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ELECTRO-CAUTERY VERSUS SCALPEL INCISION IN ABDOMINAL SURGERY

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Abstract

Electrocautery is used increasingly for tissue dissection; fears of excessive scaring and poor wound healing curtailed its use for skin incisions. This study compared electrocautery incision with traditional scalpel incision for abdominal operations in general surgery. Two groups of 62 patients in each were compared prospectively, in one of them electrocautery knife used and in the other traditional scalpel used to incised the abdominal wall layers starting from the skin. Parameters measured included, the time needed to complete the incision with all the necessary hemostasis, the wound length, the macroscopic tissue response, the incidence of infection, the final tissue scar. The electrocautery knife is quicker than the traditional scalpel 4.2Cm/Minute in electrocautery knife versus 2.7Cm/Minute in scalpel; there was little increase in macroscopic tissue response in the first 3-4 days, which do not differ in both groups in the 4th5th day. There was no difference in the incidence of infection and the final scar after one year between the two groups. Electrocautery can be used as alternative to scalpel in creating abdominal skin incisions, with the advantages of shortening the time, and decreasing the blood loss without affecting wound healing or incidence of infection and the scar formation. Incidence.

Introduction

The skin covering consist of the skin (cutis) and subcutis, specific structures in the skin include the cutaneous appendages-skin glands, hair and nails.

The skin (cutis) consists of the epidermis, which is a stratified, cornified, squamous epithelium, and the corium, a layer of connective tissue.

The corium contains the papillary layer, in which the papillae are interlocked with the epidermis, and a reticular layer, which gives the skin resistance against tearing[1].

The subcutis forms the connection with the structures, which lie beneath the skin, such as fascia and periosteum. It frequently contains fat. The major blood vessels and nerves of the skin lie in the subcutis[1].

The cells, which originate in the basal layer of the epidermis, undergo step by step transformation leading to their cornification and stratification in the epithelium. Ultimately the keratinized cells are shed from the outer surface of the epidermis. The migration of cells from the basement layer to the surface takes about

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30 days[2]. There is a layer of regeneration, of formation of the keratin and a keratinized layer. The first two of these layers also contain other layers of cells[1]. The stratification of the epidermis is best developed in glabrous skin (ecrine sweat glands, lamellar nerve endings) and is hardly developed at all in hairy skin (hair, sebaceous glands, and muscle to erect the hair, apocrine scent glands)[3]. The arteries form a network between the cutis and the subcutis from which branches descend to the hair roots and the sweat glands; other branches ascend to the papillary bodies where they form a sub papillary plexus from which capillary loops penetrate into the papillae[4].

The veins form network below the papillae in the corium and between the cutis and the subcutis[4].

The skin is amply supplied with nerves, a small proportion of them is autonomic nerves, which supply the glands, but the majority are sensory nerves. The nerves make the Skin a vital and indispensable sense organ for the sensations of touch, pain and temperature[5]. A wound is a breach in the normal tissue continuum, resulting in a variety of cellular and molecular sequelae. Wounds may be accidental, or As a result of planned surgical interventions of many different types in all the tissues of the body. Wounding has a variety of effects on the tissues:

1. Mechanical: separation of functional structures with the creation of dead space, in which will gather blood clot and serous and fibrinous exudates. The divided blood vessels at the wound edge contract and thrombose at their cut ends under the action of platelets.

2. Biological: the primary cellular events seem to be strongly influenced by platelets in the thrombus, which are an important source of cytokines, the signals which determine subsequent events. The cells adjacent to the wound margin up regulate a variety of genes, and there is proliferation of epithelial cells and fibroblasts within hours or days, which migrate into the wound[6].

Under normal conditions the phases of healing are divided into four specific events, which comprise an overlapping symphony of complex interactions:

A. Coagulation: Injury causes hemo-rrhage from damaged vessels and lymphatics. Vasoconstriction occurs immediately as a result of release of catecholamines. Various other vasoactive compounds, such as bradykinin, serotonin, and histamine, are released from tissue mast cells. They initiate the process of diapedesis, a passage of intravascular cells through vessel wall and into the extra vascular space of the wound. Platelets derived from the hemorrhage form a hemostatic clot and release clotting factors to produce fibrin, which form a mesh for the further migration of inflammatory cells and fibroblasts. Fibrin is produced from fibrinogen, which is formed by the action of thrombin in the presence of thromboplastin.

B. Inflammation: within 24 hours the wound is predominated by polymorph nuclear leukocytes, and then macro-phages which regulate the connective tissue matrix repair by cytokines.

C. Fibroplasia: the fibrous protein collagen is synthesized, and the cross- linking and deposition of collagen and other matrix proteins that provide the healed wound with strength and integrity.

