# "TO COMPARE BLOOD LOSS AND POST OPERATIVE PAIN IN SCALPEL VS DIATHERMY IN ELECTIVE ABDOMINAL INCISION, A ONE YEAR RANOMIZED CONTROL TRIAL"

**BY**

**REG NO: BH0121003**

# Dissertation

*Submitted to*
*KAHER, Belagavi, Karnataka,*
*In partial fulfilment of the requirements for the degree of*

## MASTER OF SURGERY (M.S.)

## in

## GENERAL SURGERY

**DEPARTMENT OF GENERAL SURGERY**
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**DECEMBER-2024 / JANUARY -2025**

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Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"TO COMPARE BLOOD LOSS AND POST OPERATIVE PAIN IN SCALPEL VS DIATHERMY IN ELECTIVE MIDLINE ABDOMINAL INCISION, A ONE YEAR RANDOMIZED CONTROL TRIAL AT KAHER'S JAWAHARLAL NEHRU MEDICAL COLLEGE, BELAGAVI"** is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

**(Dr. Smita Sonoli)**
Member Secretary
JNMC Institutional Ethics Committee
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**(Dr. Harsha Hegde)**
Chairman,
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi

# LIST OF ABBREVATIONS

| | | |
|---|---|---|
| JNMC | : | Jawaharlal Nehru Medical College |
| KAHER | : | KLE Academy of Higher Education and Research |
| KLE | : | Karnataka Lingayat Education |
| CT | : | Computed Tomography |
| USG | : | Ultrasonography |
| MRI | : | Magnetic resonance imaging |
| PR | : | Pulse rate |
| RR | : | Respiratory rate |
| BP | : | Blood Pressure |
| mg | : | Milligram |
| ml | : | Millilitre |
| G | : | Gram |
| Coug. | : | Coagulation mode |
| Fulg. | : | Fulgration mode |

# ABSTRACT

- **BACKGROUND AND OBJECTIVE**

There is no surgery without an incision, this entry into the human body described by an single term called incision, is usually made using the scalpel.

With every invention comes the dilemma of its use on the human body, such a dilemma is the electro-cautery invention .At present the Electro-cautery is being used extensively in ORs . This present study is done to evaluate the use of the electro-cautery for making skin incision over abdominal wall and studying the blood-loss intr-operativly and post operative pain.

- **MATERIALS AND METHODS**

One Year Randomized-Control-Trial was done in Department Of General Surgery, KLES DR. Prabhakar Kore Charitable Hospital, Belagavi from September 2022 to August of 2023. A total of 60 patients were divided into two groups of 30. Group A – CASE skin incisions made using cautery,

Group B – CONTROL skin incision made using scalpel.

- **RESULTS**

In this study, the two groups' postoperative pain at 24 hours, 48 hours, and 72 hours is compared. Using a visual analog pain scale, the degree of pain was evaluated from 1 to 10.

In the Present Study, blood loss was calculated intra-operative based on the gauze weight preoperatively and post-operatively, with a gauze generally of count = 1mg and difference of 1mg will mean a blood loss of 1ml

In the Study, The mean Blood loss measured for electro cautery is 2.02 ± 1.05 and for Scalpel group is 3.77 ± 1.83, the difference in this is statistically significant with a p value of <0.001

The mean pain scores measured at POD1 for electro cautery is 5.6 ± 1.40 and for Scalpel group is 6.6 ± 1.28, the difference in the pain scores is statistically significant with a p value of 0.0010

The mean pain scores measured at POD2 for electro cautery is 3.8 ± 1.95 and for Scalpel group is 5.53 ± 1.52, the difference in the pain scores is statistically significant with a p value of < 0.001

The mean pain scores measured at POD7 for electro cautery is 0.8 ± 1.22 and for Scalpel group is 1.6 ± 1.30, the difference in the pain scores is statistically significant with a p value of 0.045

- **CONCLUSION**

When opposed to scalpel-made incisions, electrosurgical cautery offers the advantage of reduced intra-operative blood loss and decreased postoperative discomfort and may be used safely and efficiently for skin incisions during surgical operations.

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# INTRODUCTION

In conventional practice, skin openings in laparotomy procedures have typically been created employing scalpels or single-use blades, a method frequently linked with increased blood loss and discomfort.

The first use of electrocautery was in October 1st 1926 in England subsequently, electrocautery has become a prevalent technique in diverse surgical disciplines.

Diathermy, utilizing high-frequency alternating electric current, has been recognized as an efficient method of dissection, primarily serving three purposes: coagulation, fulguration, and cutting. The potential advantages of electrosurgery include reduced blood loss, rapid tissue separation, and possibly decreased risk of accidental scalpel-related injuries to surgical staff.

The purpose of this study is to investigate the efficacy and safety of electro-cautery vs standard scalpels in creating skin incisions.The primary goals are to examine reductions in blood loss and postoperative pain, with secondary objectives focusing on assessing wound complications and incision duration.

# AIMS AND OBJECTIVES

- **Primary objective:**

To compare blood loss and Post-operative pain in Scalpel vs diathermy in elective open hernia repair.

- **Secondary objectives:**

To compare incision time and wound infection in scalpel vs diathermy in elective open hernia repair.

# REVIEW OF LITERATURE

## 1. ABDOMINAL INCISIONS [1]

The selection of an abdominal incision for exposure depends on factors such as the area requiring exposure, whether the surgery is elective or emergent, and the surgeon's preference. In surgery, it's generally recommended to create an incision that is sufficiently large and appropriately positioned to provide comfortable access to the surgical site.

Upper abdominal incisions are typically made along the midline through the linea alba or paramedian. Paramedian incisions can be muscle retracting or muscle-splitting. If needed, the midline incision can be extended through or beside the umbilicus.

Incisions in the lower abdomen can also be made along the midline, paramedian, or Pfannenstiel approaches. The Pfannenstiel incision is preferred due to its favorable cosmetic result and should be regularly employed in women undergoing pelvic gynecological procedures.

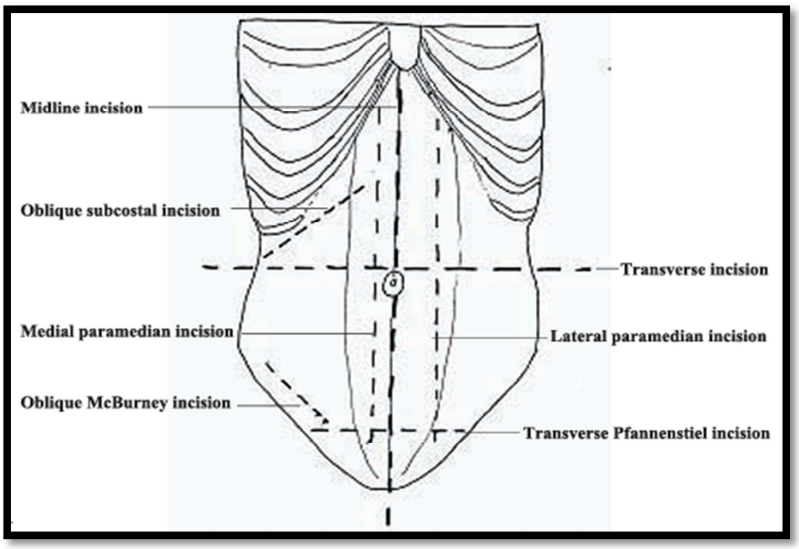


**Fig 1 : Abdominal Incisions**

According to Buerger et al the preferred incisions by surgeons is the midline approach due to its ease, better exposure, and speed. However, this approach has also been linked to complications such as elevated postoperative pain and increased risk of incisional hernias compared to the transverse or oblique approaches.

Several descriptions exist to describe the increased incidence of hernias following midline laparotomy:

1. The narrowing of the muscle layers causes the scar edges to retract away from each-other.
2. Midline incisions are known to affect the blood-supply.
3. Making an incision straight up cuts through the Linea-alba at $90^{o}$, there-by weaking it.

A systematic review conducted by K.A. Bickenbach et al. demonstrated a significantly lower use of narcotics as an analgesic among patients with incisions on either side compared to the one being made in the middle .[2]

The same study also showed a significant decrease in pulmonary functions test on POD1 in patients having undergone a midline incision surgery.[2]

According to the study by JRC Telfer et al, various reasons, like features of the wound, likely influence post-operative uneasiness. These factors may include the severity of distension of abdomen, the time it takes for normal bowel movements to re-establish, possibility of the wound being inflamed or infected, as well as psycho-logical, all of which could show significant roles in postoperative pain. The study found no evidence supporting the theory that electro-cautery reduces discomfort by damaging the superficial nerves. Researchers have proposed that the electro-surgical

approaches could be advantageous due to its consistent speed, superior cosmetic outcomes, and minimal complications.[3]

Many previous studies conducted to compare longitudinal and transverse incisions have found that, transverse incisions were more advantageous for wound healing and cosmesis compared to the longitudinal one [2].

A Study conducted by Tera&Aberg in 1976 found showed 40-60% greater strength for transverse compared to longitudinal incisions[2]

**UMBILICAL HERNIA**

**ORIGIN OF UMBLICUS**

The formation of the abdominal wall starts very early in the fetus. From the embryonic mesoderm's lateral plate, embryonic differentiation occurs. The embryo is made up of three layers at this stage: ectoderm both mesoderm and endoderm.

There are two layers in the mesoderm: splanchnic and somatic. The splanchnic layer is one of them that helps build the viscera. The somatic layer then helps in creation of abdominal-wall. As, fetus enters its third week of life, the fascial borders of the formation of the umbilical defect occurs when the four somato-pleural folds tend to fold inward.

The umbilical chord develops into a tubular shape. It is made up of the omphalomesenteric duct, fetal blood vessels, and allantois. Except for the umbilical ring, the body wall closes at the end of the third month of pregnancy. Much of the gut extends through the umbilical ring to rest in the umbilical cord when the alimentary tract lengthens more quickly than the volume of the coelomic cavity does. By tenth-week,coelomic-cavity has grown and the intestine have involuted back to the

peritoneal-cavity.Umbilical ring remains small, including the allantois, the omphalomesenteric duct, and the fetal blood vessels.

Richet's fascia provides additional support for the umbilical ring. In the event that it is missing or just partially covers the ring, weakening the surrounding tissue.

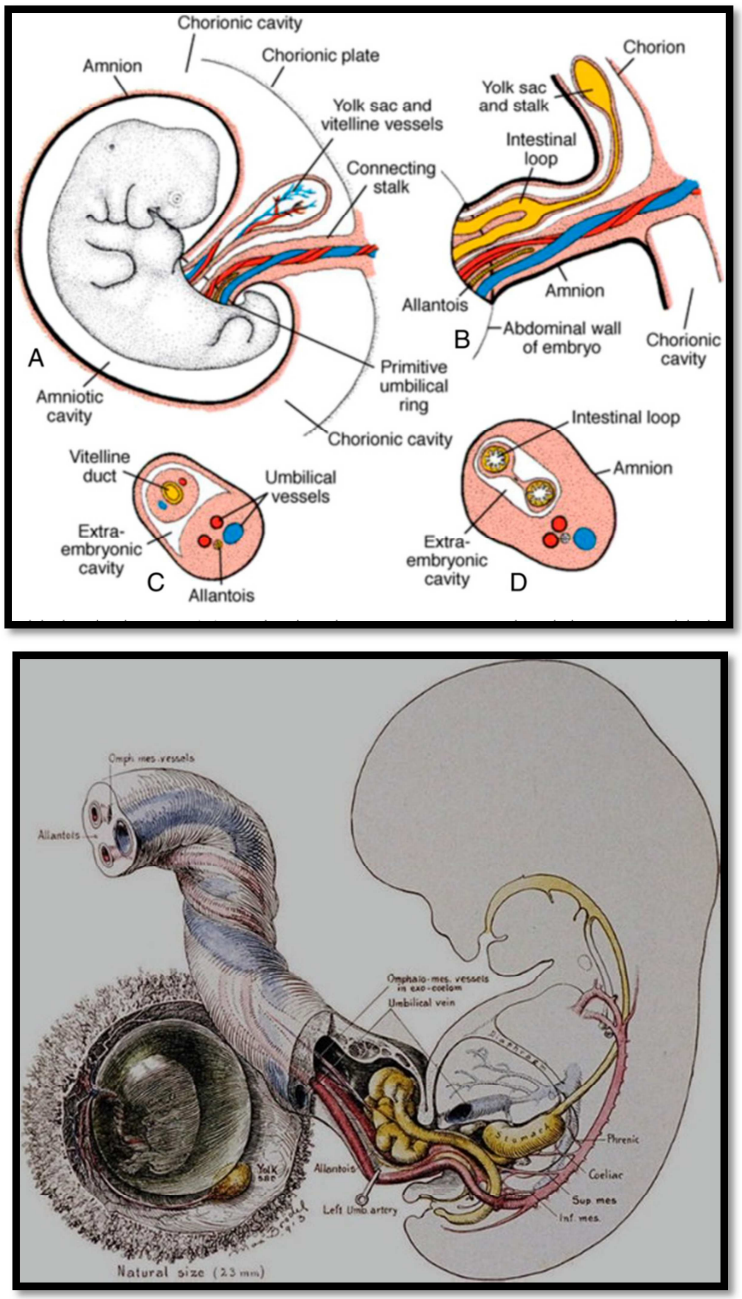


**Fig 2 -3 : Embryological Development of Umbilicus**

**UMBILICAL ANATOMY**

The place where the umbilical cord enters the fetus is indicated by the umbilicus. It is situated at the middle of the front abdominal wall in adults. The umbilicus floor is composed of fibrous fibers. Additionally, the umbilicus is a weak spot in the abdominal wall that might allow the viscus to protrude because of elevated intraabdominal pressure.[4],[5],[6]

**Umbilical Defects and Hernias:** Birth defects and hernias of the umbilical cord: Three different kinds of umbilical hernias exist which-are: acquired, infantile,resulting from omphalocele and gastroschisis.

**Acquired-Umbilical-Hernia:** Herniations frequently occur near the upper edge of the umbilicus. Umbilical ring closure results from weak umbilical cicatrix. This may occur from overstretching of the abdominal wall in circumstances such as intense labor, ascites or pregnancy. The majority of acquired umbilical hernias enlarge gradually rather than disappearing on their own. Thin fibrous ring at hernia neck might cause strangulation of omentum or herniated intestine.

**Infantile-Umbilical-Hernia:** This kind of umbilical hernia is caused by the stump of the umbilical chord sloughing. Skin covers the umbilical hernia in infants. The weakening of the adherence between the umbilical ring and the umbilicus remains as a scarred chord. This hernia typically occurs near the upper border of the umbilical ring and is usually reducible.[7]

These hernias usually heal during the first two years of life, and complications are quite uncommon. After the age of three or four, children who still have hernias must undergo surgical procedures.[8]

**Omapholocele:** It is characterized by an abdominal center deformity that resembles a funnel. Visceral protrusion occurs at the lower-end of the umbilical-cord. This outcome of the abdominal-wall muscles' inability to fuse together in the middle during fetal development. Vessels with umbilical cords are moved aside. The liver, spleen, and part of the intestine may all remain inside the cord in certain more severe abnormalities. Skin does not conceal these flaws. 50–60% of newborns with omphaloceles also have concomitant birth defects affecting other organs.

