A COMPARATIVE STUDY TO ASSESS THE SUPERIORITY OF CYANOACRYLATE GLUE APPLICATION OVER CONVENTIONAL SUTURING FOR THE SKIN CLOSURE OF LAPAROSCOPIC PORT SITES

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Dissertation submitted to

BLDE (Deemed to be University) Vijayapur, Karnataka

In partial fulfillment of the requirements for the degree of

MASTER OF SURGERY

IN

GENERAL SURGERY

Under the guidance of

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KARNATAKA

2020

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LIST OF ABBREVIATIONS USED

AEG	APOCRINE SWEAT GLAND
ATP	ADENOSINE TRIPHOSPHATE
CM	CENTIMETER
CO2	CARBON DIOXIDE
CT	COMPUTED TONOMETRY
DAMP	DAMAGE ASSOSIATED MOLECULAR PATTERN
DC	DENDRITIC CELLS
ECM	EXTRA CELLULAR MATRIX
FGF	FIBROBLAST GROWTH FACTOR
FDA	FOOD AND DRUG ADMINITRATION
GB	GALL BLADDER
H2O2	HYDROGEN PEROXIDE
HPA	HYPOTHALMIC PITUITARY ADRENAL
IGF	INSULIN GROWTH FACTOR
IL	INTERLEUKIN
ICAM	INTRACELLULAR ADHESION MOLECULE
IV	INTRAVENOUS
LA	LAPROSCOPIC APPENDECTOMY
LAP	LAPAROSCOPIC
MM	MILIMETER
MMHG	MILIMETER OF MERCURY
MSS	MANCHESTER SCAR SCALE
NSAIDS	NON-STEROIDAL ANTI INFLAMMATORY DRUGS
PDGF	PLATELET DERIVED GROWTH FACTOR
PDGF-B	PLATELET DERIVED GROWTH FACTOR SUBUNIT B
POD	POST OPERATIVE DAY
PO	POST OPERATIVE
R.C.	REVERSE CUTTING
ROS	REACTIVE OXYGEN SPECIES

SBSES	STONY BROOK SCAR EVALUATION SCALE
SD	STANDARD DEVIATION
SSI	SURGICAL SITE INFECTIONS
TEP	TOTAL EXTRA PERITONEAL REPAIR
TAPP	TOTAL TRANSABDOMINAL PRE-PERITONEAL REPAIR
TGF	TRANSFORMING GROWTH FACTOR
TNF	TUMOR NECROSIS FACTOR
VEGF	VASCULAR ENDOTHELIUM GROWTH FACTOR
VCAM	VASCULAR CELLULAR ADHESION MOLECULE
VSS	VASCULAR SCAR SCALE
VAS	VISUAL ANALOGUE SCORE

ABSTRACT

BACKGROUND

Cyanoacrylates are liquid monomer that polymerizes in an exothermic reaction on contact with a basic substance to form a strong bond between two wound edges which were discovered in 1949, but their clinical application in the closure of the surgical wound was described a decade later. Here we are comparing the superiority of cyanoacrylate glue i.e. N-Butyl-2-cyanoacrylate in the closure of laparoscopic port site skin with conventional suturing using Ethilon 2.0 RC.

OBJECTIVE OF STUDY

1. The time required for closing the wound.
2. Post-Operative pain at the wound site.
3. Analgesic used, dose and for how many days.
4. SSI infection, according to Southampton scoring system.

METHODS OF DATA COLLECTION

- All the patients admitted to the surgery ward from December 2020 to October 2022 who will be undergoing laparoscopic surgery are included in the study.
- Patients will be randomly allocated to two groups so that there will be no bias i.e.

1) Group A
2) Group B

- The principal technique for Group A patients is
- to close the skin of the ports using cyanoacrylate glue and for Group B using conventional sutures.

RESULT

70 patients who were undergoing laparoscopic surgery was randomly divided into two groups, A and B, 35 each. Group A laparoscopic port site skin was closed using N-Butyl-2-cyanoacrylate glue and group B using Ethion 2.0 RC and clinical parameters like time required for closure, postoperative pain 6 hours after surgery, POD 1, POD 2, POD 3, and surgical site infection was compared. It was observed that the time required for laparoscopic port skin closure ($P<0.0001$) and the rate of surgical site infection ($P<0.021$) was significantly low in group A skin closure with cyanoacrylate glue as compared to group B skin closure using suture but the pain and analgesics required were insignificant as depends upon the type of surgery and intraoperative complications and tissue handling.

CONCLUSION

Cyanoacrylate was beneficial as it was taking less time for laparoscopic port skin closure and has less surgical site infection at wound site.

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INTRODUCTION

Tissue approximation and sufficient tissue reunion are prerequisites for skin closure, and the ideal scar for a surgeon's profession is one that looks nice since, as the saying goes, people judge a surgeon by the scar he leaves.

The most common technique for wound closure continues to be sutures, which have been used for generations. The technique for closing wounds has changed over time, progressing from the first suturing materials to synthetic absorbable sutures, adhesive substances, staples and tapes.

In order to know which method will produce the best results, it is helpful to research and contrast new techniques, such as cyanoacrylate glue with conventional suture materials. The best technique for closing an incision must be simple, risk-free, fast, quick, inexpensive, painless, and bactericidal. It should also result in the best cosmetic appearance of the scar, less postoperative pain, less wound infection, and a shorter stay in the hospital.

Cyanoacrylate glue can be used as tissue adhesive as they are easy to apply and takes less time to close, offering a hurdle to microorganisms at the healing location so its has less rate of wound infections, and the best cosmesis is achieved as compared to sutures.

As we can see in a conventional suturing technique,the source of infection are the puncture wounds created. This is avoided in adhesive glue, decreasing the rate of surgical site infection using cyanoacrylate glue for skin closer, but in the use of cyanoacrylate glue, the dead space should be eliminated, and complete hemostasis is required to achieve a better result.

Although the price of cyanoacrylate glue is higher, the whole cost, which includes transportation costs for follow-up appointments, lost pay, local dressings, and antibiotics, was much more with the suture material used, thus the total cost-effectiveness was practically identical in both cases.

Minimally invasive surgeries have grown over the past decades this is due to less painful operations, quicker postoperative recovery, and fewer hospital stay. Traditionally laparoscopic port site skin was closed by Ethilon 2.0 RC, but the other technique, skin adhesive, like cyanoacrylate, can be used. There are numerous clinical uses for the cyanoacrylate glue. However, we studied it's use in the closure of laparoscopic port site skin.

AIM OF STUDY

A comparative study to assess the superiority of Cyanoacrylates glue application over Conventional suturing for the closure of Laparoscopic port sites.

OBJECTIVE OF STUDY

1. The time required for closing the wound.
2. Postoperative pain at the wound site.
3. Analgesic used, dose, and for how many days.
4. SSI infection, according to Southampton scoring system.

REVIEW OF LITERATURE

Scar formation is an unavoidable result of wound healing after a traumatic or surgical intervention. The aesthetic look of a scar is the most crucial factor in evaluating the surgical outcome. Experience, careful planning, and technique, in addition to knowledge of anatomy and wound repair, can all help to lessen complications and enhance surgical results. The word "scar" derives from the Greek word "eskhara" (in French, "escharre"). A scar can be defined as a flaw or mark left behind by a previous condition, wound, sore, or burn.

When a wound heals, the regular skin is replaced by a fibrous tissue, and scarring is an inevitable side effect. This scar tissue is devoid of the qualities of healthy, unharmed skin.

According to the International Advisory Panel on Scar Management, scars can be either mature or immature, linear or broad hypertrophic, minor or major keloid, or keloid-like.

The most common technique for wound closure continues to be sutures, which have been used for generations. Other new tecniques such as the use of adsorbable sutures, tapes, staples and adhesive tapes have been developed overtime. [1]

It is helpful to research and contrast new techniques, such as cyanoacrylate glue with conventional suture materials, in order to know which method will produce the best results. The best method for closing an incision should be straightforward, risk-free, quick, affordable, casusing less pain, and bactericidal. It should also result in the best visual appearance of the scar, less postoperative pain, less wound infection, and a shorter hospital stay.

