Healing, Post-operative Pain, Cosmetic Outcomes, Surgical Efficiency

1. Introduction

Abdominal procedures such as cholecystectomy, hernioplasty, and laparotomy require effective incision techniques to optimize healing, minimize complications, and enhance cosmetic outcomes. The two most common tools—scalpel and electrocautery—offer distinct advantages and drawbacks. While scalpels yield precise, clean cuts promoting faster healing, they often require more hemostatic control. Electrocautery offers a bloodless field and reduced intraoperative bleeding but may lead to greater thermal tissue damage and delayed healing.

2. Materials and Methods

a) Study Design

This was a prospective interventional clinical study aimed at comparing the outcomes of scalpel and electrocautery (diathermy) incisions in abdominal surgeries. The study involved direct observation and measurement of both intraoperative and post-operative parameters to determine the relative efficacy and safety of the two incision techniques.

b) Study Area

The study was conducted in the Department of General Surgery at Rama Medical College Hospital & Research Centre, Hapur, Uttar Pradesh. The institution provided a diverse patient population and well-equipped surgical infrastructure suitable for conducting clinical research.

c) Study Period

The research was carried out over a period of 1.5 years, from May 1, 2023, to September 30, 2024. This allowed sufficient time for patient recruitment, follow-up, and outcome assessment.

d) Intervention

Patients undergoing abdominal surgeries were randomly assigned to one of two groups based on the incision method used:

- Group A received traditional scalpel incisions.
- Group B received electrocautery (diathermy) incisions.

Each group underwent standard surgical procedures (cholecystectomy, appendicectomy, laparotomy, or hernioplasty) using their designated incision method.

e) Study Population

The study included 80 patients, aged between 18 and 70 years, who underwent abdominal surgeries. Patients with uncontrolled diabetes, severe malnutrition, skin disorders (e.g., eczema or psoriasis), immunosuppressive conditions, or those unwilling to participate were excluded.

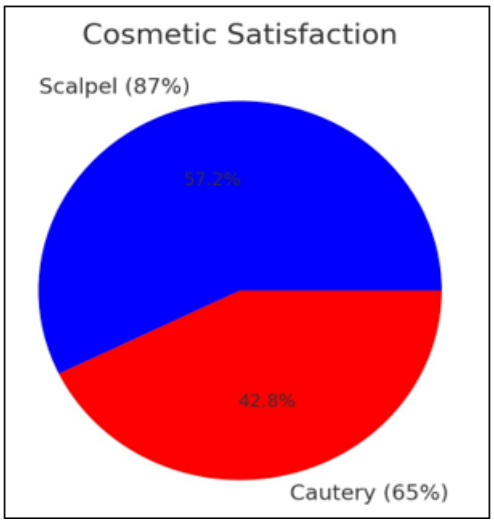
f) Number of Groups

The total sample was divided into two equal groups:

- Group A (Scalpel Incision): 40 patients
- Group B (Electrocautery Incision): 40 patients

Assessment and Data Collection

Parameters assessed included:



Incision time (measured in minutes)
Intraoperative blood loss (in milliliters)
Need for additional hemostasis
Post-operative pain (Visual Analog Scale)
Infection rates (clinical signs and symptoms)
Wound healing time (days until complete epithelialization)
Cosmetic satisfaction (patient-reported outcomes at 30 days)
Data were collected at baseline, intraoperatively, and during post-operative follow-ups on days 1, 3, 7, 14, and 30.

Statistical Analysis

Data were analyzed using appropriate statistical tools. Quantitative data were expressed as mean ± standard deviation and compared using t-tests. Categorical data were analyzed using Chi-square or Fisher's exact test. A p-value of <0.05 was considered statistically significant. All analyses were performed using standard statistical software.

Table 1: Patient Demographics

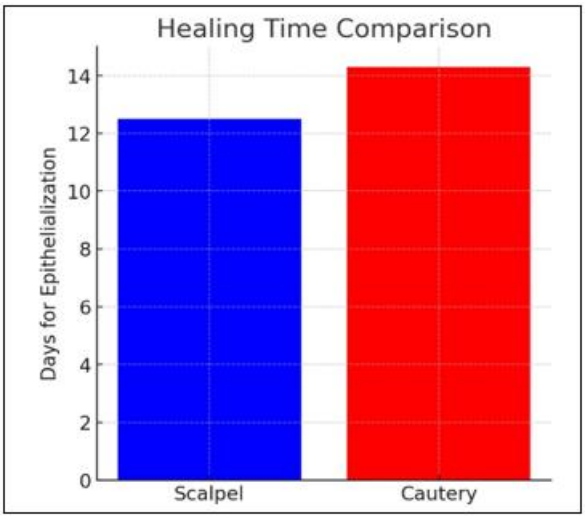
Parameter	Scalpel Group	Cautery Group	p-value
Mean Age (yrs)	45.2 ± 12.3	46.0 ± 11.8	0.64 NS
Gender (% Male)	53%	51%	0.78 NS
Diabetes (%)	20%	22%	NA
Hypertension (%)	15%	13%	NA

Table 2: Intraoperative Outcomes

Variable	Scalpel Group	Cautery Group	p-value
Incision Time (min)	6.8 ± 1.5	8.3 ± 1.8	<0.05
Blood Loss (mL)	180 ± 25	110 ± 20	<0.01
Hemostasis Required (%)	35%	10%	<0.01

3. Discussion

Scalpel incisions resulted in cleaner cuts and faster recovery but were associated with more intraoperative bleeding. Electrocautery minimized blood loss and reduced operative field clutter, but led to longer healing times and higher post-operative pain. In elective surgeries focusing on aesthetics, scalpel use was favored, while cautery was beneficial in emergent or high-risk bleeding scenarios. The decision to use scalpel or cautery depends on factors like surgery type, comorbidities, and bleeding risk. Scalpel is ideal for clean cuts and cosmesis; cautery is preferred for hemostasis and field control. Hybrid approaches are increasingly common.