**Gstroschisis:** It is a congenital abnormality of the abdomen wall caused by the rupture of the umbilical membrane during pregnancy. In this instance, the intestines herniate external to the abdomen. This abnormality is nearly invariably on the right side of the umbilical cord. Furthermore, in gastroschisis, no skin nor amnion protect the gut. In around 10% of instances, other concurrent congenital abnormalities are observed.

## CLINICAL FEATURES

These are the most typical abdominal wall abnormalities found in young children and newborns. When a kid screams, there is swelling of the umbilicus, which indicates an umbilical hernia. The most typical appearance is a protrusion or flange from the umbilicus [9]. Other possible symptoms include pain and discomfort in the gastrointestinal tract. While big hernias may become uncomfortable and irreducible, little hernias are frequently asymptomatic. One of the frequent and prevalent complications is strangulation. This is an irreducible, sensitive umbilical bulge that may show indications of intestinal blockage in addition to color changes in the skin [10].

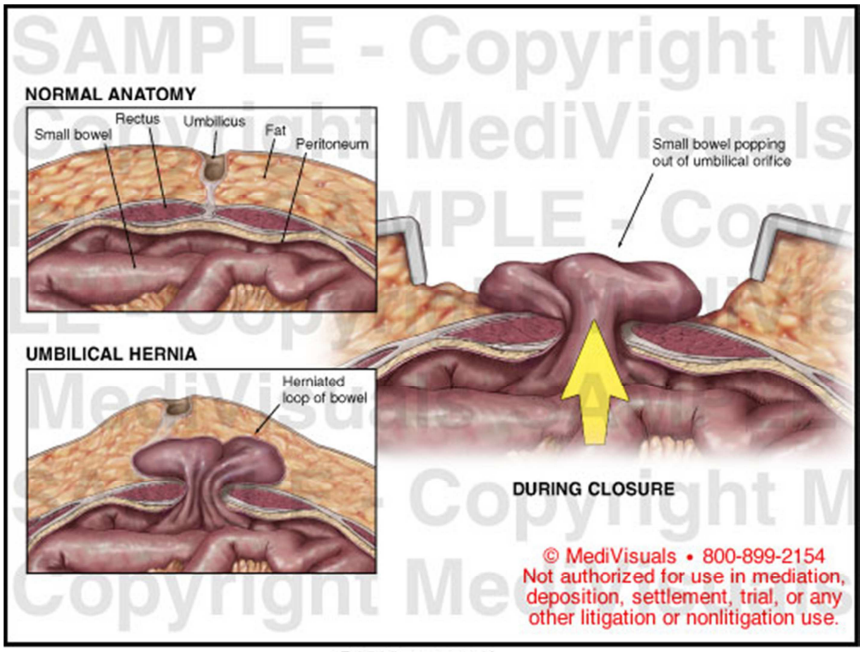


**Fig 4 : Umbilical Hernia**

## DIAGNOSIS:

An umbilical hernia can be diagnosed physically. Through clinical examination, the size of the finding and content may be determined. USG can verify if the material is intestinal or omentum. Perhaps computed tomography is required to assess intestinal viability. When making a clinical diagnosis of an obese patient, this can also be employed.[11]

**Fig 5 : CT Showing Umbilical Hernia**

## 2.2 MANAGEMENT :

**Adult Umbilical Hernia**: In asymptotic situations, particularly in cases with tiny hernias, therapy may not be required. Later on, surgery can be necessary if they get bigger. Both open and laparoscopic methods can be used to carry out this type of surgery. The following are the available treatment options:

i. Open-primary-anatomic-repair, such as Mayo's repair

ii. Mesh mending in an open environment

iv. Anatomic closure by laparoscopy

iv. Laparoscopic repair with mesh

**Open primary anatomical repair** This is the most commonly performed method and,can be accomplished using a variety of methods, including Mayo's repair, simple interrupted or continuous sutures, and delayed or non-absorbable sutures.[13]

**Benefits:** Less infection than with mesh replacement

**Cons:** Cosmesis and recurrence. Complication rate overallbeing-6.8%

**Open repair with mesh:** this method works well for lesions larger than two centimeters, however some surgeons also like to use mesh as a preventative measure for lesser problems.[14]

**Benefits:** Minimal recurrence

**Cons:** It is well known that prosthetic-materials increase risk of mesh problems & wound infection. Therefore, ongoing research is being conducted to determine the best course of action for treating umbilical hernias. Surgeons have begun using a laparoscopic technique in response to patient demands for reduced morbidity. Complication rate overall: 26.9%

**INGUINAL HERNIA**

**SURGICAL-ANATOMY-OF-INGUINAL-CANAL[14]:** Male testis initially passes through deep-inguinal-ring, a defect in transversalis-fascia that is preciously located under the abdominal-muscles, as it descends from the abdominal-cavity to scrotum. This ring is located halfway between the between the pubic-tubercle and the superior-iliac-spine, around 2-3 cm above the femoral artery pulses in the groin.Transversus and internal oblique muscles, which make up the innermost two layers of the lateral-abdominal-wall, arching over deep-inguinal-ring from the lateral to medial before plunging-down and attaching to the pubic tubercle.

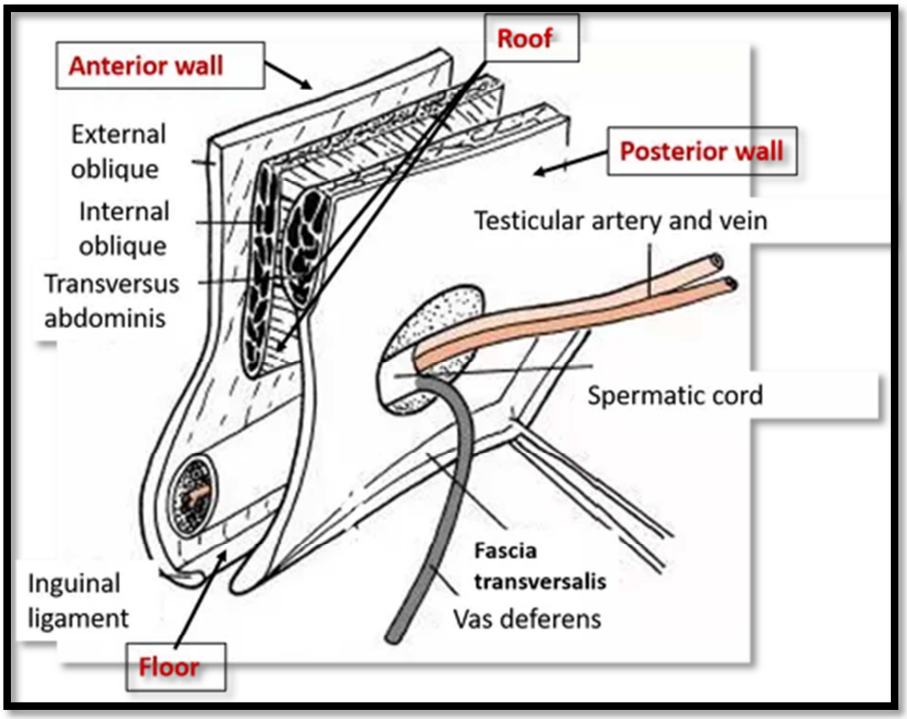


**Fig 6: Surgical-Anatomy-Of-Inguinal Canal**

The term "conjoint tendon" refers to this arch because the two muscles eventually unite and become tendinous. There is just transversalis-fascia and external-oblique-aponeurosis beneath this arch, which causes weakness.

Aponeurosis of the external-oblique-muscle, whose fibers flow diagonally downward, and is located anterior to the canal. Ultimately, the testis exits into the scrotum through a v-shaped gap in the superficial-inguinal-ring, of external-oblique-aponeurosis.

The conjoint tendon covers the inguinal canal, while the transversalis-fascia forms its wall behind , the external-oblique-aponeurosis create its anterior wall, and external-oblique floor rolls inward at the lower boundary before thickening to turn into Poupart's Ligament, the inguinal ligament.

**DEFENCE-MECHANISM-OF-INGUINAL- CANAL[15]**

1. Oblique nature of the Inguinal-canal
2. Arching-fibres of conjoint-tendon.
3. Internal-oblique with Shutter-mechanism.
4. Cremaster-muscle spasm that blocks the superficial-ring
5. Slit-Valve Mechanism.

**FRUCHARD'S-MYOPECTINEAL-ORIFICE:[15]**

An osseo-myo-aponeurotic tunnel is what it is. All groin hernias happen through this-region.

It is bordered by the following:

Superiorly: arched fibers of the transverses-abdominus and internal-oblique-muscles;

Lateral boundary of rectus sheath and Muscle of the iliopsoas lateralis

On the inferior side, it is covered with fascia and pectin fiber.

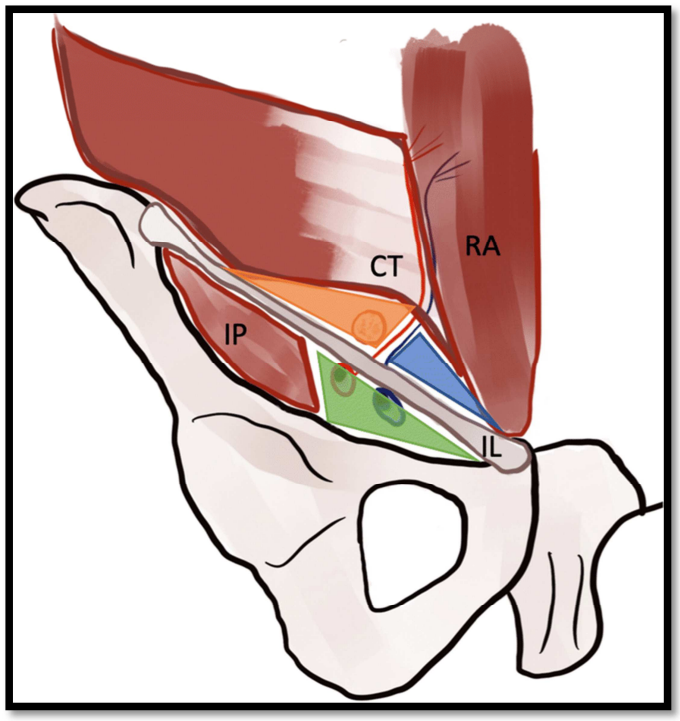


**Fig 7 : Fruchard's-Myopectineal-Orifice**

**Hesselbach's-Triangle:** [15]

**Boundries:**

1. The inferior epigastric artery laterally.
2. Outer edges of the rectus-muscle medially
3. Inginal-ligament on the lower end

The severed umbilical artery (Lateral umbilical ligament) splits Hesselbach's triangle into medial and lateral parts.

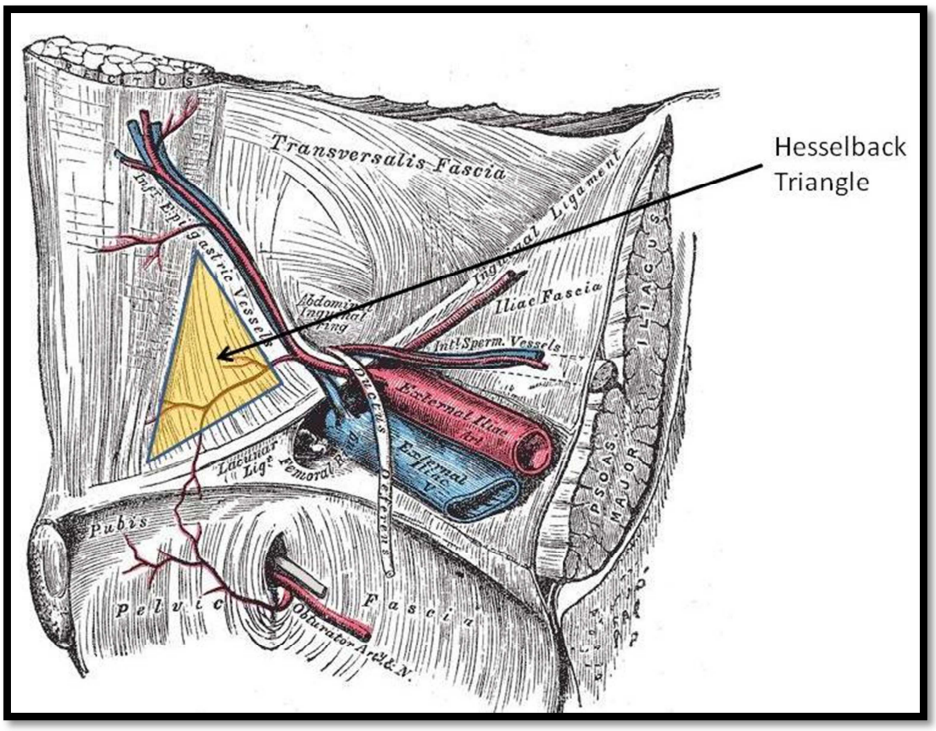


**Fig 8 : Hesselbach's-Triangle**

## CLASSIFICATION-OF-INGUINAL-HERNIA : [15]

- **Anatomical-Classification**
  - Indirect-Ing.-Hernia: Indirect-inguinal hernia occurs when the spermatic cord and internal ring are both herniated. Next to the inferior epigastric artery, it is lateral to it.
  - Direct-Ing.-Hernia: It happens through "Hesselbach's-triangle," which is the rear-wall of the inguinal canal. The inferior epigastric artery is medially to it.
- **Classification-II**
  - Complete-At this point, the sac drops to the scrotal floor. There are medial and lateral components to a saddlebag hernia sac.
  - In-Complete-
    - Bubonocoele-Sac with-in the canal.

- Funicular-The sac here does not pass through the superficial-inguinal-ring,to reach scrotal-base .

- **NYHUS-Classification :**
  - Type-I: Normal-deep-ring-indirect-hernia;
  - Type-II: Dilated-deep-ring-indirect-hernia;
  - Type-III,: Rear-wall-defect

    i. Direct; ii. Femoral; iii. Pantaloon;
  - d) Type-IV,: Recurrent-Hernia.

- **CLINICAL-CLASSIFICATION :**

1. Re-ducible
2. Ir-reducible
3. Obstructed-or-Incarcerated
4. Strangulated,[complication of irreducible hernia]
5. Inflamed,

**SURGICAL-REPAIRS**

**Patient-Selection**

For any hernia with a substantial risk of strangulation, treatment of the inguinal hernia is recommended. This group includes all hernias in infancy as well as those that are challenging to minimize. Nonetheless, repair is advised for the majority of hernia in younger individuals because their natural tendency is to enlarge, even in the absence of symptoms and with a low risk of strangulation.

The most frequent and straightforward treatment for inguinal hernias is elective surgery, which may be performed under general, spinal, or local anesthesia with little risk, even in individuals who are at high risk.