When compared to sutures, cyanoacrylate glue achieves the best cosmetic outcome and is easier to use, taking less time to close and acts as a shield to microorganisms at the healing location, reducing the risk of wound infections.

In conventionally sutured wounds, multiple puncture sites are the cause of infections. This can be avoided with the use of adhesive glue, decreasing the rate of surgical site infection using cyanoacrylate glue for skin closer but in the use of cyanoacrylate glue, the dead space should be obliterated, and complete hemostasis is required to achieve a better result.

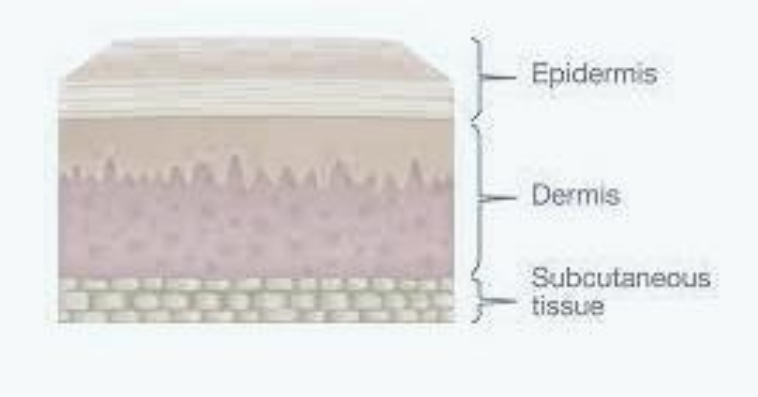
Minimally invasive surgeries have grown in popularity over the last few decades due to less painful operations, faster postoperative recovery, and shorter hospital stays. Traditionally, Ethilon 2.0 RC was used to close the skin around the laparoscopic port site, but skin adhesives such as cyanoacrylate can also be used. Numerous clinical uses already exist for the cyanoacrylate glue. However, we investigated its application in the closure of laparoscopic port site skin.

Anatomy of skin-

Skin is the largest organ in the body and makes up about 15% of the body weight. It carries out a variety of essential tasks, such as safeguarding the body from physical, chemical, and biological risks from the outside, preventing excess water loss from the body, and helping with “thermoregulation”. [2]

3 layers of the skin are-

- Epidermis
- Dermis
- Subcutaneous tissue



Keratinocytes, a specific type of cell that creates keratin. Keratin is a long, thin protein that acts as protection, make up the epidermis, the skin's top layer. Collagen, a fibrous protein is the main component of the dermis. The panniculus, or subcutaneous tissue, on which the dermis rests, includes tiny lobes of fat cells known as lipocytes. The thickness of these layers depends upon their location and varies accordingly.

1) EPIDERMIS

The epidermis is a squamous epithelial layer. It is made mainly of the keratinocytes and dendritic cells. “Melanocytes, Langerhans cells, and Merkel cells are the other type of cells present in the epidermis”.[3]

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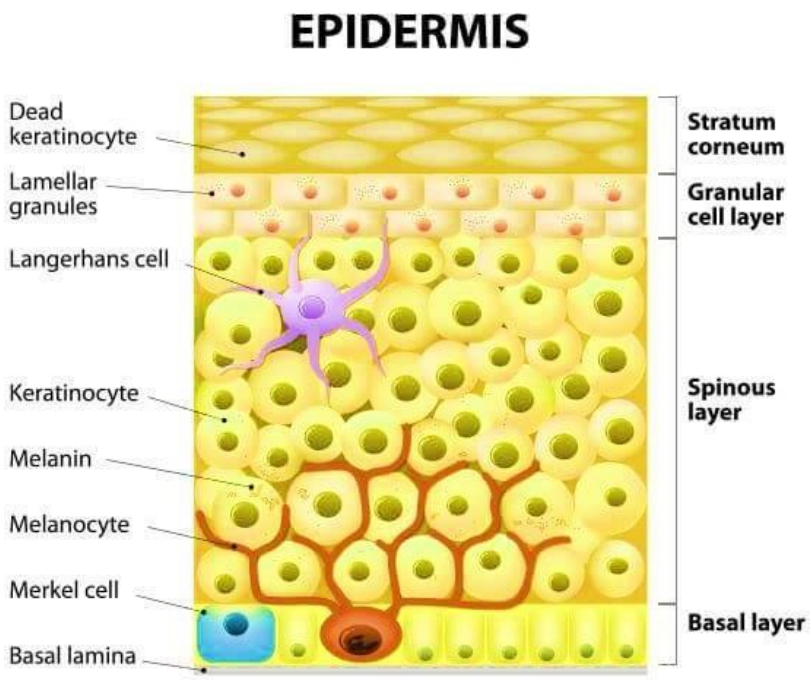
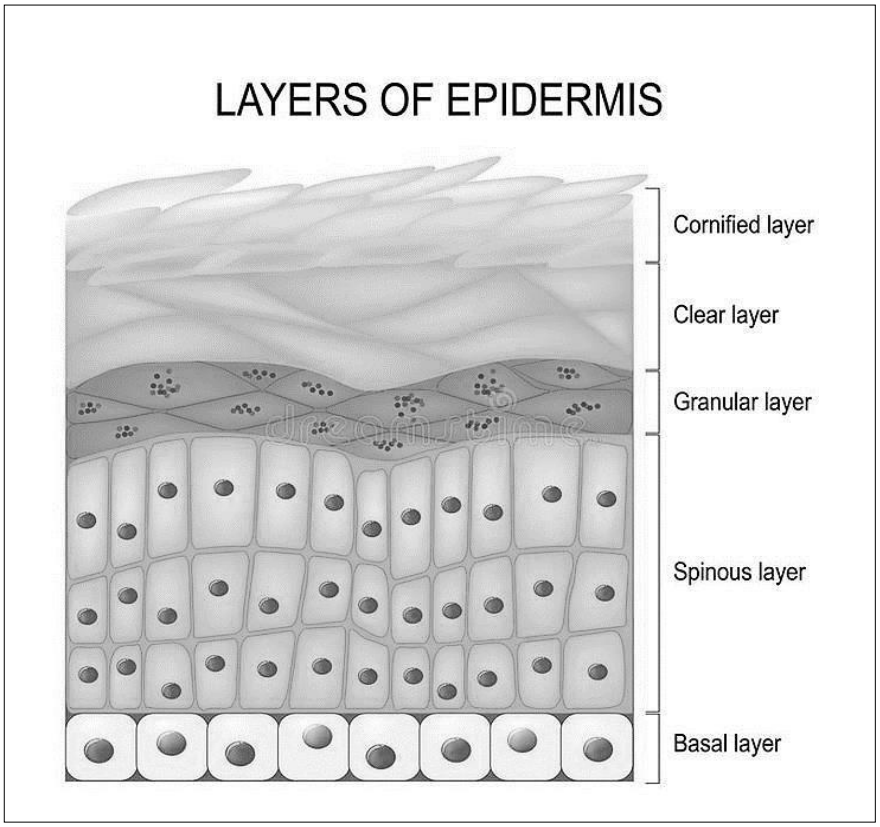


Basal cell layer (stratum germinativum), squamous cell layer (stratum spinosum), granular cell layer (stratum granulosum), and cornified or horny cell layer are the four layers that the epidermis is frequently divided into depending on keratinocyte location and structure (stratum corneum).



The epidermis is a constantly regenerating layer that produces derived structures including sweat glands, nails, and pilosebaceous apparatuses. The basal cells, which go through cell development cycles, replenish the outer epidermis. Melanocytes and Langerhans cells constantly pass other individual cell types as they move nearer the skin's surface in the active epidermis.

- "Keratinocytes"

Ectodermally generated keratinocytes account for at least 80% of epidermal cells. As cells travel from the basal layer to the skin's surface, differentiation takes place, which leads to keratinization. The keratinocyte passes through two phases throughout the process of keratinization: the first is synthetic, and the latter is degradative.