4. Results

This prospective study evaluated 80 patients undergoing abdominal surgeries, divided equally into two groups based on the type of incision: Group A (Scalpel Incision, n=40) and Group B (Electrocautery Incision, n=40). The procedures included cholecystectomy, appendicectomy, laparotomy, and hernioplasty.

Demographic and Clinical Characteristics:

The average age across both groups was comparable, with a mean of 45.6 years (Scalpel: 45.2 ± 12.3 years; Cautery: 46.0 ± 11.8 years; p = 0.64). The gender distribution was also similar (Scalpel: 53% male; Cautery: 51% male). Common comorbidities such as diabetes (Scalpel: 20%; Cautery: 22%) and hypertension (Scalpel: 15%; Cautery: 13%) showed no significant intergroup differences.

Intraoperative Outcomes:

Incision Time:

The scalpel group had a significantly shorter mean incision time (6.8 ± 1.5 minutes) compared to the cautery group (8.3 ± 1.8 minutes), with $p < 0.05$.

Blood Loss:

Average intraoperative blood loss was considerably less in the cautery group (110 ± 20 mL) than in the scalpel group (180 ± 25 mL), showing statistical significance ($p < 0.01$).

Additional Hemostasis Required:

35% of patients in the scalpel group required extra hemostatic measures (e.g., sutures, clips), whereas only 10% did in the cautery group ($p < 0.01$), demonstrating the superior hemostatic advantage of cautery.

Post-Operative Outcomes:

Pain Levels:
On post-operative Day 1, the mean pain score was lower in the scalpel group (4.2 ± 0.9) compared to the cautery group (5.0 ± 1.1). By Day 7, pain had reduced further in both groups, with the scalpel group continuing to report lower scores (2.8 ± 0.6 vs. 3.5 ± 0.8). The differences were statistically significant ($p < 0.05$).

Infection Rates:
No significant difference in infection rates was noted (Scalpel: 7.5%; Cautery: 5%; $p = 0.47$).

Healing Time:
The mean wound healing time was significantly shorter in the scalpel group (12.5 ± 2.0 days) than in the cautery group (14.3 ± 2.5 days), with $p < 0.01$.

Cosmetic Satisfaction:
At 30 days post-op, 87% of patients in the scalpel group rated their scar appearance as satisfactory or very satisfactory, compared to 65% in the cautery group ($p < 0.05$).

These findings highlight the differing advantages of each incision method, with scalpel excelling in healing and cosmetic outcomes, and cautery providing superior hemostasis.

5. Limitations of the Study

1) Small Sample Size
The study included only 80 patients, with 40 in each group. While adequate for preliminary comparison, a larger sample size would improve statistical power and generalizability of the results.

2) Single-Center Study
The study was conducted at a single institution, which may limit the applicability of the findings to other healthcare settings with different surgical practices, resources, or patient demographics.

3) Short Follow-Up Duration
Patients were followed for only 30 days post-operatively. This limited period may not fully capture long-term outcomes such as chronic pain, scar maturation, or incidence of late complications like hernia recurrence.

4) Subjective Outcome Measures
Certain outcomes, such as cosmetic satisfaction and post-operative pain, relied on patient-reported scales, which are inherently subjective and may vary due to individual pain thresholds or expectations.

5) Lack of Blinding
Surgeons and patients were not blinded to the incision technique used. This could introduce performance or observer bias, particularly in the assessment of subjective outcomes.

6) Limited Procedure Types
Although the study included common abdominal surgeries (cholecystectomy, appendicectomy, laparotomy, and hernioplasty), the findings may not be directly applicable to more complex or minimally invasive procedures.

7) Surgeon Skill Variability
Differences in surgical technique and experience among operating surgeons were not controlled, which could have influenced intraoperative outcomes such as incision time and blood loss.

8) Cultural and Demographic Constraints
The study attempted to include diverse patients, but it was still limited to a specific regional population. Cultural preferences and healing responses may differ in broader or international populations.

These limitations suggest that while the findings are valuable, further multicenter studies with larger, more diverse populations and longer follow-up periods are needed to validate and expand upon these results.

6. Conclusion

Both scalpel and cautery offer unique advantages in surgical practice. This study supports a patient-specific approach guided by clinical context. Hybrid techniques may optimize outcomes by combining precision and efficiency.

Parameter	Scalpel Group	Cautery Group	Significance
Incision Time	6.8 ± 1.5 minutes	8.3 ± 1.8 minutes	$p < 0.05$ (Scalpel faster)
Blood Loss	180 ± 25 mL	110 ± 20 mL	$p < 0.01$ (Cautery lower)
Pain Levels (Day 1)	4.2 ± 0.9	5.0 ± 1.1	$p < 0.05$ (Scalpel lower)
Infection Rates	7.5%	5%	$p = 0.47$ (Not significant)
Healing Time	12.5 ± 2.0 days	14.3 ± 2.5 days	$p < 0.01$ (Scalpel faster)
Cosmetic Satisfaction	87% “satisfactory”	65% “satisfactory”	$p < 0.05$ (Scalpel higher)

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