**Open-flat-mesh-repair :**

In the 1980s, Lichenstein developed a tension-free19, straightforward, flat, polypropylene mesh repair for inguinal hernias. Synthetic mesh were employed to enhance hernia-repairs since,1950s. The original component and Bassini's fix are the same.

An 8/15 cm segement of mesh is put over rear-wall, behind the spermatic-cord, and divided to wrap around the spermatic cord at the deep inguinal fold after the hernia sac has been removed and any medial defect has been repaired. The conjoint tendon and inguinal ligament are secured to the mesh by loose sutures.

There are two main benefits stated: Recurrence of hernias was less frequent, and recovery from surgery was quicker.[16],[17]

**SCALPEL [18]**

According to Stedman’s Medical Dictionary, a scalpel is defined as a pointed instrument with a curved edge.

**HISTORY**

Determining the precise period when a cutting tool emerged as the inaugural surgical knife is subjective. Various objects, including shels, sharp leaves, & finger-nails, could stay interpreted as per initial operating tools. Instances like , thumb-nails being utilized for surgeries on children, scar management was performed using

natural barks, and phlebotomy was carried out with shark tooth, marking earliest instances of cutting gears employed for trials on the physical-body.[1]

**PERIOD OF TRANSITION**

The transition to the modern scalpel saw the replacement of sharpened stones ith metal blades. Initially, copper blades emerged around early BC, shadowed by other materials. However, approximately around the later periods that the notion of a operating blade was originally articulated by Hippocrates. He referred to this instrument as a "macairion," which was essentially minor variety in Lacdaemonian weapon ." The weapon featured a extensive cutting blade with a single edge and sharp point, embodying the vital characteristics of the present scalpal.

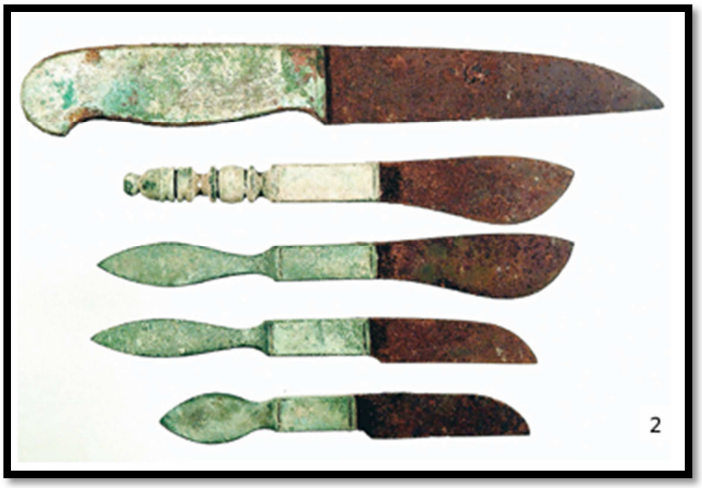


**Fig 9 : Scalpel History**

**DISPOSABLE BLADES**

In the early stages an young applied scientist Parker , introduced the current ideology of the blade system that remains prevalent even now in operating room . This innovation enabled swift mass production of sharp blades, which could be easily interchanged on standardized reusable handles. Legend has it that Mr Parkers uncle,

surgeon from New-York, grew frustrated by time-consuming blade exchange process during his hectic practice.

Mr. Parker, an engineer with no background in business, sought a partner for his invention. Turning to the phone book, he found the first name listed alphabetically below people wo supply medical equipments was C-R-Bard. Later both combinedly, they established the B-P Company, which quickly developed into most renowned terms in Operation . He Stated the following to explain his discovery

"Header studs that are designed to fit into the right slots in the blade are ideally placed on the handle in order to secure the blade to the handle. When such headed studs and slot are used, the blade may be easily fastened to the handle and, once in place, will be held so firmly that it cannot possibly move with respect to the handle".

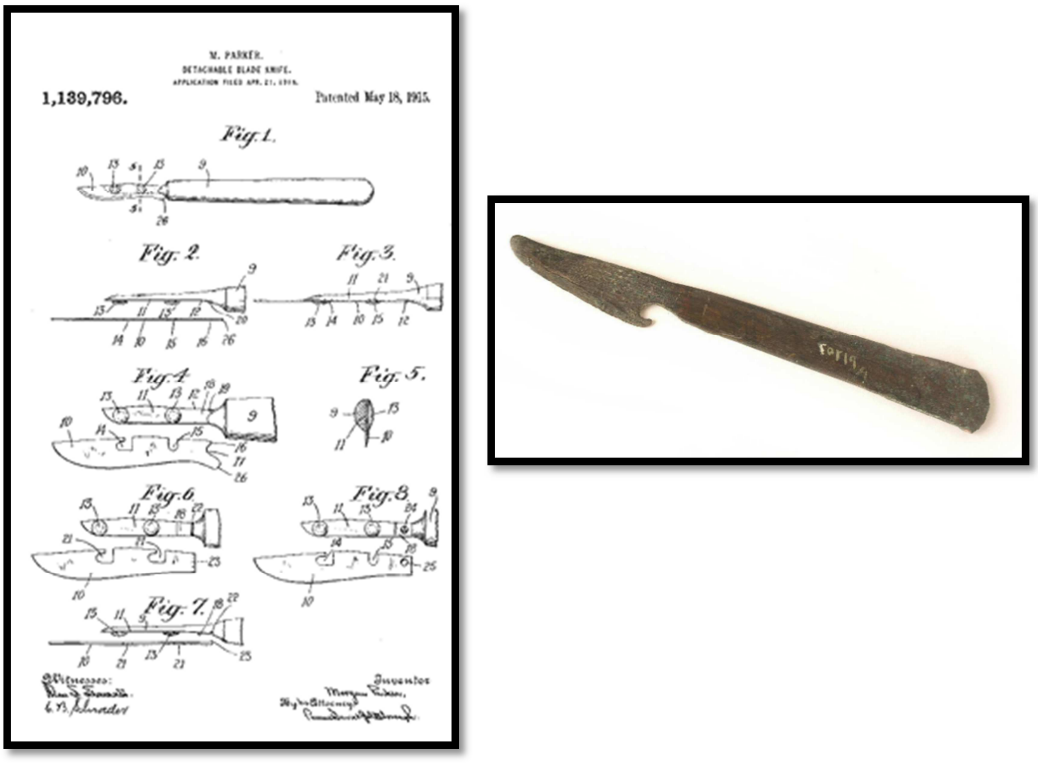


**Fig 10-11: Early Scalpel Architecture**

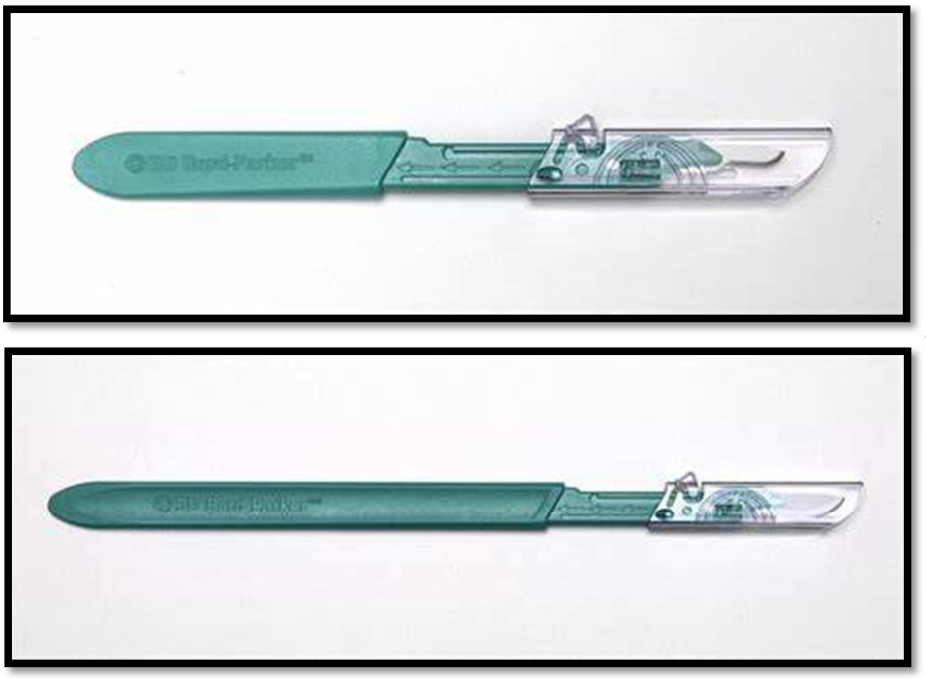

**Fig 12-13 : Modern Disposable Scalpel**

The Scalpel since its invention has been the symbol of surgery. The modification that came thereafter, mainly depended on those using it, but keeping in mind the main aspects of asepsis. Even with many technological developments over the operating table, The surgery still begins with an incision made using a scalpel

**DIATHERMY [19]**

The history of electrocautery and diathermy stems from a sequence of mishaps and experiments that eventually led to its discovery and application in surgery. Initially, the surgeon's goals were to stop the bleeding and maintain a blood-free, clean operative area.

This scalpel blade, which was first tested with heat transfer, resembles traditional scalpel blades and has the added capablity to be warmed to a certain precise degree. The sharp edges of the blades cause wounds, yet the direct transfer of heat from the cutting edge to the surrounding material causes bleeding to stop.

**History**

Utilization of heat energy for cauterization has been around for many years. Early in the 20th century, French Becqueral scientists recorded the use of direct current heating to cauterize human tissue. It has been stated that a patient was treated with this technique, called "electrocautery," as early as 1851.

An important breakthrough developed when a scientist used these principles to create an instrument to achieve the principles of electrocautery, his name Dr William T Bovie.

The intial use of this new technique in surgery was in 1st of October 1920s.

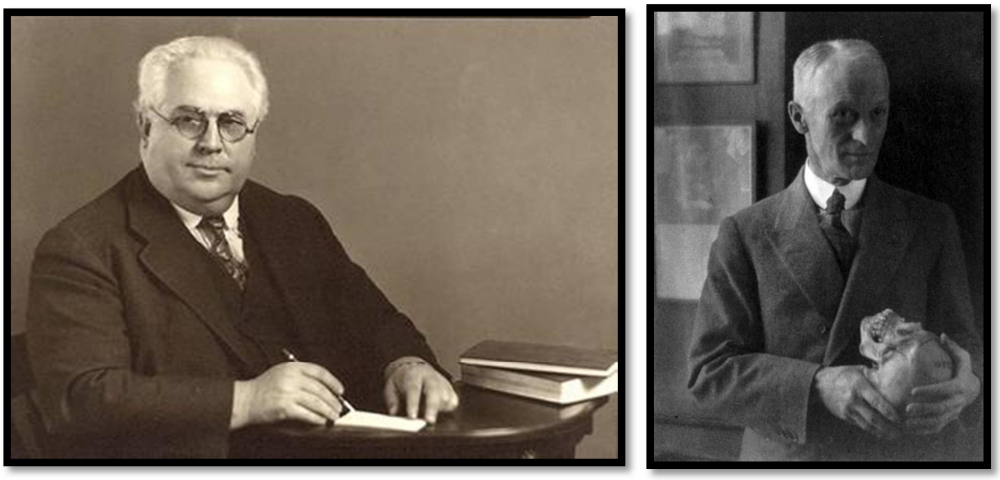

**Fig 14-15 : William-T-Bovie and Harvey Cushing**

**Electro-cautery vs Electro-surgery [20]**

Terms "electro-cautery" and "electro-surgery" are often used as synonyms , they actually describe two totally-different techniques. Electro-cautery entails application of direct-current to warm an object, such as a cutting tip or wire. This heated object at that moment is utilized to burn(cauterize) a precise position on the subjects for purposes such as removal or to cease bleed . Crucially, in electro-cautery,

no electricity passes into the patients body, in contrast to electro-surgery, where sporadic curent travels across the subject.

Electrosurgical generators provide the capability for either mono-polar or bi-polar energy delivery. In mono-polar electrosurgery, the electric current travels from the lively conductor across affected persons to diffusive arrival conductor conected to the generetor (ground). Dispersive electrode, being comparatively big, ensures safe current passage from head to toe and dissipates heat to prevent burns.

Conversely, in bi-polar electrosurgery, the current flow is within the hand-piece of the equipment itself, moving through one cathode to the subject and return onto second anode. This is achieved by grasping tissue with forceps-like instruments and applying energy.

**Effects of Electro-surgery on Tissue [21]**

**Cut (Yellow button)**

All it takes to form a tissue incision with electricity is linear vaporization. Tissue vaporization is accomplished with a low-voltage, continuous waveform utilizing a unipolar device with a thin, sharp, or blade-like tip.

Electrode placed close to the tissue, but without touching it. By turning on the generator, the thin electrode is able to concentrate the current and, consequently, the power to its tip. The local intracellular temperature is then quickly raised to more than 100°C by the current arcing between the electrode and the tissue, resulting in targeted cellular-vaporization and the formation of an organic matter, ions, and steam-filled local "plasma cloud." The electrode is advanced, maintaining its tip or edge and cutting to create an incision and expand this zone of vaporization.

**Coag.(Blue Button)**

For the objective of closing vessels or other lumen-containing structures, effective coagulation necessitates anode&cathode contact with tissue. All of the energy on a blunt or flat conductor is created when it comes into contact with tissue. This broken waveform will result in less heat being generated and a coagulation effect rather than tissue vaporization. In order to more precisely guide the coagulation, "coag" can be utilized either directly through the active electrode or through a conducting tool like insulated forceps. Similar to "Cut," there are two methods: fulguration (also known as "spray coag") and desiccation (also known as "forced coag").

**Fulg.**

Fulguration is a technique in which the tissue is repeatedly heated to temperatures over 100°C, up to 200°C, by use of high-voltage electrosurgical arcs. This causes the tissue to become superficially coagulated.

During the processes of coagulation and desiccation, organic molecules break down into their constituent atomic parts, including carbon, which gives the coagulated tissue a dark color known as "carbonization." This technique, which has also been called spraycoagulation, most likely needs local temperatures of 400°C or more.

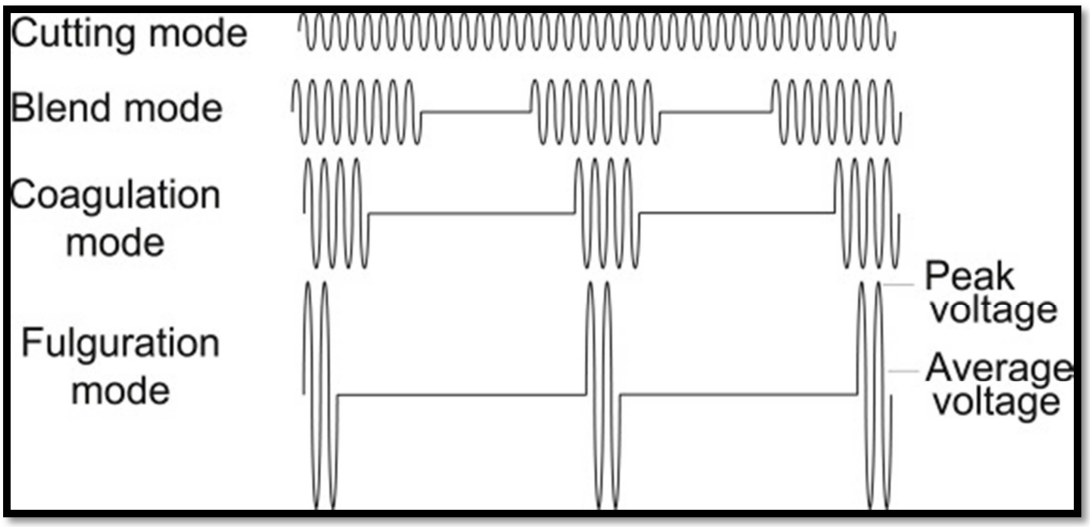


**Fig 16 : Modes Of Electro-cautery**

**Uni-Polar [22]**

The establishment of an electrical circuit including the patient, the ESU, the two electrodes, and the connecting cables is necessary for electrosurgery, just like it is for any other electrical procedure.