- "Basal Layer"

Column-shaped keratinocytes present in the basal layer, also called as the stratum germinativum, link to the basement membrane with their long axes perpendicular to dermis. These cells make up a single layer and connect into additional surface-level of squamous cells and one another via desmosomal connections. Basal cells are identified by their dark-staining oval or elongated nucleus and inclusion of melanin pigment that is transferred from nearby melanocytes.

- "Squamous Cell Layer"

Epidermis' squamous cells, sometimes referred to as the stratum spinosum, is a layer that is located above the basal cell layer and is 5–10 cells thick. The cells that make up the squamous layer come in different shapes, sizes, and subcellular features depending on where they are located. "In relation to cells of the top spinous layers, which are often larger in size, flat as they are driven toward the surface of skin, and contain lamellar granules, suprabasal spinous cells, for example, are polyhedral in form and include rounded nucleus". Desmosomes, which are common and link the crevices between spinous cells, aid in the mechanical connection of epidermal cells and provide resistance to external stresses.

Another sort of connection between epidermal cells is called a gap junction. These junctions, which essentially act as an intercellular pore, enable physiologic communication via chemical signals, which is essential for controlling cell metabolism, development, and differentiation.

- "Granular Layer"

The granular layer, also known as the stratum granulosum, is the epidermi's outermost layer that contains live cells. Flattened cells with many keratohyaline granules make up its structure. These cells are in charge of carrying out ongoing protein synthesis and modification associated to keratinization. As per the thickness of the horny cell layer above it, the granular layer's thickness varies.

Soft keratin is produced by periodic frequent cutting of keratin filaments. Contrarily, the inclusion of disulfide bonds causes the tonofibril filaments that traverse the cell cytoplasm to harden, resulting in "hard" keratin in the nails and hair despite a lack of keratohyaline granules in those tissue.

- "Cornified Layer"

Horny cells of cornified layer serve as a physical barrier to guard the underlying epidermis as well as a barrier to prevent moisture loss and penetration by foreign objects.[4]

<u>The regulation of epidermal proliferation and differentiation</u>

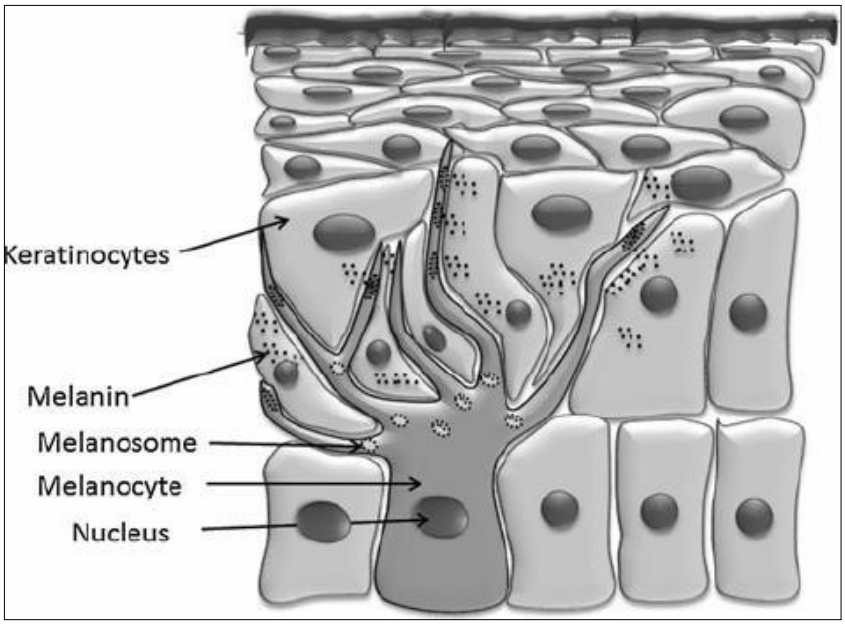
" Epidermis has to maintain a steady number of cells and control the linkages and connections between epidermal cells because it is a tissue that is constantly renewing. It is important to control the contractures among both keratinocytes, interconnections between keratinocytes and immigrant cells and process of proliferation and differentiation to produce corneocytes because throughout formation and during lifespan, cells move about. Epidermal development and differentiation are partially regulated by the underlying dermis, which is crucial for maintaining postnatal structure and function".

Another important location for the growth of epidermal appendages is the contact between dermis & epidermis. One of the key features of epidermal cells that helps to maintain a constant epidermal thickness is their capacity to undergo apoptosis, also known as programmed cell death. In contrast to necrosis, which commonly causes harm to neighbouring cells, apoptosis is a process that causes ordered biological and morphological changes in cells without actual cell death.

"This crucial homeostatic process is controlled by variety of cellular signalling molecules, including growth hormones, growth factors, and cytokines". Development of skin, cell population management, and defence against mutant cells, ce lls infected by virus, or cells damaged due to other reasons depend heavily on apoptosis.[5]

- The epidermis- Nonkeratinocytic cells
  - "Melanocytes"

Melanocyte is a neural crest-derived dendritic, pigment-producing cell that is typically found in the basal layer of skin. Attachments of the melanocyte come into interaction in keratinocytes as they split into more superficial layers, but they do not link cellularly.

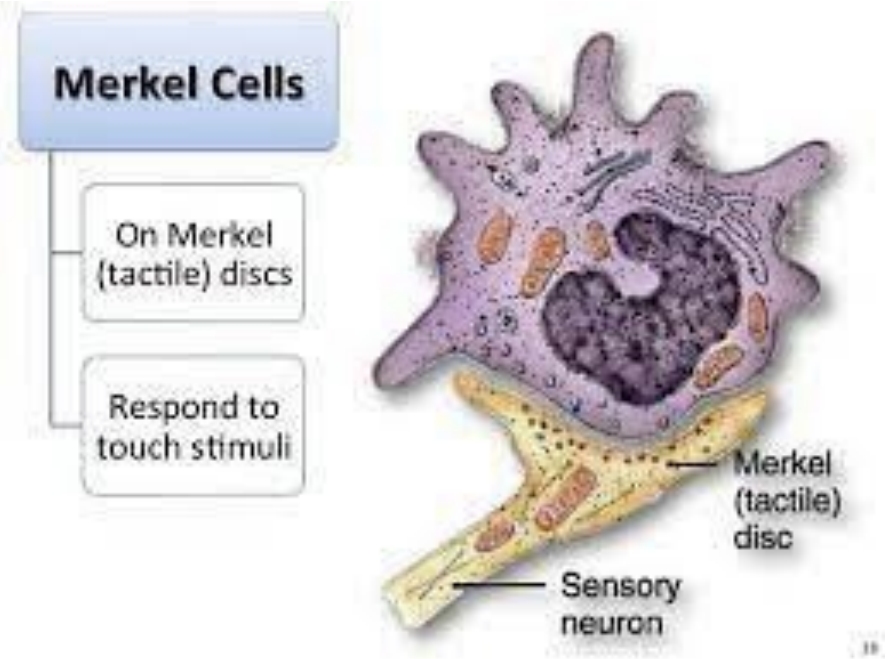


The generation of melanin and its delivery to keratinocytes is carried out by melanocytes. A chain of receptor-mediated, hormone-stimulated, enzyme-catalyzed events called the melanosome. Melanosome is a spherical, membrane-bound organelle which produces melanin.