D. Remodeling: acute and chronic inflammatory cells diminish gradually, angiogenesis ceases, and fibroplasia ends. The equilibrium between collagen synthesis and collagen degradation is gradually restored. Normally a fibrous repair is imperfect, but functional and not excessive[7,8].

In a clean, incised wound there is little

separation of tissue and approximation of the edges by sutures effectively approximates the margins, thereby minimizing the amount of cellular proliferation and migration necessary to bridge the defect, this type of wound healing called primary intention. Where a significant gap must be bridged between margins, there is outgrowth of vascular granulation tissue from the raw wound edges, and this is the essential component of healing by Secondary intention[9].

The principles of selecting an incision are simple and include insurance of adequate exposure and good healing, an acceptable scar. An incision is properly planned as to shape, direction, and size. In general, incisions are made along the normal skin lines. In reoperations, every attempt should be made to use the original incision. Counter traction, if properly applied, allows the surgeon to make a clean, precise incision. Skin incisions may be made with the stainless steel surgical scalpel, with care taken to ensure that the cutting edge does not drag or crush as it cuts[9]. Often incisions are made with the No 15 blade on a flat surface. Cutting with the tip of a blade makes it more difficult to control the depth of the incision. Incision of the skin made at an oblique angle may cause a trapdoor appearance. An incision should be beveled only to preserve the integrity of hair follicles[10].

Surgical lasers are multipurpose tools that can cut coagulate, vaporize tissue, weld, and selectively destroy pigmented pathologic tissues. The CO_2 laser produces its effect through instantaneous heating of intracellular water to boiling, exploding cells in its pathway. It is used by some surgeons to cut tissue: Laser heating generates steam and carbonization of tissues. The laser creates a 0.1mm. zone of histologic necrosis, which is equivalent to that of the scalpel. The superior hemostatic effect of the laser scalpel makes it especially suitable for massive surgical excision[11].

Electrosurgical excision has 1.67 times the blood loss of laser excision. Most comparative studies performed in the animal model as well as in the clinical setting prove that the CO_2 laser is not superior to electro surgery in postoperative adhesion formation. The infection-potentiating effect of the laser scalpel militates against its us in incisional surgery. Ho:YAG Laser, The holmium laser has a wavelength of 2.1 nm. and is highly absorbed by water. With this instrument one can vaporize, cut, coagulate, smooth, and sculpt tissue. This method is gaining wide acceptance among orthopedic surgeons as a useful arthroscopic surgical tool. It has a minimal amount of thermal necrosis and is able to cut and blate tissues with great ease[12].

Electrocautery:

Bovie discovered that high-frequency alternating current could be used to incise or coagulate tissue to obtain hemostasis. The technique was popularized by Cushing in the performance of neurosurgical procedures and sub-sequently extended to other operations[13].

A unipolar electrosurgical unit is used both for surgical dissection and for hemostasis. When undamped high-frequency electrical current is passed through tissue, the active electrode functions as a bloodless knife and the cells at the edge of the wound disintegrate. A mild thermal injury occurs away from the plane of cutting, and blood vessels thrombose[13]. When the oscillations are dampened, hemostasis is accomplished without cutting. The cells experience a rapid dehydration, and the vessels within the tissue coagulate. The precise tip of the divided vessel is all that requires coagulation, and the power of the unit should be set at the lowest level possible[14]. The cutting cautery may be of significant

value in saving operative time and diminishing blood loss during massive excisional surgery or when large flaps of skin or muscle are elevated. The grounding plate must be well secured at some appropriate point under the patient and kept as large as possible for dispersing the energy[13].

Objective: This is a comparative prospective study done during the period from the first of October- 2001 to the first of July-2003 to find the differences between the use of electrocautery versus stainless steel disposable scalpel in abdominal wall incisions in respect to:

Time needed to incise the abdominal wall layers. The tissue response and wound healing. The incidence of infection. The scar left after six-month and one year.

Patients & Methods

This prospective study included 124 patients, in 62 (group E) of them electrocautery incisions were used and in the other (group S) 62 patients the scalpel incisions were used. The patients were chosen randomly according to their numbers in the operation list, odd numbers for patients in group E, even numbers for patients in group S.

All patients were given intravenous prophylactic antibiotics (single dose of I gram of Cefteriaxon + 500 milligram of Metronidazol at induction of anesthesia) for those allergic to penicillin 1 gram of Erythromycin were used instead of Cefteriaxon.

All incisions were classified as clean or clean-contaminated according to the classification of the American College of Surgeons committee on control of surgical infections[15].

All layers were incised with either scalpel or diathermy, and diathermy was used for hemostasis in both groups. Diathermy incisions were created using a standard diathermy pen electrode delivering a sinusoidal current of Valleylab device 0086(manufactured by Valleylab incorporation, Pfizer Hospital Products Group, 5920 Longbow Drive Boulder, Colorado 80301 USA). Set on cutting mode of 75mv, which is the optimal voltage to incise the skin easily without harm, as discovered by trial on several voltages.