The patient is positioned between the single electrode on monopolar/unipolar instruments, which is referred to as the "active electrode," and the big dispersive electrode, which is likewise connected to the ESU but situated substantially,far away from the target area, usually the back or thigh.

Active electrodes come in a variety of shapes and sizes, but those featuring a point, hook, narrow tip, or bladed edge are typically employed to focus current and power in order to cut and evaporate tissue. Dispersive electrodes nearly invariably made with an adhesive to allow for ongoing patient touch and prevent a local temperature effect that would be clinically significant. On the other hand, if there is a partial separation, the dispersive electrode may become "active" and capable of causing thermal harm, and the current or power density will rise.

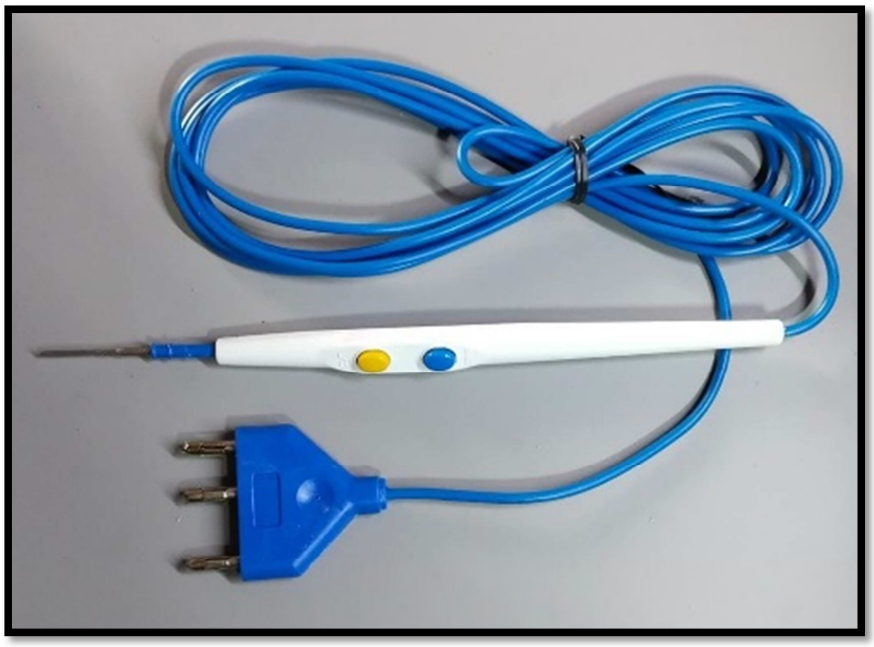

**Fig 17: Monopolar Cautery**

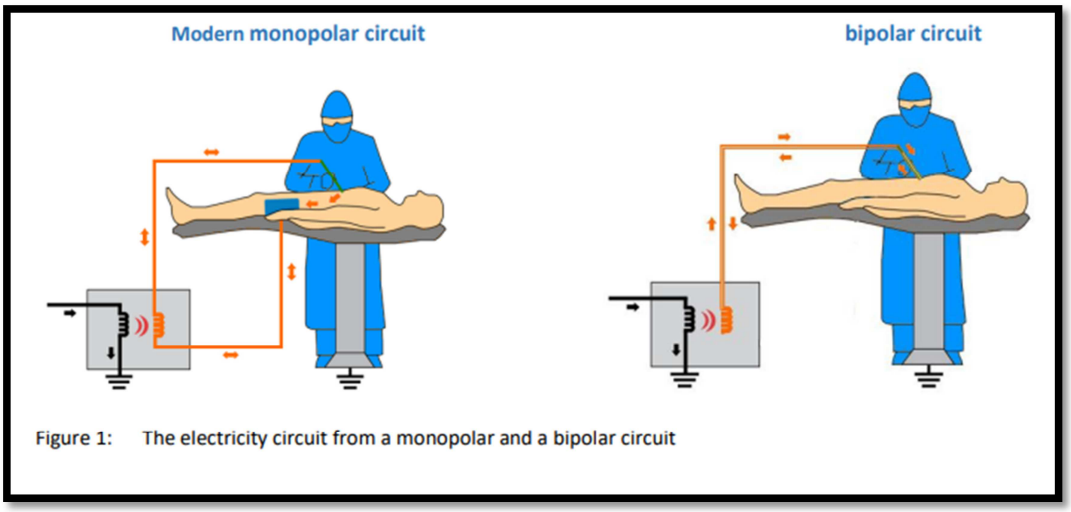


**Fig 18 : Electricity-circuit in mono-polar and bi-polar cautery**

**Bi-Polar Cautery** [22]

In order to include just the tissue situated between the two electrodes in the circuit, bipolar instruments have both electrodes positioned on the device, often at or close to the distal end. Put more simply, bipolar systems are intended to be used with instruments that have both electrodes placed on the same surgical instrument. As a

result, both the dispersive and the "active" electrodes are connected to the ESU via a single cable that connects the generator to the bipolar instrument, rather than two separate wires. The tissue positioned between the two electrodes is the basic idea of the patient participating in the circuit; this design avoids issues associated with current diversion and increases the precision of measurements of local tissue characteristics like impedance and temperature. Bipolar systems do have certain drawbacks, though, as it is more challenging to include an electrosurgical vaporization and cutting technique into the design.

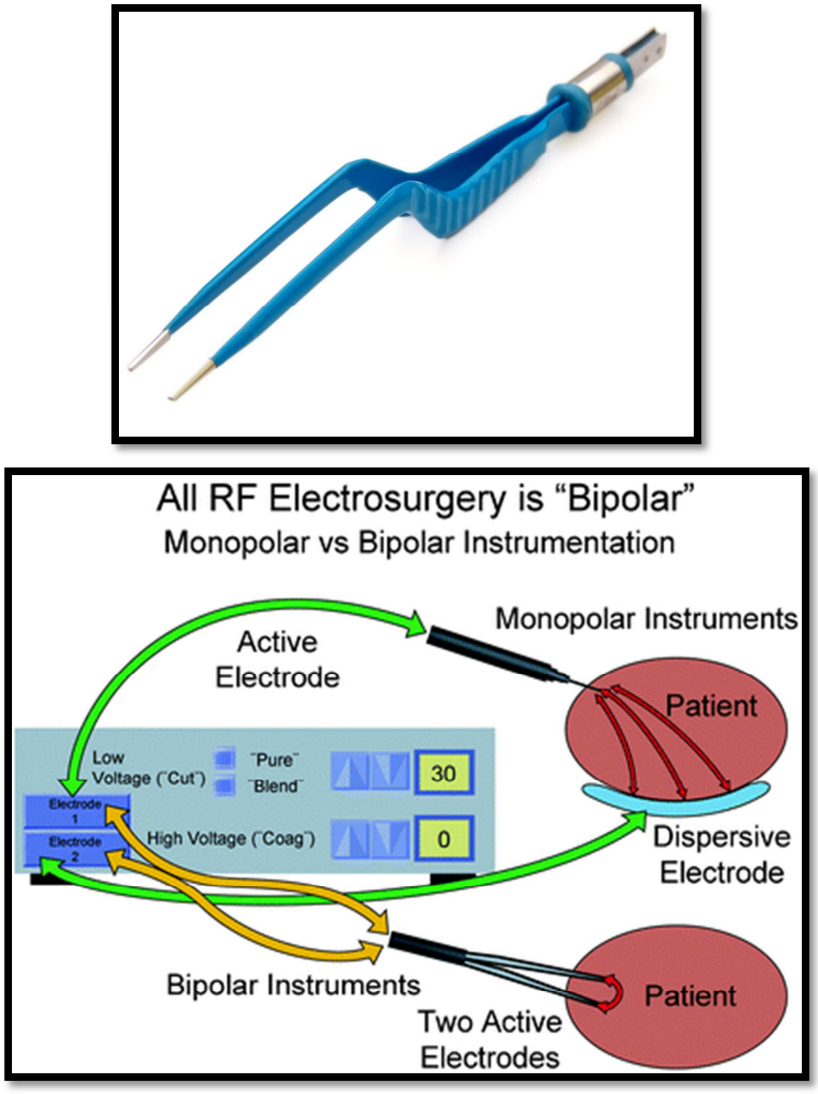


**Fig 19-20 : Bipolar Cautery and its Mechanism**

**Scalpel Vs Electrocautery**

Scalpel from the time of discovery is the instrument of choice to make a skin-incision.the advantage of cold knife over heated electrocautery was presumed that there will be no burn injuries that would then later cause scaring and poor wound healing.[23]

In a study by Peery-et-al it was noted that scalpel was related to 8% of injuries to surgeons in hospitals and even few contracting serology positive status . [23]

The present electrodes used in electro-cautery pencil is found to generate sinusoidal even current which can produce a single linear incision without causing damage to surrounding tissue thus minimising its complications.[24]

Studies have demonstrated that electrocautery is safe and effective for splitting muscle and subcutaneous tissue layers, and it can also be used safely for bowel resection. Nevertheless, electrocautery usage in making initial skin incision is still a debateable issue.[25]

In a study conducted by Kearns-et-al were laparotomy incisions were taken using monopolar cautery and scalpel, it was noted incisions made using electro-cautery were significantly quicker than those made using scalpel.[26]

In the same study it was also noted there were significant lower blood loss and post-operative pain after 48 hrs in the electrocautery group when compared to scalpel incisions.[26]

The significant difference in pain between the two groups, can be credited with the notion that the application of pure sinusoidal current causes cell vaporization, which results in immediate tissue and nerve necrosis without substantially affecting

surrounding structures; as a result, cutaneous nerves in the surgical wound area are completely destroyed or only slightly injured. [27]

In a study conducted by Sheikhwhere he had taken 177 skin incisions for neurosurgery operations employing a steel and micro needle electrocautery scalpel resulted in much reduced time spent and blood lost during skin opening, with just one wound dehiscence.[28]

It has been proposed that localized tissue heating raises subcutaneous oxygen tension, which strengthens the surgical wounds' ability to fend against infection.[27]

**PAIN ASSESSMENT [29-32]**

An unpleasant sensory and emotional experience connected to existing or potential tissue injury is called pain.

Pain is measured using two techniques.

1) Type 1 technique

An objective method where the researcher assigns numbers . Indices used to study is

- Physiological indices

1. Endocrinal
2. Cardiovascular
3. Respiratory

- Neuro pharmacological

1. Co-rrelation with beta-endorphin
2. Thermo-graphy

- Neurological

1. Nerve-conduction-velocity

- Behavioural

1. Sighing-crying-shouting-trembling

2) Type 2 technique

- Single dimension methods

2. Visual-analogue-scale
3. Graphic-rating-scale
4. Numerical-rating-scale

- Multi dimension methods

1. Mc-ill-pain-questionnaire
2. Dartmouth-pain-questionnaire
3. West-haven-yale-pain-questionnaire

In studies where clinical data is being gathered and compared, a rating scale is required.

**VISUAL-ANALOG-SCALE**

It's one of the most widely applied single-dimensional pain rating techniques. Freyd utilized this instrument for the first time in psychology in 1923.

- Benefits of using a visual analog scale
- Easy to use and quick
- Not reliant on language
- Simple to comprehend and duplicate
- Is a statistically significant ratio scale

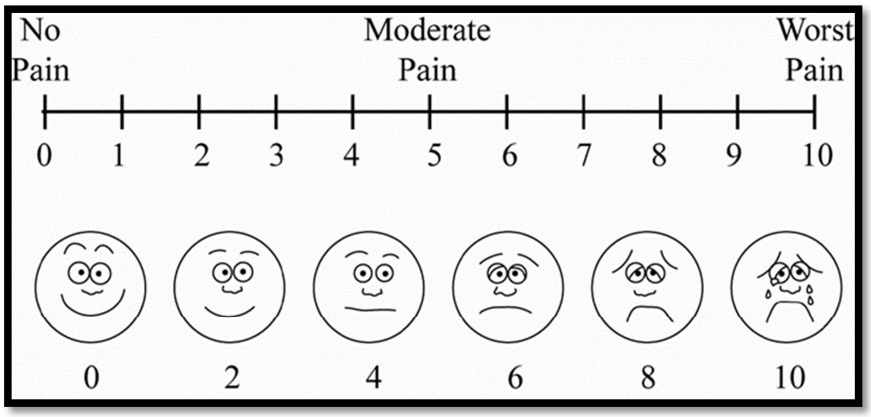


**Fig 21: Pain Visual Analog Scale**

# MATERIAL METHODS

**Method of Data-Collection:** The source-of, Data will be patients undergoing elective midline abdominal surgeries in general surgery wards at in KLE Dr-Prabhakar Kore Charitable, Hospital & Medical-Research-Centre Belagavi. Patients interviewed with presenting symptoms were noted. After a clinical examination and assessment for clinical symptoms, these individuals underwent further testing. The results were recorded and a proforma was designed.

**Study Design**:

- Randomized Control Trial **(RCT)**

**Study Period:**

- 1 year
- September 2022 to August 2023

**Sample Size:**

- The sample size is calculated as-follows:

$$n = \frac{2\,(\text{Z-alpha} + \text{Z-beta})^{2} \times SD^{2}}{d^{2}}$$

Z-alpha is equal to 1.96 (corresponding to type I error of 5%, i.e., 0.05); Z beta is equal to 1.28 (corresponding to power of 90%); SD is the standard deviation which is equal to 3; and d is equal to 2.5.

Therefore, a total of 60 subjects with 30 in each of the two groups were analysed in the study

**Sampling technique:** Computer generated random numbers by SPSS program are used to assign the type of intervention chosen for the patient that is, group A (incision using electrocautery ) and group B (incision using scalpel blade)

**Inclusion Criteria:**

- Willing to participate in study
- Patients of both sexes needing a , Elective Open Hernia Repair

**Exclusion Criteria:**

- Age above 60 years and age less than 18 years
- Patients with serious co-morbidities like coagulopathies or ASA-3 and above.
- Patients with diabetes with glycosylated haemoglobin (HbA1c) above 7.5.
- Patients with complaints of pre-existing pain at the incision site or any neuropathy.
- Patients on psychotropic drugs or history of drug abuse.
- Patients with grossly distorted liver or renal function parameters.
- Patients with pre-existing gross infections at surgical site.
- Patients on corticosteroids, chemotherapy, immunosuppressants, or anti-coagulation therapy.