Despite the fact that dark-skinned individuals' keratinocytes tend to remove melanosomes from these complexes more rapidly, these melanosomes form membrane-bound melanosome complexes with 2 or 3 melanosomes in white skin. There are several factors that contribute to strongly pigmented skin, including increased melanosome production in melanocytes, increased levels of melanization in melanosome, huge melanosome sizes, increased melanosome dispersion on keratinocytes, and slower rate of melanosome deterioration in comparison to fair skin.[6]

- "Merkel Cells"

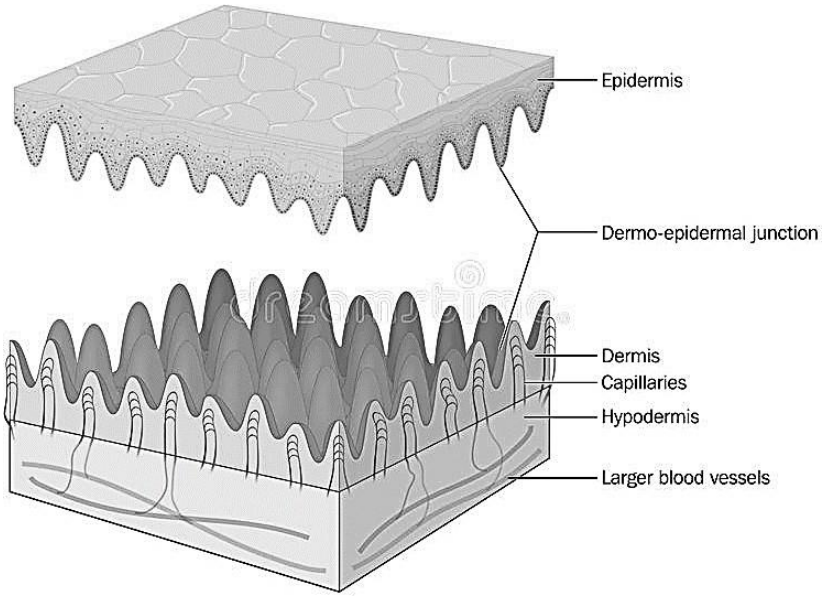
Desmosomal connections connect basal keratinocytes to the sluggish, type I mechanoreceptors with an oval form known as Merkel cells, which are found in areas with high tactile sensitivity. The hairfollicle's outermost root sheath, the lips, the oral cavity, and the digits all contain Merkel cells. Receptive fields are smaller and more tightly packed as a result of the greater density of Merkel cells in specific areas, like the fingers, which leads to improved tactile sensitivity and resolution.[7]



- "Langerhans Cells"

Different T-cell responses include Langerhans cells in varying degrees. These cells originate in the bone marrow. Then, early in embryonic development, they move to the parabasal region of the epidermis, and they flow and recolonise the epidermis throughout life. Langerhans cells make about for 2%-8% of all epidermal cells. Langerhans cells are responsible for identifying and processing soluble antigens present in epidermal tissue.[8]

THE DERMAL-EPIDERMAL JUNCTION

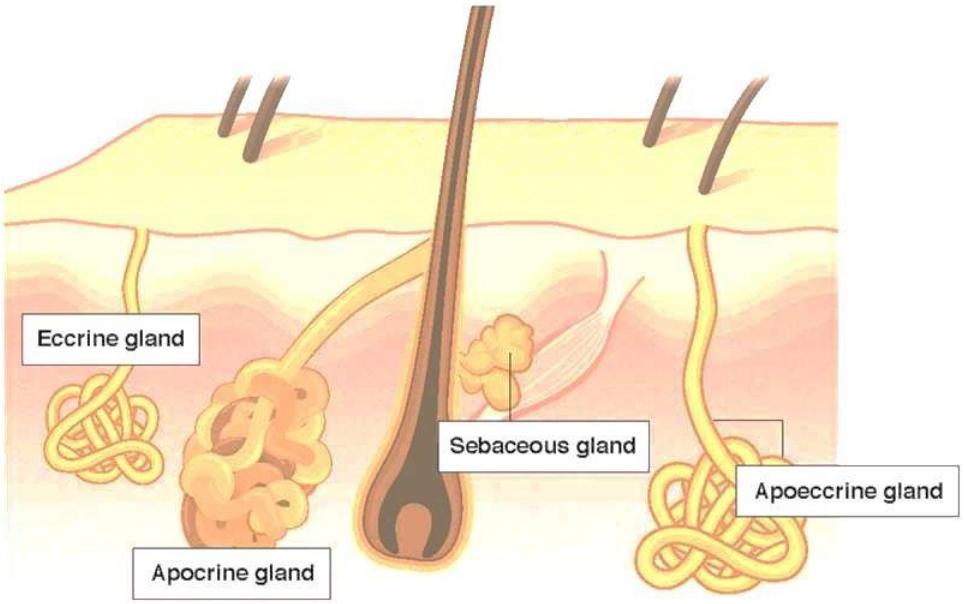


A porous basement membrane zone separates the epidermis and dermis and allows cells and fluid to flow while also holding the two layers together. The most crucial elements of subcutaneous junction structures are basal keratinocytes. The basal lamina is a layer comprised primarily of the type IV collagen, tethering fibrils, and dermal microfibrils that is formed by epidermal basal cells. Both the lamina densa and the electron-lucent lamina lucida fall within this category.

The dermal-epidermal interface organises the cytoskeleton in basal cells, acts as a permeability membrane between layers, supports the epidermis, controls cell polarity and growth direction, and conveys developmental signals.[9]

➢ Epidermal Appendages

The skin's appendages, which comprises of ducts, pilosebaceous units, eccrine glands, apocrine glands are a bunch of ectodermally derived appendages that appear as downgrowths from the epidermis. All adnexal structures can regenerate epithelium after damage thanks to keratinocyte migration from the adnexal epithelium to the epidermal surface.



- Eccrine Sweat Glands

The dorsum of the feet has the most number of eccrine sweat glands, which regulate body temperature, and the back has the fewest.A ring of epithelial cells that descends from the epidermal ridge contains the sweat glands.[10]

- Apocrine Sweat Glands

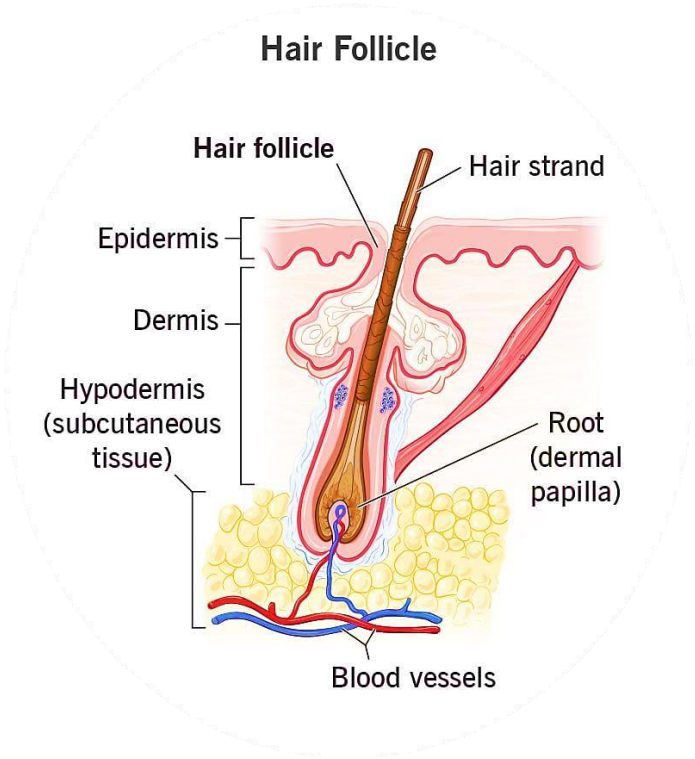
Apocrine glands emit smells, whereas eccrine glands mostly regulate body temperature. In humans Apocrine sweat glands are mostly found in the axillae and perineum. They start to develop their secretory components and are activated right before puberty. Hormonal stimuli are most likely what cause this activity. The sticky, proteinaceous discharge has an unique odour and can be used as a warning signal.[11]

- Apoeccrine Sweat Glands

Eccrine-like precursors emerge throughout puberty to create the apoeccrine sweat gland (AEG), which has an opening that faces the skin. “It was identified when human axillary sweat from individuals with axillary hyperhidrosis, a condition characterised by abnormally high rates of perspiration, was isolated.” Adult axillae are where the AEG is located. The AEG is considered to play role in development of axillary hyperhidrosis since it secretes more often than the eccrine gland.[12]

