Surgical Incision by High Frequency Cautery

S. T. Vedbhushan · Muneer A. Mulla · Haroonrasid ·
D. M. Chandrashekhar

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Abstract Traditionally, the knife has been used to make surgical incisions on the skin, but recent data suggest that diathermy blade allows the incision to be made more quickly, with less blood loss, less postoperative pain and no adverse effects on wound healing or cosmetic effect.

Keywords Cautery incision · Electrosurgical unit

Introduction

There are many articles in the literature highlighting the uses of electrosurgical cautery especially of incisions. We wanted to use the electrosurgical unit for surgical incisions; hence, this study was undertaken.

Objectives

The study was undertaken to evaluate the efficacy of cutting cautery in surgical incisions with regard to time taken, pain

at the incision site, postoperative pain, wound infection, and cosmesis as felt by the patient.

Material Methods

All patients attending surgical “D” Unit of Belgaum Institute of Medical Science Belgaum needing operations, such as appendectomies, inguinal hernia repairs and open cholecystectomies, from June 1, 2009, to December 31, 2010, were enrolled in the study.

Inclusion Criteria

In the hernia group, all one-sided hernia cases were included. In the appendectomy group, all acute, subacute, and chronic cases were included. In the cholecystectomy group, all chronic calculus and acalculus cholecystitis were included.

Exclusion Criteria

In the hernia group, all complicated hernias such as obstructed, strangulated, and bilateral hernias were excluded. In the appendectomy group, all cases of perforated appendix with localized peritonitis were excluded. In the cholecystectomy group, all cases of gangrenous, perforated gall bladder were excluded. Laparoscopic appendectomy and cholecystectomy were excluded.

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S. T. Vedbhushan · M. A. Mulla · Haroonrasid ·
D. M. Chandrashekhar
Department of Surgery, Belgaum Institute of Medical Sciences,
B R Ambedkar Road,
Belgaum, Karnataka 590001, India

S. T. Vedbhushan (✉)
F1 Vignarajendrapartment,
II Main 7th Cross Sadashiv Nagar,
Belgaum, 590001 Karanataka, India
e-mail: theobhushan@rediffmail.com

Results

A total of 100 cases were included in the study, 40 each for appendicitis and inguinal hernia repairs and 20 cholecystectomies.

	Appendectomies	Inguinal hernia repair	Cholecystectomies
Time in seconds	3–5 s	4–6 s	6–9 s
Blood loss (gauze)	Partly soaked	Partly soaked	Partly soaked
Pain at incision	Mild	Mild	Mild
Analgesics first 24 h	Injection fortwin (Pentazocin) 30 mg at bed time only	Injection fortwin (Pentazocin) 30 mg at bed time only	Injection fortwin (Pentazocin) 30 mg at bed time only
POD second to fifth (500 mg)	Oral paracetamol 1 BD	Oral paracetamol 1 BD	Oral paracetamol 1 BD
Incision	5–7 cm	6–8 cm	7–9 cm
Cosmesis	Good	Good	Good

Discussion

Surgical diathermy involves the passage of high-frequency alternating electric current through body tissues. Heat is produced where the current is locally concentrated resulting in temperature of up to 1,000°C.

Surgical diathermy involves current frequencies in the range of 400 KHz to 10 MHz. Currents up to 500 MA may then be safely passed through the patient.

Diathermy may be either monopolar or bipolar. Monopolar diathermy is the one most commonly used; in this, high-frequency current from diathermy machine is delivered to an active electrode held by the surgeon. Density of the current is high where the electrode touches the body tissues, and a pronounced local heating effect occurs. The current subsequently spreads out in the body and then returns to the diathermy machine via the patient plate electrode (a pad which is kept under the patient).

Bipolar diathermy avoids the need for a plate and uses less power. The surgeon holds the tissue to be coagulated in a pair of forceps connected to the diathermy machine; the current passes down one limb of the forceps and then back to the machine via the other limb. This is safer than the monopolar system since no current passes through the body. However, it is not very popular because of the following drawbacks: (a) it cannot be used for “cutting” tissues and (b) it will not coagulate tissues held by a hemostat when touched with an active diathermy electrode. Bipolar current

Fig. 1 Hernia (cautery incision)

can pass only directly from one diathermy forceps limb to the other.

The patient plate electrode should be properly placed to have a good and close contact with the body. Improper application of the diathermy pad is the most common cause of inadvertent diathermy burns. The active diathermy electrode should be kept on the instrument trolley to avoid its accidental touching of the patient's body. The electric wires connecting the diathermy machine to the electrodes should be free from moisture, and care should be taken that no water is spilled on the floor. Care should also be taken to prevent the patient from touching earthed metal objects, such as drip stands, uninsulated screens, and parts of the operating table. These small skin contacts can become alternative return pathways for the current and cause burns.

The following guidelines must be strictly observed for safe diathermy:

- Only the surgeon using the active electrode should activate the machine.
- Spirit and ether-based skin preparation fluids must completely evaporate or should be wiped out before the diathermy use.
- All setting on the machine should be checked and adjusted before use.
- If diathermy is ineffective, pad and other connections should be checked and rectified rather than increasing the current.
- Diathermy should be used carefully on appendages since the high-current density may spread beyond the operative site.

Fig. 2 Hernia (scalpel incision)

Fig. 3 Appendectomy (scalpel incision)

Electrosurgical unit (ESU) is the most common electrical equipment in the modern operating rooms.