**Study protocol:** Using a random number generator computer program, patients will be randomized into two groups the scalpel and the diathermy groups after undergoing preoperative evaluation, investigations, and informed permission.

The surgeon will be notified of the skin incision technique shortly before the procedure begins, and the initial skin incision will be made in accordance with the assigned group.

For patients assigned to the scalpel group, a surgical scalpel blade (number 15 or number 22) mounted on a size 3 bard parker handle will be used to make the abdominal skin incision. Following the initial full-thickness skin incision, pressure will be applied using a sterile swab to establish hemostasis. No diathermy or suction will be employed.

Diathermy will be used to finish the remaining abdominal incision, and coagulation will be used to provide the best possible haemostasis.

Instead of using a scalpel blade to make skin-incisions, the diathermy group will employ a mono-polar diathermy pencil manufactured by coviden, with a flat tip that is assembled with an electro-surgical generator set at the "30" CUT mode (sinu-soidal current, 390 kHz). The incision will be finished as in the group using the scalpel.

A resident surgeon who is blinded to the procedure will estimate the amount of blood lost during the incision by weighing a sterile swab both before and after the incision on a digital scale.

A one milliliter rise in swab weight corresponds to one milliliter loss of blood, which is measured in milliliters per square centimeter of the incisional region.

The closure of wound and skin will be done by the postgraduate residents with similar, comparable level of clinical experience.

Based on the method of surgery, several layers of closure of wounds will be performed using 2-0 nylon sutures with vertical mattress technique for skin closure and no. 1 loop PDS sutures for closing the rectus sheath in midline laparotomy and reconstruction of subcutaneous tissues.

The postoperative treatment will be administered in accordance with the standards of care. On postoperative days (PODs) 1, 2, and 7, postoperative pain will be measured using the visual analogue scale (VAS).The patient will be instructed to rate their greatest pain over the last 24 hours.

Mostly on POD-3, the postoperative wound dressing will be changed. Daily or every other day dressings will then be applied as needed. On POD 7, the wound will be assessed as an outpatient or during an inpatient stay.

Depending on the condition of the wound, POD-10 will undergo the majority of suture removal procedures.

**Data processing and analysis/statistical analysis:** An Excel spreadsheet created in Microsoft was used to enter the data. Version 20.0 of the SPSS statistical program was used to examine the data. Rates, ratios, and percentages were used to express the categorical data, and fishermen were used to compare

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram.

The association between explanatory variables and categorical outcomes was assessed bybcross tabulation and comparison of percentages. Chi square test was used to test statistical significance.

The association between quantitative explanatory variables and categorical outcomes was assessed by independent sample t-test (2 groups) will be used to assess statistical significance.

P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.

IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

**Does the study require any investigations or interventions to be conducted on patients or other humans or animals? If so, please describe briefly.**

Yes,

1. CBC

2. RBS, HBA1c

3. COAGULATION PROFILE

Intervention-To give incision to the allotted patients either with a scalpel no 15, 22 or using a electrocautery.

# RESULTS

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram.

The association between explanatory variables and categorical outcomes was assessed by cross tabulation and comparison of percentages. Chi square test was used to test statistical significance.

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1. IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk,

NY: IBM Corp.

**Table 1: Descriptive analysis of study group in the study population (N=60)**

| Gender | Frequency | Percentages |
|---|---|---|
| Male | 34 | 56.67% |
| Female | 26 | 43.33% |

**Graph 1: Bar chart of study group in the study population (N=60)**

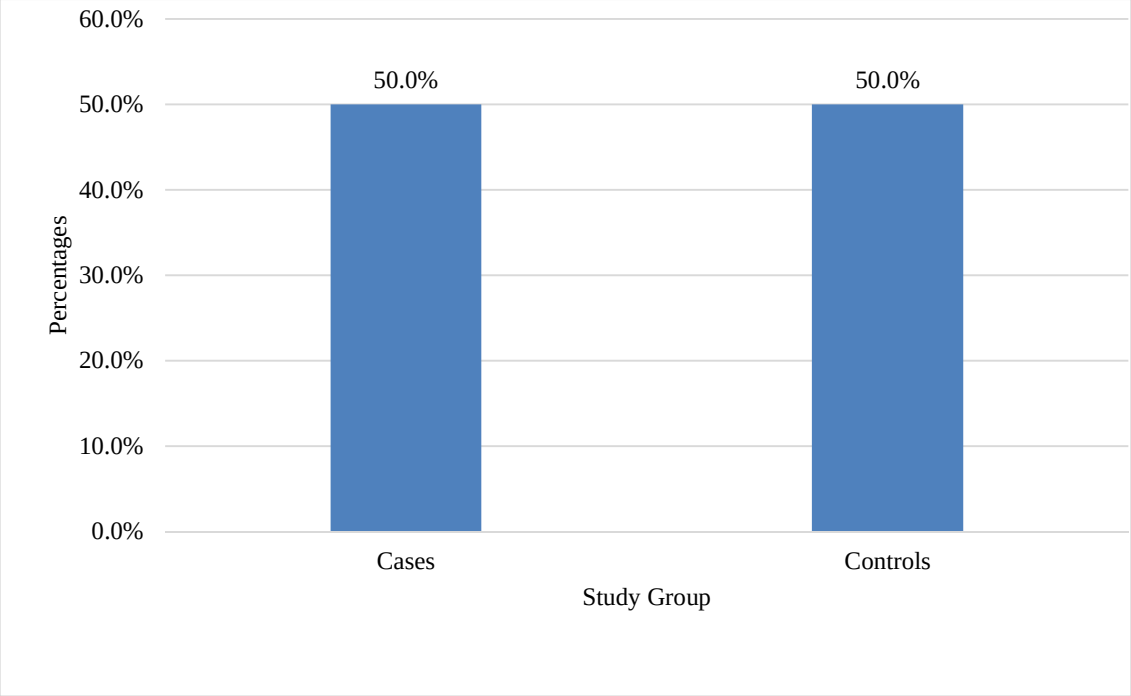


**Table 2: Descriptive analysis of gender in the study population (N=60)**

| Gender | Frequency | Percentages |
|---|---|---|
| Male | 34 | 56.67% |
| Female | 26 | 43.33% |

**Graph 2: Bar chart of gender in the study population (N=60)**

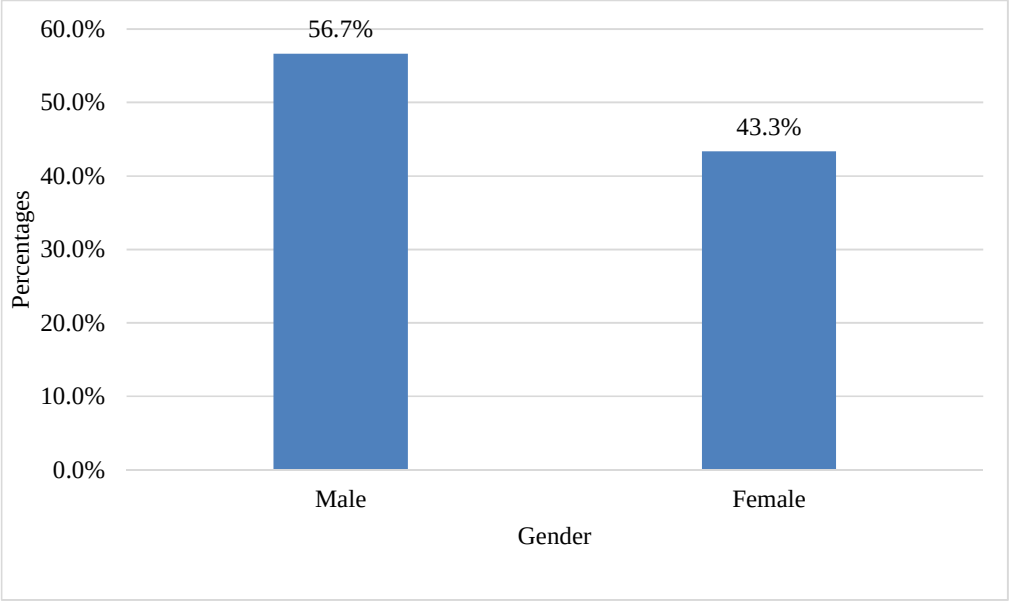



**Table 3: Descriptive analysis of age in study population (N=60)**

| Parameter | Mean ± SD | Median | Minimum | Maximum | 95% C.I | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Age | 48.42 ± 12.82 | 55.0 | 19.0 | 73.0 | 45.1 | 51.7 |

**Table 4: Comparison of gender between study group (N=60)**

| Gender | Study Group | | Chi square | P value |
|---|---|---|---|---|
| | Cases (N=30) | Controls (N=30) | | |
| Male | 15 (50%) | 19 (63.33%) | 1.086 | 0.297 |
| Female | 15 (50%) | 11 (36.67%) | | |

**Graph 3: Cluster bar chart of comparison of gender between study group (N=60)**

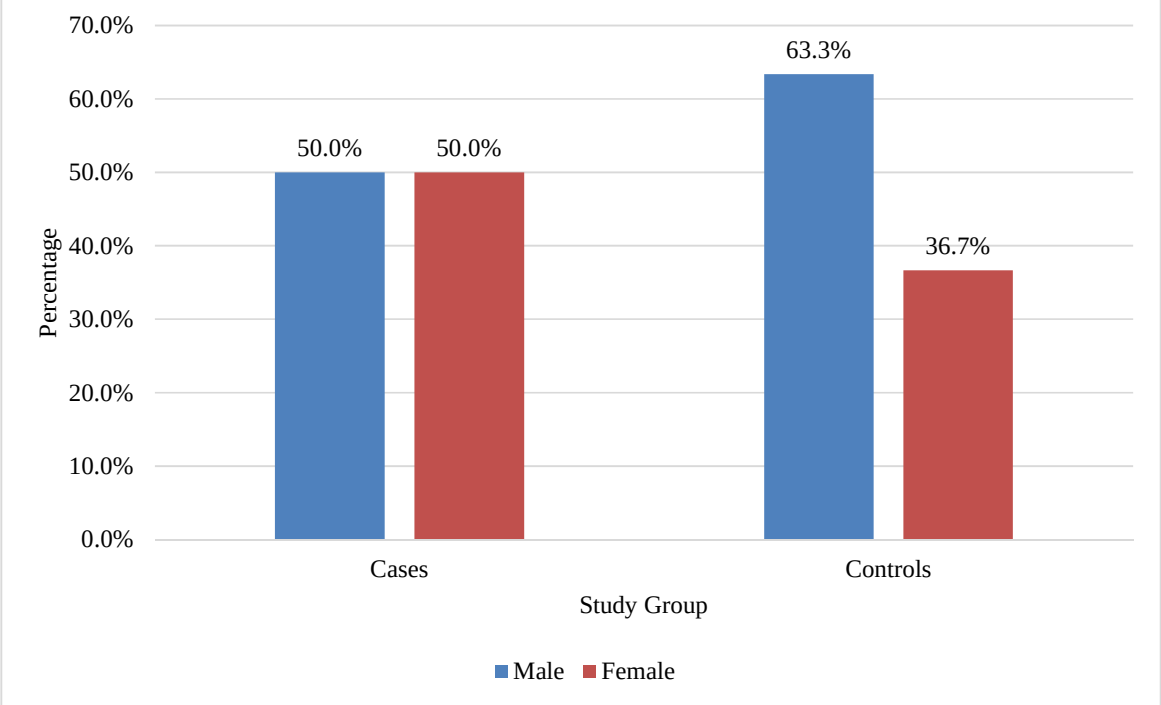


**Table 5: Comparison of diagnosis between study group (N=60)**

| Diagnosis | Study Group | | Chi square | P value |
|---|---|---|---|---|
| | Cases (N=30) | Controls (N=30) | | |
| Bilateral Inguinal Hernia | 1 (3.33%) | 3 (10%) | 1.133 | 0.769 |
| Incisional Hernia | 2 (6.67%) | 2 (6.67%) | | |
| Inguinal Hernia | 11 (36.67%) | 11 (36.67%) | | |
| Umbilical Hernia | 16 (53.33%) | 14 (46.67%) | | |

**Graph 4: Cluster bar chart of comparison of diagnosis between study group (N=60)**

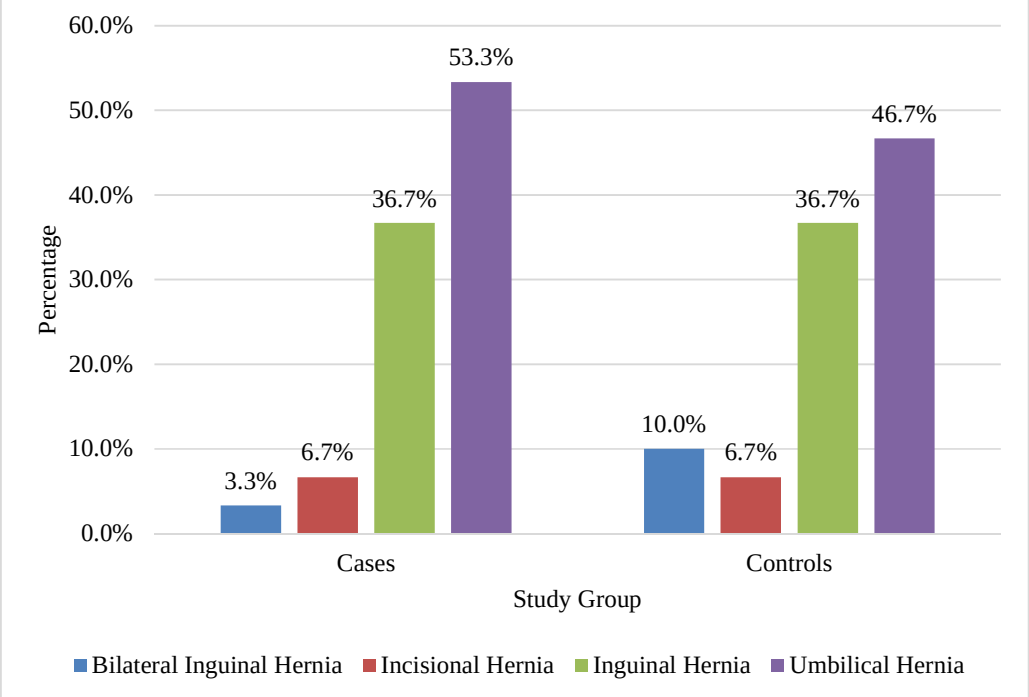
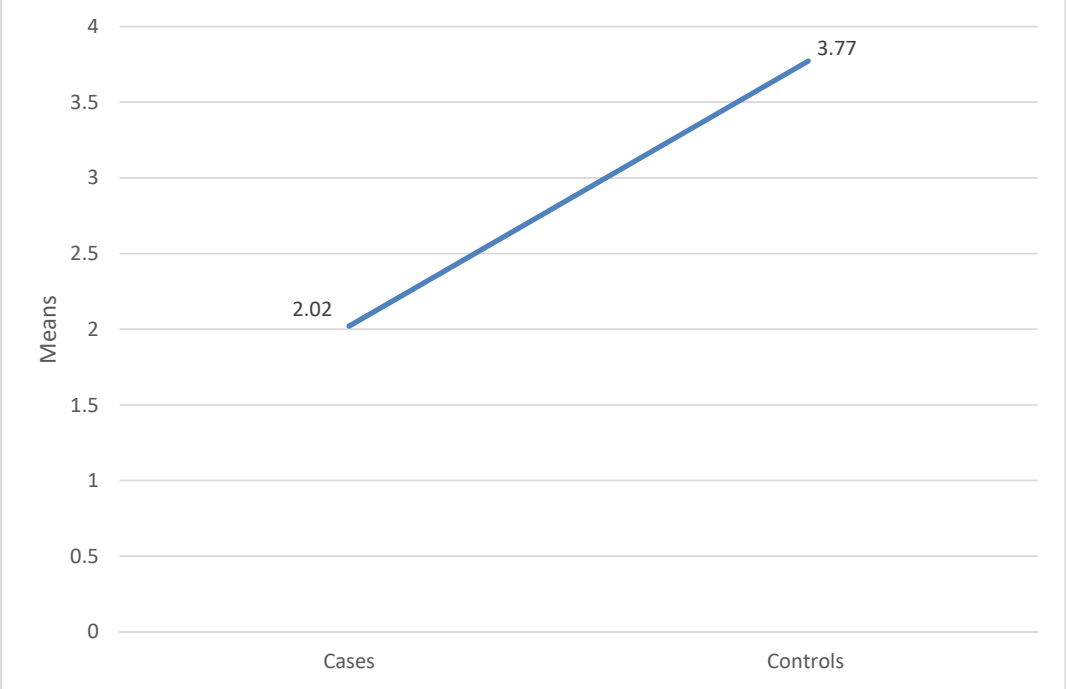