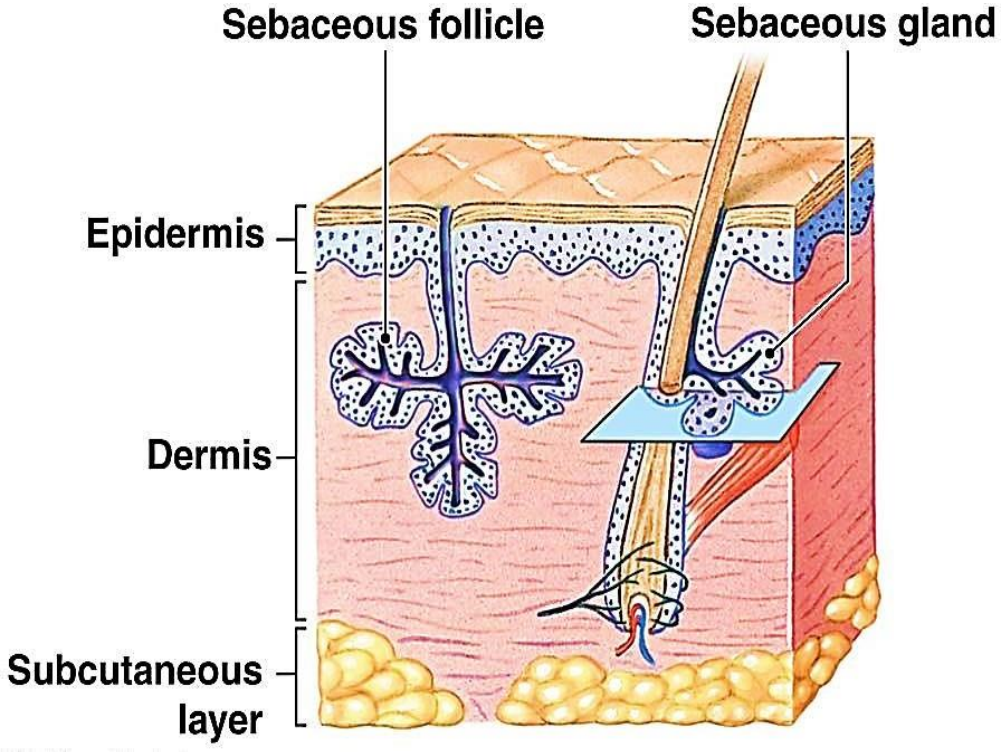
- Hair follicles

The biological benefits of hair include distribution of sweat-gland products and protection from the elements. Depending on where they are, hair follicles might differ greatly in size and shape, but they always share the same fundamental structure. No additional hair follicles are introduced after birth; throughout foetal development, the number and distribution remain constant.

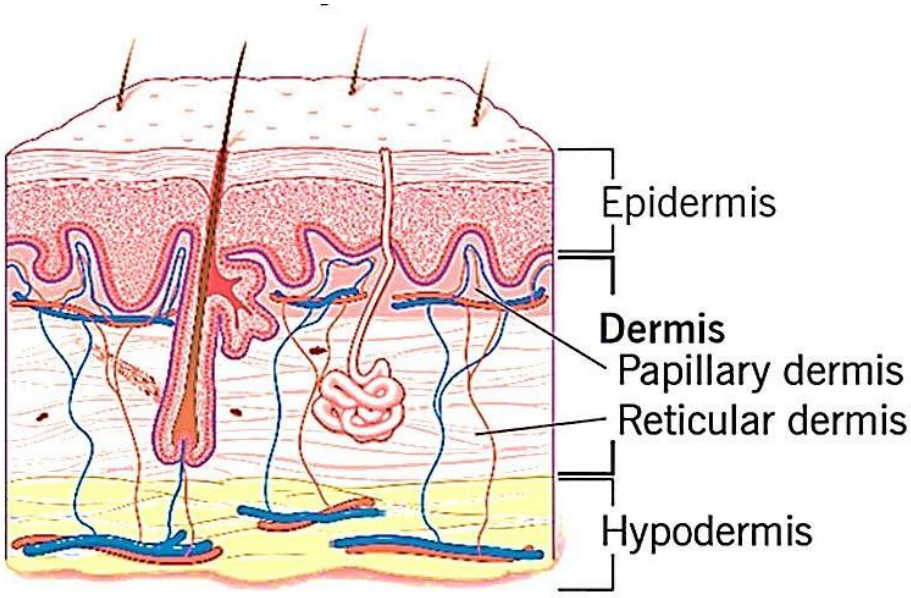


- Sebaceous Glands

Sebaceous glands are found on nearly every other region of the body with the exception of the tarsal plate of the eyelids, the buccal mucosa and vermilion margins of the mouth, the prepuce and mucosa adjacent to the penile frenulum, the labia minora, and the female areola.



2) Dermis



Dermis is a dense fibrous, polymeric, granular connective tissue. when stimulated, permits the entrance of fibroblasts, macrophages, mast cells, appendages produced from the epidermis, and nerve and circulatory networks.

The dermis, which makes up the bulk of the skin, is responsible for the skin's adaptability, suppleness, and compressive strength. It defends the body against mechanical damage, hydrates, helps regulate body temperature, and has sensory stimulation receptors. In order to maintain the characteristics of both tissues, the dermis and epidermis interact with eachother. [13]

- Vasculature

Subpapillary or superficial plexus, which is made up of postcapillary venules is situated at intersection of papillary, reticular dermis. The lower plexus is situated at the dermal-subcutaneous interface. Two intercommunicating plexuses make up the dermal vasculature. “Capillaries, end arterioles, and venules of the superficial plexus supply the dermal papillae”. The deeper plexus is supplied by larger blood arteries.

Due to the preoptic-anterior hypothalamus' control over blood flow, the human skin's response to heat stress changes significantly. Vasodilation, enhanced cutaneous blood flow, and perspiration are all necessary for heat dissipation during thermal stress and activity. Vasoconstriction in the skin prevents hypothermia by reducing heat loss from the body when it is exposed to cold.

- Nerves

The neurovascular bundles of the dermis contain numerous nerve bundles as well as arterioles and venules. Meissner corpuscles, which are present in the dermal papillae mostly on the front of the hands and feet, aid mediating touch. Meissner corpuscles are more common on the hands, with the fingertips having the highest density. Large nerve-end organs called Vater-Pacini corpuscles, which produce sense of pressure, are found in deeper layer of dermis of weightbearing surfaces and genitalia. Additionally, they are frequently encountered in nipple and anogenital area. Unmyelinated nerve fibres that terminate in the papillary dermis and hair follicles carry pain, temperature, and itch signals.

- "Mast Cells"

They are specialised cell found in connective tissues all over the body. They are formed from bone marrow. They can be found in the subcutaneous fat as well, despite being more prevalent in papillary dermis. They look as oval to spindle-shaped cells with a round to oval nucleus located in the centre, in the typical dermis. Recent research indicates that these cells, which have historically been linked to the allergic response, may also be able to control inflammation, host defence, and innate immunity.

Antigens or allergens can activate mast cells by binding to the highly compatible immunoglobulin E, superoxide, complement, neuropeptide, and lipoprotein receptors. Mast cells release leukotrienes, histamine, prostanoids, proteases, as well as a variety of cytokines and chemokines after becoming activated. These mediators might play a key role in how an inflammatory response develops. [14]

3) Subcutaneous fat

Fat cells start to form in the subcutaneous tissue at the end of the fifth month of development. These fat cell lobules, also known as lipocytes, are divided by fibrous septa comprised of collagen and big blood arteries. Depending on the location on the skin, the panniculus' thickness varies.