Surgeons are very comfortable to see a good ESU in the operation theater which is a part and parcel of surgeon's armamentarium.

William T. Bovie, a biophysicist of Harvard Medical School, has been credited for commercially producing the first ESU, capable of cutting and coagulating the human tissues in the 1926 [1].

ESU uses alternating high-frequency current. Frequency is the number of times an AC current reverses its direction in 1 s, and this is measured in cycles per second or hertz (Hz).

Radiofrequency, 10,000 Hz, can pass through the human body without causing stimulation of the muscle or nerve. An ESU uses radiofrequency of 100,000–10,000,000 Hz to cut, coagulate, and desiccate the tissues.

Electrical Surgical Cutting (Use of Thermal Effect)

The tissues are heated so rapidly that the cells explode into steam leaving a cavity in the cell matrix. The heat is dissipated in steam so that it does not conduct through the tissues or dry out the adjacent cells.

When the electrode moved through the fresh tissue, the incision is made.

Surgical cut is made when the voltage between the cutting electrode and the tissue to be cut is sufficiently high to produce electric arcs between them (high-frequency AC).

Peak voltage—approximately 200 V—is required to produce an arc.

Fig. 4 Appendectomy (cautery incision)

Fig. 5 Cholecystectomy (cautery incision)

High-Frequency Surgical Equipment

- 1) Shape of the cut electrode
- 2) Speed single motion
- 3) Intensity of high-frequency current (power)
- 4) Tissue properties
- 5) High-frequency current characteristics (waveform)

In our institute, we have three types of ESU—maestro from Johnson and Johnson, L&T 400 digital and ARC Surgical diathermy D-400.

In maestro the settings are cut (1–100), coagulate (1–100), blend from (1–4) cut to coagulation.

We set 60–70 in cut mode, 70–80 in coagulate mode, and use thin blade to cut the tissues.

In L&T digital 400, the settings are cut (1–9), coagulate (1–9), and we set at cut (3.5–4.5) and coagulate (3.5–4.5) modes to cut the tissues.

Settings for ARC Surgical diathermy D-400—cut (60–70) and coagulate (55–70)—on mono-cut and mono-coagulation modes are employed.

We performed 40 cases of appendectomies, 40 cases of inguinal hernia, and 20 cases of cholecystectomies. Incision time in seconds varied from 3 to 6 s for hernia and appendix and 6–9 s for cholecystectomies. Blood loss was very minimal and the gauze dabbed after the incision is partly soaked for appendix and hernia, moderately soaked for cholecystectomies.

All the patients were followed up weekly for 4 weeks for any wound infections, stitch abscess, and erythema.

Fig. 6 Cholecystectomy (scalpel incision)

Electrocautery (Bovie) was used in a study of 322 spinal operations and the postoperative wound infections were analyzed. The overall rate of wound infection was around 2 %.

The conclusion was that the use of electrocautery does not increase the chances of wound infection [2].

There were only minor wound infections in the appendectomy group (2/40). In the hernia group, there was no wound infection. In the cholecystectomy group, there were minor wound infections (stitch abscess 1/20).

There is a randomized clinical trial (RCT) of diathermy versus scalpel incision in elective midline laparotomy, and the authors conclude that electrosurgical incision in elective surgery has significant advantages over scalpel use on the basis of incision time, blood loss, early postoperative pain, and analgesia requirements [3].

A prospective RCT was done comparing diathermy and scalpel incisions in tension-free inguinal hernioplasty. In the study the authors compared the following parameters such as blood loss, pain in the first postoperative day (POD 1), and the requirement of analgesics in the first and second post-operative days (POD 1 and POD 2).

It is concluded that diathermy of skin incisions is safe, blood loss is minimal, and reduces the need for analgesics in the early postoperative period [4].

A meta-analysis was done recently.

In a study, 369 patients divided into two groups, group A 185 patients (diathermy) and group B 184 patients (scalpel), underwent general surgical procedures both elective and emergencies. Variables studied were (a) surgical wound with regards to incisional length and depth, (b) blood loss from the wound, and (c) post-operative pain and need for analgesics.

The authors concluded that incision time was longer as well as blood loss in the group B (diathermy); this was statistically significantly ($P=0.001$ and $P=0.683$).

Diathermy incision has significant advantages compared with the scalpel because of reduced incision time, less blood loss, and reduced early postoperative pain [5].

The authors did literature search of Medline and Cochrane databases. There were 11 clinical trials comparing

scalpel and diathermy incisions where meta-analysis was done.

End points studied were pain in the first 24-h time taken for skin incision, blood loss, and post-operative infections.

It is concluded that diathermy incision is quick and has reduced blood loss and reduced early post-operative pain [6].

Summary

The use of high-frequency electrosurgical cautery is efficacious in routine surgical operations. We concur with other authors that the surgical incision by cautery has significant advantages such as incision time, blood loss and early post-operative pain and analgesia requirement, and so we recommend surgical incisions by high-frequency cautery.

Figures 1, 2, 3, 4, 5 and 6 clearly show the advantages of cautery incisions over scalpel incisions in cases of hernia, appendix, and gall bladder surgeries. In cases of cautery incisions, there is a clear incision mark with almost no bleeding in the incision wound compared to scalpel incision where bleeding is present in the wound.

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