**Table 6: Comparison of mean blood loss between study groups (N=60)**

| Parameter | Study Group (Mean± SD) | | P value |
|---|---|---|---|
| | Cases (N=30) | Controls (N=30) | |
| Blood Loss (ml) | 2.02 ± 1.05 | 3.77 ± 1.83 | <0.001 |

**Graph 5 : Line chart for comparison of mean of Blood Loss (ml) between study group (N=60)**



**Graph 6 : Boxplot for comparison of median of Blood Loss (ml) between study group(N=60)**

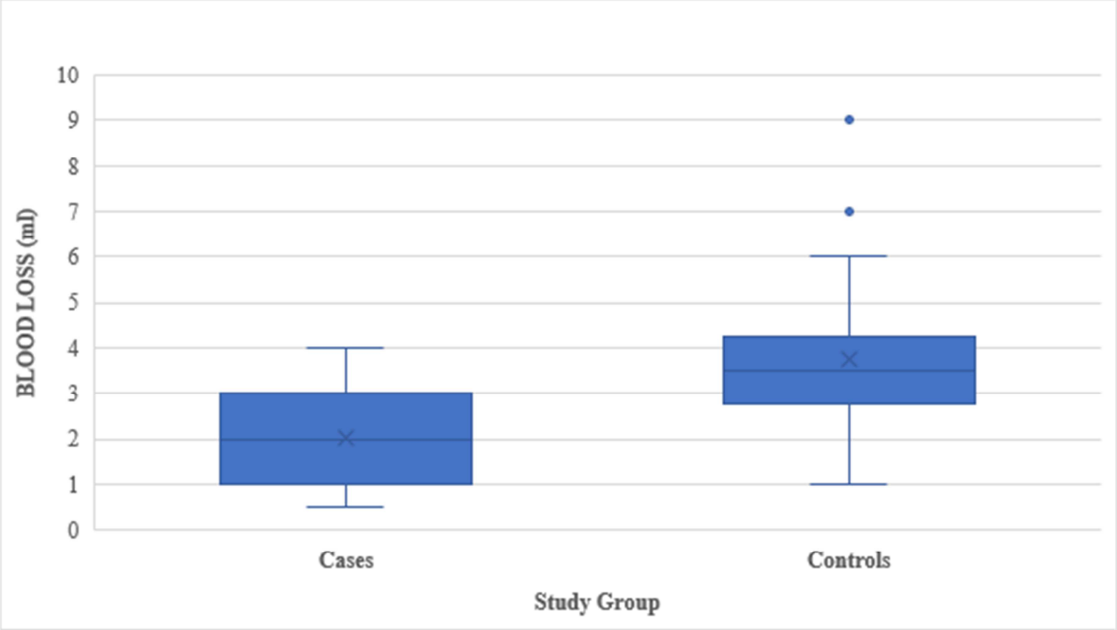



**Table 7: Comparison of mean of pain score between study group(N=60)**

| Parameter | Study Group (Mean± SD) | | P value |
|---|---|---|---|
| | Cases (N=30) | Controls (N=30) | |
| POD 1 Pain Score | 5.6 ± 1.43 | 6.53 ± 1.28 | 0.010 |
| POD 2 Pain Score | 3.8 ± 1.99 | 5.4 ± 1.5 | <0.001 |
| POD 7 Pain Score | 0.8 ± 1.24 | 1.47 ± 1.28 | 0.045 |

**Graph7: Line chart for comparison of mean of pain score between study group (N=60)**

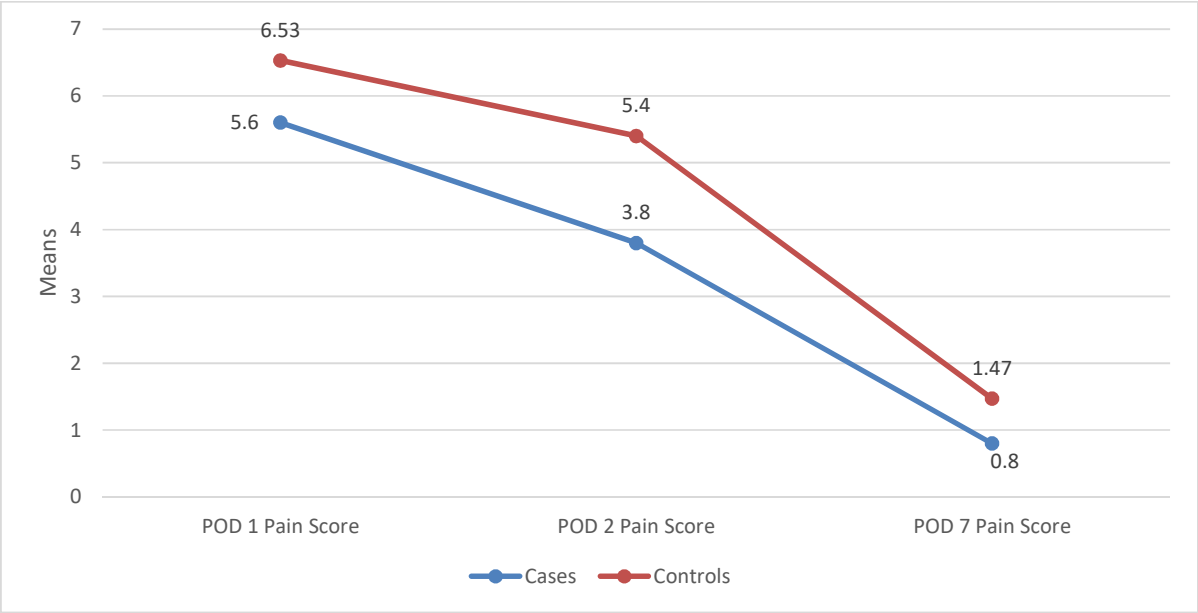



**Table 8: Descriptive analysis of incision time (sec) in study population (N=60)**

| Parameter | Mean ± SD | Median | Minimum | Maximum | 95% C.I | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| Incision Time (sec) | 14.53 ± 3.12 | 14.0 | 10.0 | 22.0 | 13.7 | 15.3 |

**Table 9: Descriptive analysis of wound infection in the study population (N=60)**

| Wound Infection | Frequency | Percentages |
|---|---|---|
| Yes | 8 | 13.33% |
| No | 52 | 86.67% |

**Graph 8: Pie chart of wound infection in the study population (N=60)**

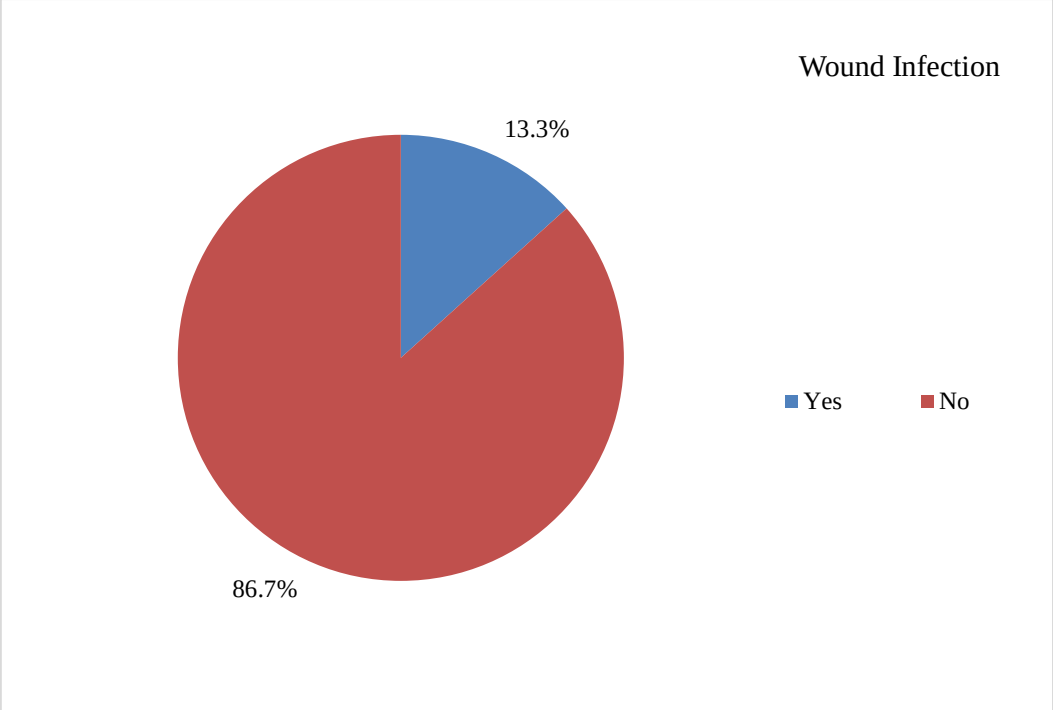
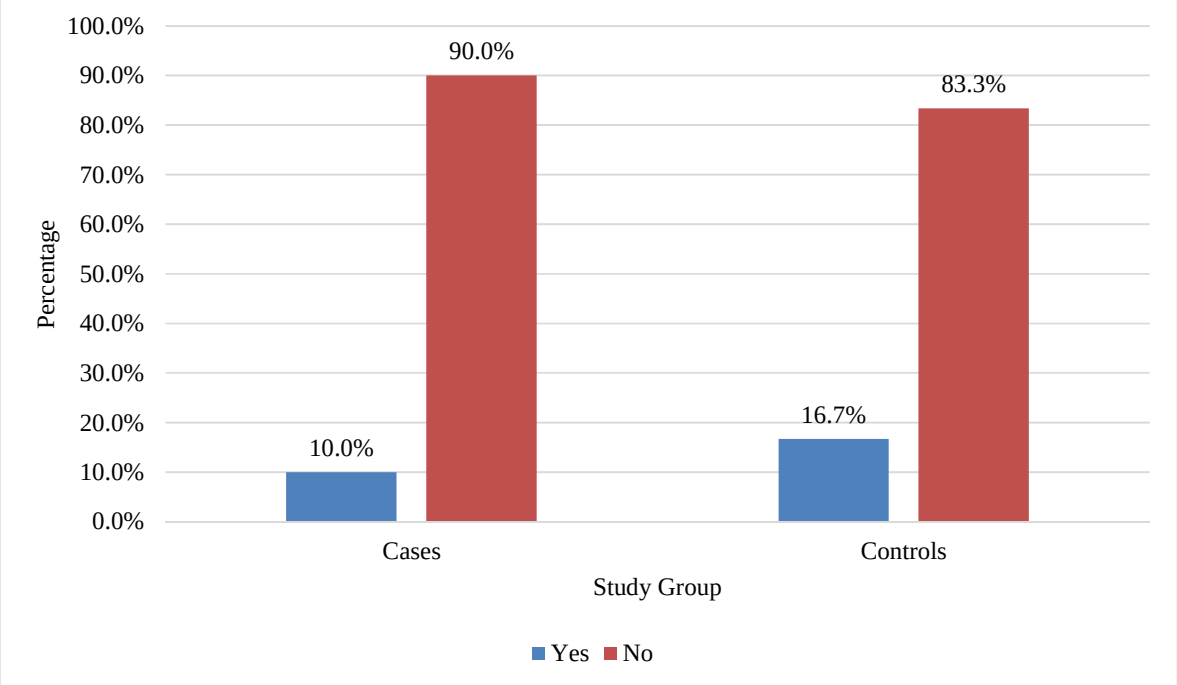


**Table 10: Comparison of wound infection between study group (N=60)1**

| Wound Infection | Study Group | | Chi square | P value |
|---|---|---|---|---|
| | Cases (N=30) | Controls (N=30) | | |
| Yes | 3 (10%) | 5 (16.67%) | 0.577 | 0.706 |
| No | 27 (90%) | 25 (83.33%) | | |

**Figure 9: Cluster bar chart of comparison of wound infection between study group (N=60)**



# DISCUSSION

Ever since William T. Bovie first introduced electrosurgical cautery, it has been widely employed in operating rooms for a variety of purposes, most notably hemostasis. Given the current developments in electrosurgical machines, the range of applications has been growing.

Prior to the development of non-explosive anaesthetics, electrosurgical machines were not widely used. After halothane was developed, electrosurgery was utilized for cutting and, to a lesser extent, hemostasis.

The concept of diathermy revolves around swiftly elevating the temperature of cells within tissues to the extent of vaporization, resulting in the formation of a void within the cellular structure. The generated heat dissipates as steam rather than transferring to surrounding tissues. As the electrode advances, fresh cells undergo vaporization, enabling incisions devoid of scarring and fostering subsequent healing with minimal scar formation.

Although possessing numerous benefits, the adoption of diathermy over traditional scalpels for surgical cuts has encountered scepticism among many surgeons. Concerns regarding potential excessive scarring, heightened risk of wound infection, and delayed wound healing have contributed to a diminished prevalence of surgical diathermy for skin incisions.

Early research using antiquated diathermy equipment revealed a link between poor wound healing and charring following electrosurgical incisions. Numerous benefits of electrosurgical cautery, including less postoperative discomfort, shorter surgical times, and less blood loss, have been demonstrated by recent research.

In this study, we evaluate the use of electro surgical cautery for making skin incisions when compared to traditional scalpel in terms of blood-loss & postoperative pain .