The layers of skin serve as a solid defence from the outside world, allow transmission of sensory information, essential for maintaining homeostasis. The skin's basic shear test is provided by collagen and the elastic fibres in dermal layer, whereas layer of subcutaneous adipose acts as the body's energy store. [15]

WOUND

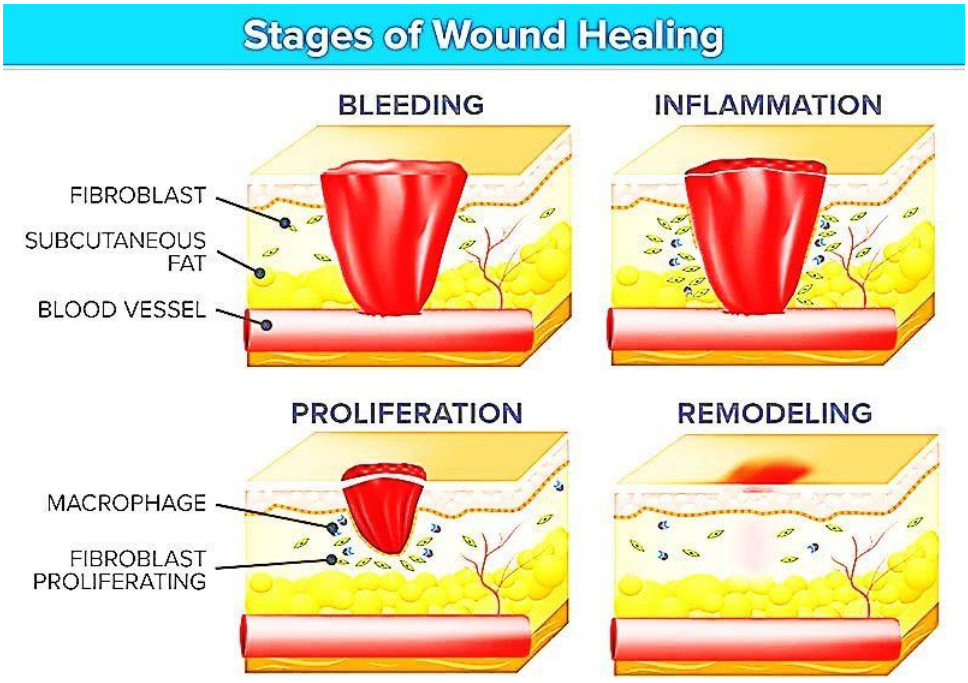
Basic science of wound healing[16]

"Wound is a break in the body's epithelial barrier that may change the underlying normal tissue's form and function". Anything from the surgeon's knife's precise tissue rupture (incision) to extensive tissue destruction may lead in a wound.

It is necessary to restore the skin's continuity as soon as possible since it is critical in maintaining homeostasis. Acute wound healing entails a complicated, dynamic, and well-planned chain of processes. A 'healed wound' is one:

- When the wound has fully recovered its epithelium and the connective tissues have healed.
- When the wound has recovered to its natural form and function, and requires no further drainage or dressing.

Few wounds do not heal within the expected time and in an organised manner, which causes chronic, non-healing wounds that must be managed indefinitely. Additionally, errors made during specific stages of the rehabilitative healing process could lead to overhealing.



Types of wound healing

- Primary healing (healing by first intention)

Primary healing is when a wound heals in 12 to 24 hours after being created. Different techniques are used to immediately approximate the wound borders. Simply put, the incision destroys a limited handful of epithelial cells, supporting connective tissue cells and thus disturbs the stability in epithelial basement membrane. As a result, fibrosis is outnumbered by epithelial regeneration. Additionally, wounds heal correctly and close quickly because all phases of the healing process are in perfect balance (including cellular proliferation, collagen metabolism, matrix metalloproteinase activity, and extracellular matrix disintegration).

When a filthy or poorly defined wound is closed after already being left open for a few days to prevent infection, delayed primary healing happens. Skin plus subcutaneous tissues are left unopposed and closure is performed after the wound has been debrided by host defences. Recruitment of local phagocytic cells in the wound begins after 3-4 days, and inflammatory cells kill contaminated bacteria. Even after many days, the wound boundaries can be approximated. Metabolism of collagen is undisturbed, as it maintains its mechanical properties as it had been instantly closed.

- Secondary healing (healing by second intention)

In wounds with significant soft tissue damage, such as those from severe burns, substantial trauma, or following some surgical procedures, secondary healing occurs (e.g. laparostomy). Granulation tissue develops from the wound edge because epithelial cell regeneration alone cannot recreate the original architecture. This tissue is then followed by extracellular matrix buildup and collagen placing. These open, full-thickness wounds heal through wound contraction and epithelialization.

Healing by Secondary intention is slow and more prone to contractures (especially around joints), and more likely to result in functional limitations.

- Healing of superficial (partial-thickness) wounds

Injury to epithelium plus surface layer of dermis from abrasions, split-thickness donor graft sites, and surface burns cure superficial (partial-thickness) wounds. Cells of dermal appendages, hair follicles, and sebaceous glands duplicate so it covers exposed dermis while cells of the basal layer migrate closely together to cover the wound. Cells in the basal layer are undamaged. The only process of healing, epithelialization, has almost entirely completed all physiological and anatomical restoration.

"WOUND HEALING-CELLULAR RESPONSES"

A. "Hemostasis"

"Hemostasis is the initial stage of healing process that stops bleeding after vascular injury". Three steps are

1) vasoconstriction

2)primary hemostasis

3)secondary hemostasis.

Platelet is a crucial component of this process, and fibrinogen is a crucial part of the matrix[17.] Vasoconstriction of the vessel walls happens as soon as there is a wound on the skin to stop the bleeding. "Next, two simultaneous and mechanically connected channels allow for primary hemostasis and secondary hemostasis to occur".

- Vasoconstriction

Vascular constriction immediately follows injury, stop bleeding from microvasculature. It is accomplished by vascular smooth muscle reflexively contracting, which is brought about by the release of vasoconstrictors such as endothelin by the injured endothelium. "Additionally, vasoconstriction is regulated by catecholamines, epinephrine, norepinephrine, and prostaglandins generated by damaged cells".[18]

- Platelet plug formation

The thrombogenic subendothelial matrix is exposed after injury and also sthere is rupture of blood vessels. "Platelets bind to this matrix via G protein-coupled receptors on their surface, activating the inside-out signalling cascade, which induces integrin activation and enhanced platelet attachment to other platelet."[19]

Outside-in signalling pathway is activated, that enhances platelet activity and modifies the actin cytoskeleton.

Activated platelets also emit chemicals that promote platelet aggregation, such as thromboxane A2. The "platelet plug" is created as a result of these events. [20], [21]

- Reinforcement and Coagulation of platelet plug

Conventional coagulation mechanisms are the extrinsic routes and intrinsic routes, both triggered by stimulation of subendothelial matrix which lead to factor X activation. Prothrombin is transformed into thrombin after factor X is activated by either pathway, and thrombin then cleaves fibrinogen to form fibrin. Factor XIII along with fibrin eventually forms secondary hemostasis plug or thrombus. In later stages of healing, the clot serves as a temporary matrix of wound for the invasion of several additional cells.

B. <u>The Inflammatory Phase of Wound Healing</u>

- Mechanisms of inflammatory cell recruitment

Transcriptional-independent pathways that are easily triggered are first activated by the wound. “These comprise purigenic molecules, reactive oxygen species (ROS) gradients, and Ca2+ waves. Injured cells also emit chemokines, hydrogen peroxide (H2O2), lipid mediators, and damage-associated molecular patterns (DAMPs), which serve as signals for the engaging of inflammatory cells”.[22]

- Neutrophils role-

Neutrophils are frequently invisible. “Promyelocytes in bone marrow create DAMPs, hydrogen peroxide, lipid mediators, chemokines, and other signals that are released from injury or infection sites and recruited as "first responders" from the bone marrow”.[23]

By releasing proteases from their intracellular granules, neutrophils fight infections. Additionally, they create NETs, or neutrophil extracellular traps, which are used to acquire pathogens using a method known as NETosis.