The time taken to complete the incision from initial skin incision to complete all the layers of abdominal wall with all the necessary hemostasis was recorded by an independent observer in the operating theater. The length of the skin incision at the end of the procedure was recorded as wound length in centimeters using sterile tape-measure.

The wounds were examined in the 1st postoperative day and every day as long as the patient is in the hospital. Notes were taken in regard to the macroscopic appearance of the wound. The patients were seen again after discharge in one-week time, after 6 months and after 1 year to evaluate the final scar.

All the incisions were done by the same surgical team, applying the same values and incision procedure.

Patients with factors that can affect wound healing like anemia, jaundice, prior wound infections and potential wound infections were not included in the study.

Results

The age and sex distribution of the patients are shown in table I. Different types of skin incisions and different sites were used as shown in table II, for both groups of patients.

Table I: The age and sex distribution of the patients in both groups.

No. & Group of patients	Age in years	Male-Female
62E	1-73	34-28
62C	3-65	34-28

Table II: Sites of skin incisions.

Incisions site	No. of patients
Mid-line	31
Suprapubic	7
Lumbar	7
Paramedian	6
Transverse	4
Subcostal	3
Inguinal	4

The time needed to complete the incision is shown in table III.

Table III. Time needed to complete incision.

Group	Cm/Minute	Mean
E	1.2- 6.4	4.2
S	2-5	2.7

The first tissue response to incisions in the inflammatory phase shows more erythema and swelling in group E. in the first three to four days postoperatively. This returns back to normal as compared with group S in the 4^{th}–5 day post operatively.

The incidence of wound infection is shown in tableIV, for both groups.

Table IV: Incidence of wound infection in both Groups in the first five days.

Days	Group E No. of Patients with signs of infection	Group S No. of Patients with signs of infection
1	0	0
2	1	0
3	2	3
4	0	0
5	2	0

The total number of patients with wound infection was 5 in group E versus 3 in group S. One patient in group E developed wound seroma in day three which was evacuated versus two in group S.

There was no macroscopical difference in the scar left between the two groups in 6 months and One-year periods in all the patients.

Discussion

Laser and electrocautery devices have been applied as an alternative to the scalpel because of better hemostasis and lymphatic sealing[16].

While electrocautery instruments are used increasingly for tissue dissection, concerns about excessive scaring and poor wound healing have curtailed the widespread use of electrocautery for skin incisions. The incisions of this type is not a true cutting incision[17], it heats the cells within the tissue so rapidly that they vaporized, leaving a cavity within the cell matrix. The heat created dissipates as stream rather than being transmitted into adjacent tissue. As the electrode is moved forward, new cells are contracted and vaporized with the creation of an incision[18].

This may explain the absence of tissue charring and the subsequent healing of tissues with minimal scaring[17].

In this study the mean time recorded for completing the incision with all the necessary hemostasis was 4.2 cm/minute for the electrocautery knife versus 2.7 cm/minute for the scalpel, so the electrocautery knife decreases the time needed to complete the incision to the half.

There was no significant difference between the two groups in tissue response apart from slight erythema and edema which disappears in few days in group E. Laser knifes produces more tissue response than electrocautery and scalpel[19], this is comparable with other studies[16,17].

There were no significant differences in wound infections between the two groups (5 in group E and 3 in-group S). Laser knife has higher incidence of infections than scalpel[19].

There were no differences in the scar left by the incision between electrocautery incisions and scalpel incisions on long-term basis (6 months and 1 year), which is comparable with other studies[16,17,20].

The above data shows a significant advantage for the exclusive use of electrocautery in creating abdominal wall surgical incisions. The traditional fears of excessive tissue devitalization and poor healing were not reflected in this study, which is comparable with other study[17,18,21]. Early studies with primitive diathermy machines suggested that electrocautery incisions were associated with just such charring and poor wound healing[8]. However the development of oscillator units capable of delivering pure sinusoidal current has generated renewed interest in electrocautery incisions. Subsequent animal studies show no difference between diathermy and scalpel in either wound inflammation or infection rate[20].

Conclusion: Electrocautery knife can be used as an alternative to scalpel in creating abdominal surgical incisions, especially in emergency and lengthy operations without affecting wound healing, infection or leaving more scars.

Recommendations

We recommend the use of electrocautery knifes as alternative to scalpel and laser knifes in creating skin incisions in general surgery because of their fastness, simplicity and availability in theaters without the fear of affecting wound healing, increasing incidence of infection and leaving more scar. Furthermore, the recent increase in blood borne diseases such as hepatitis C and human immunodeficiency virus infection makes exclusion of the scalpel from the operative field an attractive option.

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