The present study is one year randomized controlled trail conducted in the Department of General Surgery KLES Dr.Prabhakar Kore hospital, Belagavi from September of 2022 to August of 2023 . A total of 60 patients divided into two groups , electrocautery group and scalpel group of 30 patients each , having undergone elective surgeries over abdomen were taken into consideration . The participants were evaluated based on intraoperative blood loss and post operative pain as primary objective and incision time and wound infection as secondary objective

Overall, there was no significant difference between the two groups' demographic features in the research population. Anthropometric factors (weight and height) and vital signs (heart rate, blood pressure, and temperature) were also compared similar in terms of the two groups.

In the Present Study , blood loss was calculated intra-operative based on the gauze weight preoperatively and post-operatively, with a gauze generally of count = 1mg and difference of 1mg will mean a blood loss of 1ml

In the Study, The mean Blood loss measured for electro cautery is $2.02 \pm 1.05$ and for Scalpel group is $3.77 \pm 1.83$, the difference in this is statistically significant with a p value of $<0.001$

In a study conducted by Rappaport-et-al it was found that there weree significant decrease in blood loss when using electro-cautery while making midline laparotomy incision.[33]

In this study, the two groups' postoperative pain at Day1 ,Day2 , and Day 7 is compared. Using a visual analog pain scale, the degree of pain was evaluated from 1 to 10.

The mean pain scores measured at POD1 for electro cautery is 5.6 ± 1.40 and for Scalpel group is 6.6 ± 1.28, the difference in the pain scores is statistically significant with a p value of 0.0010

The mean pain scores measured at POD2 for electro cautery is 3.8 ± 1.95 and for Scalpel group is 5.53 ± 1.52, the difference in the pain scores is statistically significant with a p value of < 0.001

The mean pain scores measured at POD7 for electro cautery is 0.8 ± 1.22 and for Scalpel group is 1.6 ± 1.30, the difference in the pain scores is statistically significant with a p value of 0.045

When electrosurgical cautery is utilized for skin incision, the blood loss during surgery and post-operative pain scores are lower after 24 and 48 hours and POD 7. These results are consistent with other research that have investigated this topic.

According to the findings of Lisa N.F. Aird et al.'s comprehensive evaluation, skin incisions made with electrosurgical cautery result in reduced post-operative discomfort and necessitate lower painkiller dosages on days 1 and 2.[34]

A research by Gilmore M. and McCabe JP evaluated blood loss during hemi arthroplasty using diathermy versus knife and found that diathermy incisions result in less blood loss than scalpel incisions.[35]

Previous electrosurgical cautery skin incisions were linked to skin edge charring and delayed wound healing because the edges' devitalization left a poor scar

and exacerbated wound infections, however with current advancements in electrosurgical devices that supply only sinusoidal current. There is no edge charring, and several studies evaluating the scars from skin incisions made with electrosurgical cautery have produced results that are comparable.

In a study by Peery-et-al it was noted that scalpel was related to 8% of injuries to surgeons in hospitals and even few contracting serology positive status [33] .

In a study conducted by Kearns-et-al were laparotomy incisions were taken using monopolar cautery and scalpel, it was noted incisions made using electro-cautery were significantly quicker than those made using scalpel [36]

In the same study it was also noted there were significant lower blood loss and post-operative pain after 48 hrs in the electrocautery group when compared to scalpel incisions.[36]

The significant difference in pain between the two groups, can be credited with the notion that the application of pure sinusoidal current causes cell vaporization, which results in immediate tissue and nerve necrosis without substantially affecting surrounding structures; as a result, cutaneous nerves in the surgical wound area are completely destroyed or only slightly injured.[36]

In a study conducted by Sheikhwhere he had taken 177 skin incisions for neurosurgery operations employing a steel and micro needle electrocautery scalpel resulted in much reduced time spent and blood lost during skin opening, with just one wound dehiscence.[28]

In a Study conducted by Carrie-Suss-et-al to study the two groups in open inguinal hernia repair , it was found that the electro-cautery group were associated with less blood loss and post operative discomfort in first 48 hrs of surgery.

In another study by Chrysos-et-al it was noted that the electro-cautery group required only half the doseage of parenteral analgesics compared to the scalpel group[7]

According to the study's findings, electrosurgical cautery-assisted skin incisions are safe and linked to reduced post-operative discomfort and intra-operative blood-loss .

# CONCLUSION

In the current study, there is a significant difference noted in intra-operative blood-loss and post-operative discomfort . It is also seen the time taken to give incison is less among the electro-cautery group .

However, a bigger sample size is recommended in order to extrapolate this research to a broader population, and a longer post-operative follow-up is suggested in order to examine post-operative wound infection and cosmesis.

# SUMMARY

Traditionally, scalpels or single-use blades have been used to produce skin incisions during laparotomy procedures; this technique has been associated with higher blood loss A and post-operative discomfort.

Electrocautery was initially used on October 1st, 1926 in England. Since then, it has become a widely used treatment in several surgical specialties.

The three main functions of diathermy, which uses high-frequency alternating electric current, are coagulation, fulguration, and cutting. It has been acknowledged as an effective dissection technique. Potential benefits of electrosurgery include faster tissue separation, less blood loss, and perhaps a lower chance of surgical staff members suffering unintentional scalpel-related injuries.

In this study it was found that with the usage of electrocautery there is a significant decrease in blood loss and post operative pain.

It was also seen that the time taken to give the incision is also less in electrocautery group and there is no significant change noted in wound infections in both groups .

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# ANEXURE I - INFORMED CONSENT FORM

**"TO COMPARE BLOOD LOSS AND POST OPERATIVE PAIN IN SCALPEL VS DIATHERMY IN ELECTIVE MIDLINE ABDOMINAL INCISION, A ONE YEAR RANOMIZED CONTROL TRIAL AT KAHERs JAWAHARLAL NEHRU MEDICAL COLLEGE, BELAGAVI"**

**Objective: "TO COMPARE BLOOD LOSS AND POST OPERATIVE PAIN IN SCALPEL VS DIATHERMY IN ELECTIVE MIDLINE ABDOMINAL INCISION"**

**Introduction:**

- Surgical skin incision can be made with a scalpel or a cutting diathermy
- Making an incision using Scalpel involves cutting through skin using a sharp blade while cutting diathermy incises skin by generating heat
- An optimum technique for making a skin incision should allow precise incision with minimal risk of bleeding and surgical site infection

**Explanation of procedure:** Intraoperatively, the method of giving initial skin incision will be as per the allotted group, and the surgeon will be informed of the method of skin incision just before the start of the surgery. In patients allotted to the scalpel group, the abdominal skin incision will be placed using a surgical scalpel blade no.15 by standard on a size 3 bard parker handle. After the initial full-thickness skin incision, haemostasis will be achieved by applying pressure with a sterile swab. Suction or diathermy will not be used. The rest of the abdominal incision will be completed using the diathermy for cutting as well as coagulation for optimal haemostasis. In the diathermy group, monopolar diathermy pencil with a flat tip assembled with Valley lab Force-FX electrosurgical generator set at '30' CUT mode

(sinusoidal current, 390 kHz) will be used instead of scalpel blade for skin incision. The rest of the incision was completed as in the scalpel group. Blood loss during incision will be measured weighing the sterile swab pre- and post-incisionally on a digital weighing machine and noted by a blinded observer, a resident surgeon.An increase of 1 g in the weight of swab is equal to 1 ml blood lost, and expressed in millilitre per square centimeters of incisional area. The closure of wound and skin will be done by the postgraduate residents with similar, comparable level of clinical experience. Wound closure will be done in layers using no. 1 loop PDS sutures for the closure of the rectus sheath in midline laparotomy and 2-0 polyglactin sutures for approximation of subcutaneous tissues depending upon the surgical procedure and skin closure using 2-0 nylon sutures with vertical mattress technique

Once you have signed the informed consent, necessary personal information and detailed medical history will be taken by the investigator. After this blood sample will be collected and will be sent for investigations viz, CBC, platelet counts, reticulocyte counts, platelet indices after which the patient will be shifted to operation theatre for the said procedure and abdominal incision by scalpel or electrocautery will be used

**Withdrawal from participation in the study:** Participation in this study is voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

**Possible benefits from participating in the study:** You will/will not have nor get any benefits by participating in this study. The data gathered will help the population at large.

**Possible risks from participating in the study:** There are no risks involved in participating in this study.

**Privacy and confidentiality:** The information collected from you will be coded, to prevent any person from identifying you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

**Financial incentives:** You will not receive any payment for participating in this study.

**Authorization for publication of aggregated data:** Results obtained after processing of the aggregated data will be published for scientific purposes and or presented to scientific groups. However, your identity will never be revealed.

**Legal rights:** By signing this consent form, we are not waving any of your legal rights.

## CONSENT STATEMENT

I am making a voluntary decision to participate in the study**" TO COMPARE BLOOD LOSS AND POST OPERATIVE PAIN IN SCALPEL VS DIATHERMY IN ELECTIVE MIDLINE ABDOMINAL INCISION , A ONE YEAR RANOMIZED CONTROL TRIAL AT KAHERs JAWAHARLAL NEHRU MEDICAL COLLEGE , BELAGAVI "** . My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator:

Signature of the investigator:

## ANNEXURE II - SCREENING FORM

1. Patient's UHID No. : ☐☐☐☐☐☐☐
2. Age (in years) : ☐☐
3. Gender: 1. Male : ☐
   2. Female : ☐
4. DOA (dd/mm/yy) : ☐☐ ☐☐ ☐☐☐☐
5. DOD (dd/mm/yy) : ☐☐ ☐☐ ☐☐☐☐
6. Date of Interview (dd/mm/yy) : ☐☐ ☐☐ ☐☐☐☐
7. Address : 1. Belagavi : ☐
   2. Outside Belagavi : ☐
8. Occupation : 1. Unemployed
   2. Unskilled
   3. Semi-Skilled
   4. Skilled
   5. Professional
9. Education: 1. Illetrate
   2. Primary ($1^{st}$ - $7^{th}$ Std)
   3. High Schoole ($8^{th}$ – $10^{th}$ Std)
   4. Intermediate
   5. Degree and above
10. Socio – Economic status 1. Low
    2. Middle
    3. High

11. Applicant is willing to give consent: 1. Yes

2. No

12. Final results: 1. Inlegible

2. Eligble but refued

3. Eligble and participating

# ANNEXURE III - PROFORMA

I.P. No

1. Name of the Patient:

2. Age:

3. Gender: 1. Male 2. Female

4. DOA:

5. DOD:

6. Date of Interview:

7: Address:

8: Phone:

9: Occupation:

- Unemployed
- Unskilled
- Semi
- Skilled Skilled
- Professional

10: Education:

- Illiterate
- Primary ($1^{st}$-$7^{th}$ std)
- High school ($8^{th}$-$10^{th}$ std)
- Intermediate
- Degree and above

11: Socio-economic status:

- Low
- Middle
- High

**Data collection instrument:**

1. Duration of Pain –
2. Location of pain-

- Right lower quadrant
- Left lower quadrant
- Right upper quadrant
- Left upper quadrant

3. Mode of onset-

- Spontaneous
- Insidious

4. Associated symptoms-

- Fever
- Pain
- Vomiting
- Nausea

3. Medical history:

- Diabetes mellitus
- Hypertension
- Asthma
- CVD

**Examination:**

1.

| Height | Weight | BMI |
|---|---|---|
| | | |

2.

| Pulse rate | Blood pressure | Temperature | Respiratory Rate |
|---|---|---|---|
| | | | |

3. Per abdomen examination

1) Point of tenderness-

2) Guarding

- YES
- NO

3) Rigidity

- YES
- NO

4) Bowel Sounds

- YES
- NO

**PROFORMA TO CALCULATE INTRA OPERATIVE BLOOD LOSS**

Bloodloss during incision was measured weighing the sterile swab pre- and post-incisionally on a digital weighing machine and noted by a blinded observer, a resident surgeon.An increase of 1 g in the weight of swab is equal to 1 ml blood lost, and expressed in millilitre per square centimeters of incisional area.

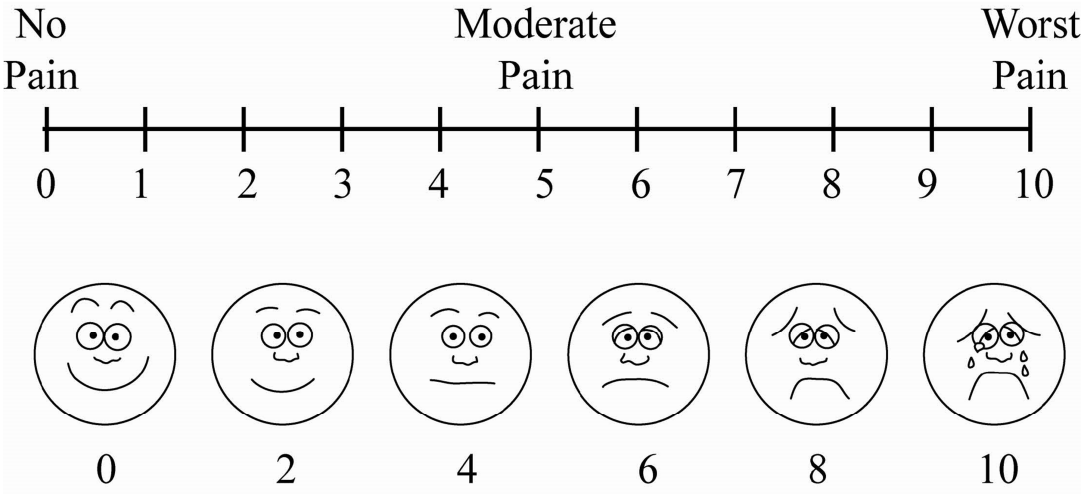
| No of swabs (gauze) | Pre operative weight (mg) | Post operative weight (mg) |
|---|---|---|
| | | |

**PROFORMA TO CALCULATE POSTOPERATIVE PAIN**

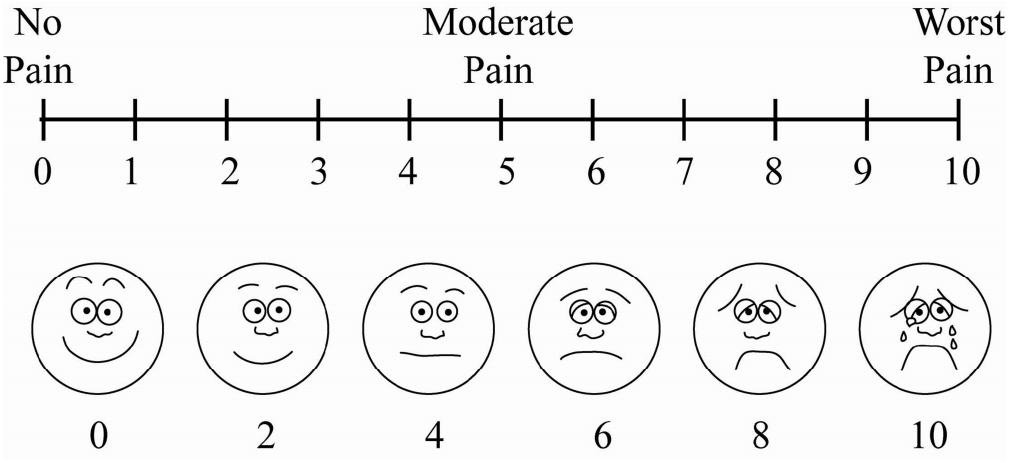
Calculated using the visual analogue pain scale on post operative day (POD) 1 ,2