- Macrophages in wound healing

Macrophages emit pro-inflammatory cytokines like interleukin (IL)-6, tumour necrosis factor (TNF), and IL-1 to combat infection after a wound during the inflammatory phase of recovery. Dead neutrophils being ingested by macrophages after the inflammatory stage of wound healing is over.[24]

- Mast cells in wound healing

Several different cell types interact with mast cells during the healing of wounds. [25] They generate antimicrobial peptides which guard against skin infections during initial phases of wound healing. It produces histamines plus VEGF, which increase vascular permeability, enable neutrophil inflow, as well as the enzymes chymase, tryptase, which are crucial in the break-down of the extracellular matrix.[26]

Scarring and skin fibrosis are linked to an increase in mast cell counts.

- “Dendritic cells”

Dermal cells and Langerhans cells are both common during skin infections in skin-draining lymphnodes. It goes from epidermis to the dermis and into draining lymphnodes to start a T cell-mediated adjustment. [27]

C. "Wound Healing in growth phase"

- Granulation tissue and neovascularization formation

One of crucial phases of healing wound is the development of new blood vessels. "Vascular endothelial growth factor (VEGF) and other growth factor signals from epidermal cells, macrophages, subcutaneous adipose tissue cause the leading edge or tip endothelial cells to "sprout" or branch out to create new capillaries". During phase of angiogenesis, endothelial cells are permeable, allowing circulating cells and immune cells to extravasate from the blood vessel lumen into the wound. Growth factors for endothelial cell development are released by pro-angiogenic macrophages, which also fuse newly formed capillaries. They disappear when the wound heals. [28]

- New vessel and Endothelial cells formation

"Microvascular cells cover the inside of blood vessels and are the main kind of cell involved in the development of new vessels". "In reaction to pro-angiogenic signals such VEGF, FGF, PDGF-B, TGF-, and angiopoietins, endothelial cells sprout, multiply, and migrate to begin angiogenesis". [29]

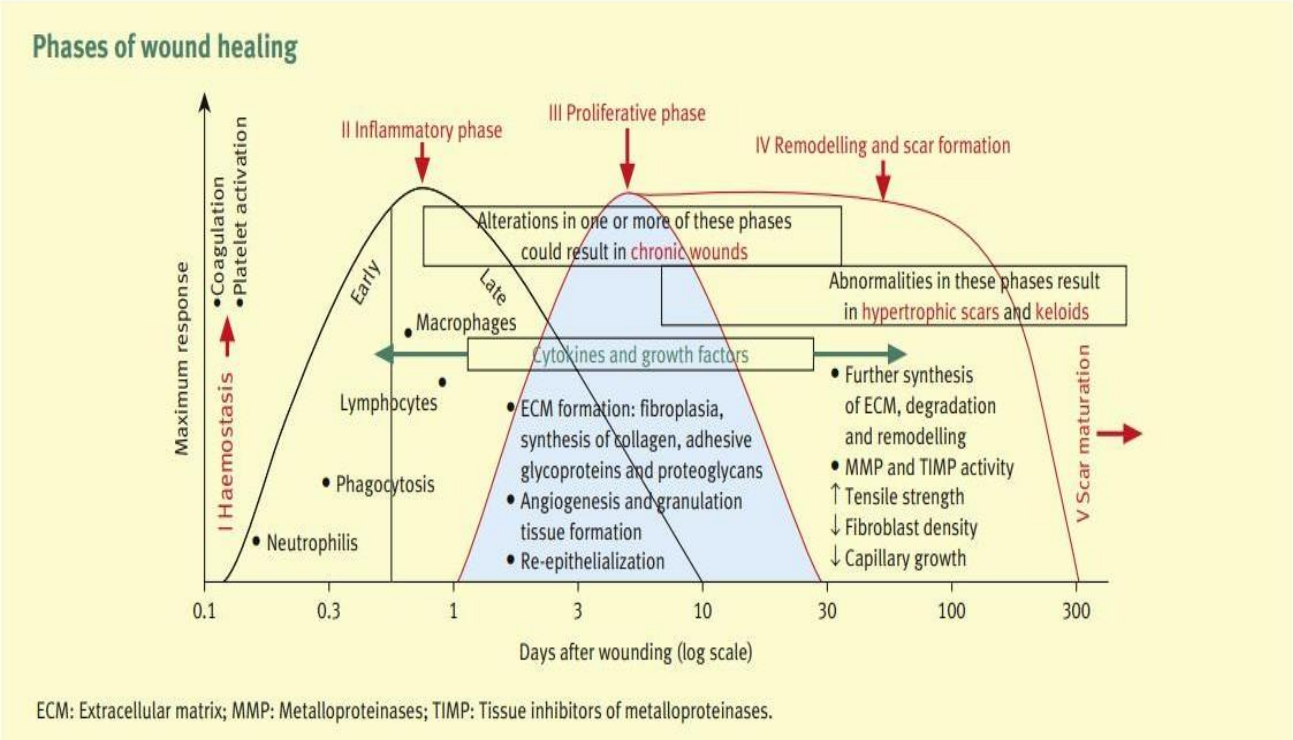
- "Pericytes in neovascularization and wound healing"

In blood vessels, pericytes encircle endothelial cells and perform crucial roles such as microvasculature instability and stabilization, blood flow modulation, and bacterial barrier formation. Pericytes are essential for wound healing because of these capabilities.

- Re-epithelialization

In healthy skin, the epidermis has many layers, the lowest of which is connected to the underlying membrane via the basal layer. Keratinocytes of the spinal and granular layer are made up of stem cells that are K14+/1-integrin positive, divide, and mature in this layer. The cells that make up the stratum corneum, the outermost layer, are cornified and impermeable. [30]

CELLS INVOLVED IN WOUND HEALING	
CELL TYPE	FUNCTION
PLATELETS	Thrombus formation Major stimuli for inflammation Alpha granules-Rich source of inflammatory mediators
Neutrophils	Primary to enter the wound site Phagocytosis & intracellular killing of bacteria
Monocytes (Macropghages)	Phagocytosis necrotic tissue, Clear debris Rich source in inflammatory mediators “Fibroblast division, collagen sysnthesis, angiogenesis”
Lymphocytes	Cytokines production in different types of wound
Fibroblasts	Collagen Producer, fibronection, hyaluronic acid in extracellular matrix Synthesis of granulation tissue



ECM: Extracellular matrix; MMP: Metalloproteinases; TIMP: Tissue inhibitors of metalloproteinases.

Local and systemic factors that impede wound healing

A variety of reasons can contribute to poor wound healing. These can be divided as: local and systemic.

Local factors affect the wound's appearance right away, whereas systemic factors, like the person's overall health or illness status, affect how well the person will recover. Many of these components interact with one another and affect wound healing.

I. Locals Factors Influencing Healing of wound [31]

- "Oxygenation"

"Oxygen is essential for cell metabolism, particularly energy synthesis via ATP, and is required for practically all wound healing processes. It protects wounds from infection, stimulates wound contraction,

produces angiogenesis, increases keratinocyte differentiation, migration and re-epithelialization, boosts fibroblast proliferation and collagen synthesis". It also decreases infection.

Numerous systemic conditions, including diabetes and ageing, can impair arterial flow, setting the scenario for insufficient tissue oxygenation. The correct oxygen concentration is essential for wound healing. By enhancing the release of growth factors and angiogenesis, hypoxia accelerates wound healing, although oxygen is necessary to maintain the healing process.

- Infections

When the skin is wounded, microorganisms that are normally restricted to the surface of skin reach deeper tissues. Bacterial site infection and multiplication status determine whether a wound is classified as dirty, colonised, local infection/critical colonisation, or spreading invasive infection.

II. Systemic Factors That Influence Healing [32]

- Age

Ageing is main risk factor for slower healing. A great deal of cellular and molecular, clinical and animal research has examined age-related changes and delays in wound healing. It is widely acknowledged that the result of ageing produces a temporal halt in wound healing in healthy older persons

- Stress

"The sympathetic nervous system, which is primarily composed of the hypothalamic-pituitary-adrenal (HPA) and sympathetic-adrenal medullary axis, is what causes the immune system to become dysregulated as a result of the pathophysiology of stress". The normal cell-mediated immunity at the location of the wound is compromised by psychological stress, significantly delaying the healing process. Stressors can cause negative emotional states like despair and anxiety.