And day 7

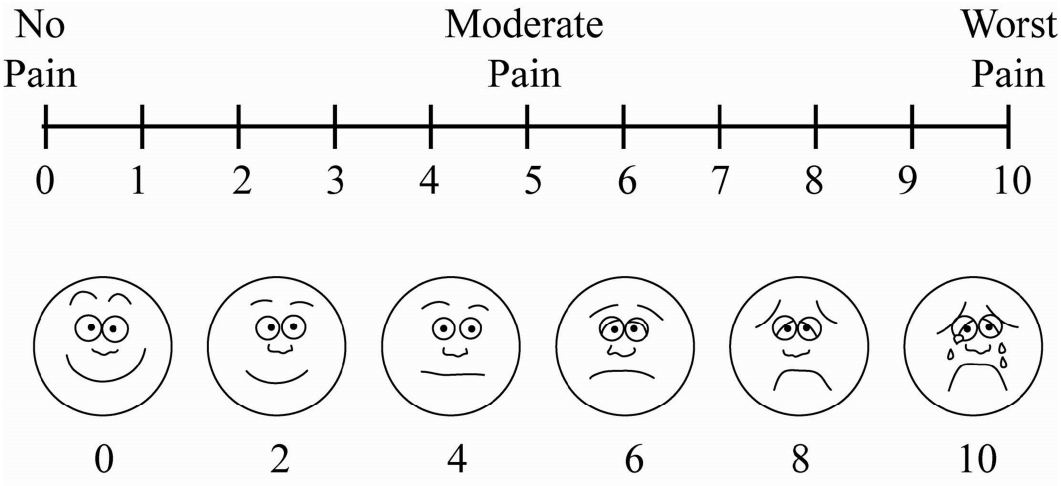
**POD 1**



**POD 2**


No Pain
Moderate Pain
Worst Pain
0 1 2 3 4 5 6 7 8 9 10
0 2 4 6 8 10

**POD 7**


No Pain
Moderate Pain
Worst Pain
0 1 2 3 4 5 6 7 8 9 10
0 2 4 6 8 10

# ANNEXURE IV - PHOTOGRAPH

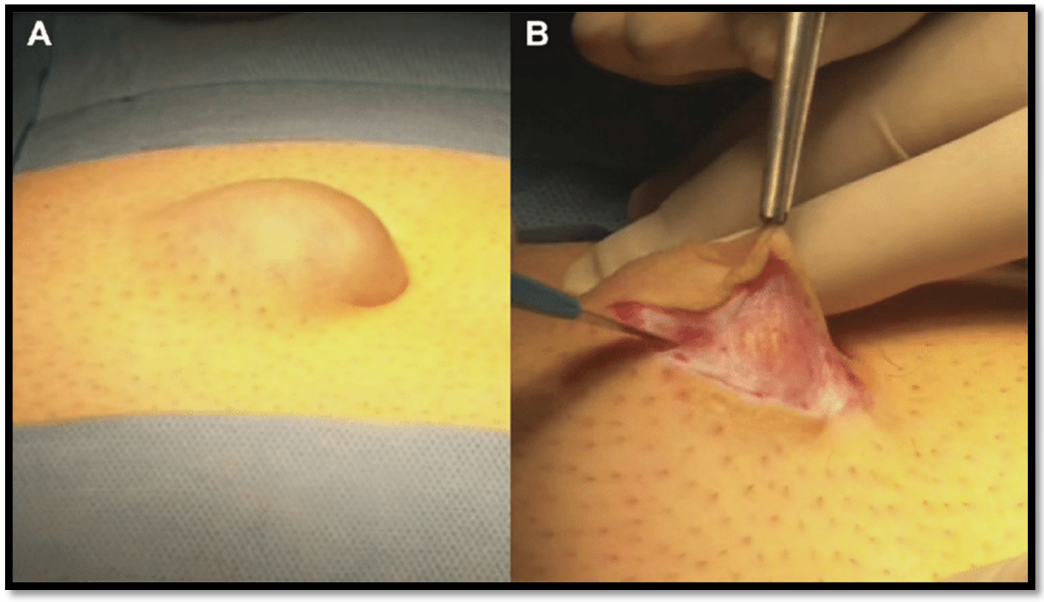



**Fig 22-23 Incision made using Electrocautery**

**Fig 24 POD 0 sutures in electrocautery incision**

**Fig 25 POD 7 suture site**

## ANNEXURE IV - MASTER CHART

| CASES | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **AGE/SEX** | **IP NO** | **DIAGNOSIS** | **NUMBER OF SWABS** | **PRE-OP WEIGHT** | **POST - OP WEIGHT** | **BLOOD LOSS** | **INCISION TIME** | **POD 1 PAIN** | **POD 2 PAIN** | **POD 7 PAIN** | **WOUND INFECTION** |
| | 60 / M | 10035572 | incisional hernia | 4 | 4mg | 8mg | 4ml | 14sec | 6 | 4 | 2 | NO |
| | 60/ F | 10031466 | Incisional hernia | 3 | 3mg | 5mg | 2ml | 15sec | 8 | 4 | 2 | NO |
| | 32 / F | 10030159 | Umbilical Hernia | 3 | 3mg | 5mg | 2ml | 18sec | 6 | 6 | 2 | NO |
| | 52 / F | 10034575 | Umbilical Hernia | 2 | 2mg | 6mg | 4ml | 22sec | 6 | 4 | 0 | NO |
| | 32 / F | 10029939 | Left Inguinal Hernia | 3 | 3mg | 6mg | 3ml | 14sec | 4 | 2 | 0 | NO |
| | 40 / F | 1207010 | Umbilical Hernia | 4 | 4mg | 4.5mg | 0.5ml | 18sec | 8 | 8 | 2 | NO |
| | 60 / M | 1208943 | Right Inguinal Hernia | 4 | 4mg | 6mg | 2mg | 16sec | 8 | 8 | 4 | NO |
| | 60 / M | 1208960 | Left Inguinal Hernia | 3 | 3mg | 4mg | 1ml | 12sec | 6 | 6 | 4 | NO |
| | 39 / F | 1209186 | Umbilical Hernia | 2 | 2mg | 2.5mg | 0.5ml | 8sec | 4 | 2 | 0 | NO |
| | 59 / M | 1003412 | Right Inguinal Hernia | 3 | 3mg | 4mg | 1ml | 8sec | 6 | 6 | 2 | NO |
| | 39 / M | 1209186 | Left Inguinal Hernia | 2 | 2mg | 2.5mg | 0.5ml | 6sec | 4 | 2 | 0 | NO |
| | 57 / M | 1206967 | Left Inguinal Hernia | 3 | 3mg | 5mg | 2ml | 8sec | 6 | 2 | 0 | NO |
| | 57 / M | 3011801 | Umbilical Hernia | 3 | 3mg | 5mg | 2ml | 12sec | 2 | 2 | 0 | NO |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 27 / M | 1209144 | Left Inguinal Hernia | 3 | 3mg | 6mg | 3ml | 12sec | 6 | 4 | 2 | NO |
| | 45 / M | 10011720 | Right Inguinal Hernia | 2 | 2mg | 4mg | 2ml | 8sec | 6 | 2 | 0 | NO |
| | 60 / M | 10013580 | Bilatreal Inguinal Hernia | 5 | 5mg | 9mg | 4ml | 12sec | 8 | 4 | 2 | NO |
| | 46 / F | 10016304 | Umbilical Hernia | 2 | 2mg | 3mg | 1ml | 6sec | 4 | 0 | 0 | NO |
| | 55 / F | 10016329 | Umbilical Hernia | 3 | 3mg | 6mg | 3ml | 12sec | 6 | 4 | 2 | NO |
| | 57 / F | 10016461 | Right Inguinal Hernia | 3 | 3mg | 5mg | 2ml | 14sec | 4 | 0 | 0 | NO |
| | 55 / M | 10024528 | Umbilical Hernia | 3 | 3mg | 5mg | 2ml | 16sec | 6 | 4 | 0 | NO |
| | 60 / M | 10027690 | Left Inguinal Hernia | 4 | 4mg | 7mg | 3ml | 16sec | 6 | 6 | 0 | YES |
| | 59 / F | 10018583 | Umbilical Hernia | 3 | 3mg | 6mg | 3ml | 14sec | 6 | 4 | 0 | NO |
| | 58 / F | 10044883 | Umbilical Hernia | 3 | 3mg | 6mg | 3ml | 18sec | 6 | 6 | 0 | NO |
| | 57 / F | 10057859 | Umbilical Hernia | 3 | 3mg | 5mg | 2ml | 14sec | 6 | 4 | 0 | NO |
| | 37 / F | 10057773 | Umbilical Hernia | 2 | 2mg | 3mg | 1ml | 16sec | 4 | 2 | 0 | NO |
| | 37 / F | 10056479 | Umbilical Hernia | 1 | 1mg | 2mg | 1ml | 12sec | 4 | 2 | 0 | NO |
| | 32 / F | 10055709 | Umbilical Hernia | 2 | 2mg | 3mg | 1ml | 12sec | 6 | 4 | 0 | YES |
| | 55 / M | 10047823 | Left Inguinal Hernia | 2 | 2mg | 4mg | 2ml | 14sec | 6 | 4 | 0 | NO |
| | 60 / M | 10034533 | Umbilical Hernia | 2 | 2mg | 3mg | 1ml | 8sec | 4 | 4 | 0 | NO |
| | 60 / M | 10034563 | Umbilical Hernia | 2 | 2mg | 4mg | 2ml | 12sec | 6 | 4 | 0 | YES |

| CONTROLS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **AGE/SEX** | **IP NO** | **DIAGNOSIS** | **NUMBER OF SWABS** | **PRE-OP WEIGHT** | **POST - OP WEIGHT** | **BLOOD LOSS** | **INCISION TIME** | **POD 1 PAIN** | **POD 2 PAIN** | **POD 7 PAIN** | **WOUND INFECTION** |
| 38 / F | 10016622 | Umbilical Hernia | 4 | 4mg | 8mg | 4ml | 18sec | 8 | 6 | 2 | NO |
| 57 / F | 10016140 | Umbilical Hernia | 4 | 4mg | 8mg | 4ml | 14sec | 6 | 6 | 2 | NO |
| 26 / F | 10017016 | Incisional Hernia | 5 | 5mg | 12mg | 7ml | 16sec | 8 | 6 | 4 | NO |
| 56 / M | 10014077 | Right Inguinal Hernia | 3 | 3mg | 6mg | 3ml | 18sec | 6 | 4 | 0 | NO |
| 57 / M | 10011520 | Left Inguinal Hernia | 3 | 3mg | 6mg | 3ml | 20sec | 8 | 6 | 2 | NO |
| 20 / M | 10026050 | Umbilical Hernia | 2 | 2mg | 3mg | 1ml | 12sec | 4 | 2 | 0 | NO |
| 60 / M | 10023588 | Umbilical Hernia | 4 | 4mg | 7mg | 3ml | 18sec | 8 | 6 | 0 | NO |
| 30 / M | 10022347 | Umbilical Hernia | 4 | 4mg | 6mg | 2ml | 18sec | 6 | 4 | 2 | NO |
| 59 / M | 10020680 | Umbilical Hernia + Infra Umbilical Hernia | 6 | 6mg | 12mg | 6ml | 16sec | 8 | 6 | 2 | NO |
| 60 / M | 1179827 | Epigastric Hernia + Umbilical Hernia | 7 | 7mg | 14mg | 7ml | 18sec | 6 | 4 | 2 | NO |
| 55 / F | 10003428 | Umbilical Hernia | 8 | 8mg | 17mg | 9ml | 20sec | 8 | 8 | 4 | NO |
| 73 / M | 10014330 | Bilatreal Inguinal Hernia | 5 | 5mg | 10mg | 5ml | 10sec | 8 | 6 | 4 | NO |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 55 / M | 10017936 | Left Inguinal Hernia | 3 | 3mg | 6mg | 3ml | 14sec | 8 | 6 | 2 | NO |
| | 54/ M | 10016519 | Bilateral Inguinal Hernia | 7 | 7mg | 12mg | 5ml | 15sec | 8 | 6 | 2 | NO |
| | 19 / M | 10033785 | Right Inguinal Hernia | 2 | 2mg | 6mg | 4ml | 16sec | 6 | 6 | 2 | NO |
| | 38 / F | 10032248 | Umbilical Hernia | 2 | 2mg | 5mg | 3ml | 10sec | 6 | 6 | 0 | YES |
| | 38 / M | 10032358 | Right Inguinal Hernia | 2 | 2mg | 5mg | 3ml | 16sec | 6 | 6 | 2 | NO |
| | 48 / M | 10032247 | Umbilical Hernia | 3 | 3mg | 7mg | 4ml | 14sec | 6 | 6 | 2 | NO |
| | 58 / M | 10030796 | Right Inguinal Hernia | 3 | 3mg | 7mg | 4ml | 16sec | 6 | 6 | 2 | NO |
| | 46 / F | 10031112 | Umbilical Hernia | 2 | 2mg | 6mg | 4ml | 14sec | 6 | 4 | 0 | YES |
| | 60 / M | 10029981 | Left Inguinal Hernia | 2 | 2mg | 5mg | 3ml | 12sec | 6 | 6 | 2 | NO |
| | 38 / F | 10030710 | Incisional Hernia | 4 | 4mg | 8mg | 4ml | 18sec | 8 | 8 | 2 | YES |
| | 48 / F | 10030605 | Umbilical Hernia | 2 | 2mg | 4mg | 2ml | 16sec | 6 | 4 | 2 | NO |
| | 60 / M | 10057833 | Left Inguinal Hernia | 2 | 2mg | 6mg | 4ml | 18sec | 6 | 6 | 0 | NO |
| | 27 / F | 10054073 | Right Inguinal Hernia | 2 | 2mg | 5mg | 3ml | 16sec | 6 | 6 | 0 | YES |
| | 58 / F | 10057427 | Umbilical Hernia | 2 | 2mg | 4mg | 2ml | 8sec | 6 | 4 | 0 | YES |
| | 36 / F | 10055560 | Umbilical Hernia | 1 | 1mg | 2mg | 1ml | 22sec | 4 | 4 | 0 | NO |
| | 60 / M | 10093060 | Bilateral Inguinal Hernia | 6 | 6mg | 12mg | 6ml | 6sec | 8 | 8 | 2 | NO |
| | 38 / M | 10030685 | Left Inguinal Hernia | 3 | 3mg | 5mg | 2ml | 12sec | 4 | 4 | 0 | NO |
| | 26 / M | 10034331 | Left Inguinal Hernia | 2 | 2mg | 4mg | 2ml | 14sec | 6 | 2 | 0 | NO |