- Diabetes

Diabetes mellitus is a complex condition that exacerbates the complications of severe illness. It has a specific impact on wound healing, producing delayed healing and an increased risk of infection. Diabetes comorbidities, such as macrovascular, microvascular, and neuropathic disorders, have an additional impact on wound healing. [33]

- Medications-

- Glucocorticoid Steroids

By stabilising neutrophil lysosomes, triggering anti-inflammatory proteins, and preventing cytokine production and chemotaxis, corticosteroids have an impact on wound healing. Fibroblast dysfunction, decreased collagen synthesis, angiogenesis, re-epithelialization, and decreased wound tensile strength are further impacts. Care should be taken to avoid corticosteroids wherever possible. [34]

- Non-steroidal Anti-inflammatory Drugs

Nonsteroidal anti-inflammatory medications are generally affordable and frequently used for pain management. Selective cyclooxygenase 2 inhibitors like celecoxib and valdecoxib are other drugs in the same class. Prostaglandin E2, a lipid mediator of inflammation in the healing process of wounds, is inhibited by their method of action. Blood vessel antiproliferative effects have been shown in animal experiments to slow the process of repair. Nonsteroidal anti-inflammatory medications and selective cyclooxygenase 2 inhibitors should be used cautiously due to the inhibition of inflammation being a crucial part of wound healing. [35]

- Chemotherapeutic Drugs

Chemotherapeutic drugs hinder wound healing in addition to killing quickly dividing cancer cells. Decreased fibrin deposition and collagen production, a delayed inflammatory phase of healing, and a delayed wound contraction are only a few possible effects. Capecitabine is an illustration of an oral chemotherapy drug. Malignancies and autoimmune illnesses are both treated with methotrexate, an oral immunosuppressant and chemotherapeutic drug. The disease-modifying antirheumatic medications methotrexate and azathioprine, which are frequently administered for autoimmune illnesses, may all have a detrimental effect on wound healing. [36].

- Obesity

Obese persons may be more likely to develop a surgical site infection due to the hypoperfusion of their subcutaneous adipose tissue. This is probably due to a higher risk of ischemia and

necrosis as well as impairments in the leukocyte oxidase system. Phagocytosis is followed by a spike in oxygen consumption in the typical, unimpeded process, and this coincides with bacterial death. The host's defence system's bactericidal processes depend on this oxygen consumption to function.

Due to altered immune mediator populations and circulatory inadequacies, which may extend the inflammatory stage of wound healing, obese patients are more susceptible to infections. Wound healing is also slowed down in obese individuals due to macro- and micronutrient deficiencies. [37]

- Alcohol Consumption

By slowing early inflammatory response, alcohol prevents wound closure, angiogenesis, decreasing collagen formation, and changing the protease balance at the wound site. Acute ethanol exposure can result in poor wound healing. [38]

- Smoking

Although substantial controlled research has not yet been conducted, it is widely accepted in clinical practice that smoking delays wound healing. Effects of nicotine, carbon monoxide, hydrogen cyanide—three dangerous components of cigarette smoke—point to potential mechanisms by which smoking can slow down the healing of wounds. Because nicotine is a vasoconstrictor, which lowers the amount of blood that carries nutrients to the skin, it prevents wounds from healing. Tissue ischemia is the effect of this. Smoking also makes platelets stickier, which raises the risk of ischemia damage and thrombotic microvascular blockage. Nicotine also inhibits the growth of fibroblasts, macrophages, and red blood cells. Carbon monoxide decreases oxygen transport and metabolism, but hydrogen cyanide disables the enzyme systems necessary for oxidative metabolism and oxygen transport at the cellular level. Clinical investigations have demonstrated that smokers' wounds heal more slowly after surgery, illness, or trauma. [39]

- Nutrition

A healthy diet is essential for wound healing. The natural mechanisms that enable development through the phases of wound healing are prevented by malnutrition. Malnutrition has also been connected to lower scar tensile strength and greater infection rates. Malnourished patients are more likely to develop chronic, non-healing wounds as a result of ulcers, infections, and delayed wound healing. The fact that several patients' chronic wounds are a substantial cause of morbidity and death is a major clinical problem. Current nutrition therapies focus on the deficiencies that cause delayed wound healing since malnutrition and decreased micronutrient status are frequent in people with recurrent skin ulcers. [40]

SURGICAL SCAR

There will always be a scar after a surgical incision. The scar's final appearance after development is what matters, though. The ideal scar should be barely noticeable, match the surrounding skin's tone appropriately, and neither be elevated nor inverted. Preoperative planning of incision, tension during closure of wound, postoperative treatment are all essential for achieving the optimum scar result. [41]

- Factors related to patient that affect scar formation [38]
  - Intraoperative care
    - Planning of incision and Handling of tissue

Incisions should be designed to match relaxed skin tension lines as much as possible. Incisions near the intersection of facial subunits should be planned carefully to reduce scar appearance after healing

When incisions must be made close to hair-bearing regions, the scar can be effectively concealed by beveling incision so hair can develop between it.

- "Closure of wound"

The borders of the wound are often kept apart by skin tension, which frequently retards scar repair. The body tries to shut the wound more securely in an effort to release stress, but this causes more scarring and small collagen deposits to form. Thus, it is necessary to weaken the tissue. When possible, placing sutures in multiple layers will lessen the tension at the wound's surface where the scar is evident.

- Wound care Postoperatively
  - Postoperative Period - Immediate

Most crucial things to remember in the period following of surgery are to keep the incision wet, avoid infection, and reduce inflammation. While the tissue itself is mending the wound, each of these aspects needs to be kept under observation. In order to speed up the skin's healing, maintain the wound tidy and regularly clear off any blood or crust.

- One Week After Surgery

The majority of nonabsorbable sutures are taken off after one week. Tape can be used to the incisions to alleviate strain while the sutures are taken out. Keeping the wound wet is still crucial at this point. Using alternative occlusive ointments, such Aquaphor, may hasten the healing process, for wounds that really are healing well and exhibiting no signs of infection.

- Postoperative Care - First Few Months

✓ Topical applicant

If not previously done so, all sutures should be taken out by the end of the second week. Many medical professionals will now emphasise the value of utilising silicone sheets and gels to prevent hypertrophic scarring.

✓ Dermabrasion

Diamond burns, wire brushes, or sandpaper can be used in dermabrasion to smooth out blend the skin's level in the elevated portion in scar. The goal is to damage the papillary dermis while protecting the deeper layers of skin in order to promote re-epithelialization and the production of new collagen. Scarring is significantly more likely to occur following any injury to the reticular dermis or deeper than the papillary dermis.

Various types of scars

These are large, spherical, asymmetrical clusters of scar tissue that appear at the location of a wound but extend past its limits. In contrast to the nearby normal skin, they frequently appear red or deeper in colour. Keloids develop from collagen that the body produces after a cut has healed. The chest, back, shoulders, and earlobes are where they appear most frequently. People with darker skin tones experience them more frequently. [42]

- Complications of surgical scar

Pathological scars having functional, cosmetic, or psychological consequences are examples of surgical incision complications. For a complete functional assessment and as a measure of the result, the evaluation of postoperative scars is essential.[43,86]

- Physical characteristics

Physical properties are crucial for preserving physiological and mechanical functions of skin. Excessive either thickness or relief, constriction, extension of the overall area, a lack of pliability can all result in scar contractures, lack of motion, or weakening of the muscles. Because of this, determining these criteria reliably forecasts the functional outcome of scars.[44,87]

- ✓ "Thickness/height- Scar thickness, which is calculated as the mean distance between both scar's epidermal surface and subcutical-dermal boundary, is linked to hypertrophy".
- ✓ "Relief/irregularity- The extent of surface abnormalitie when compared to surrounding normal skin is referred to as relief". Subjective scales can reliably assess the degree of irregularity; equipment to assess

the irregularity of skin surfaces (profilometers) were created solely for use in the cosmetic sector and have not been investigated in the evaluation of scars.

- ✓ Surface area - parameter specifies scar's surface area, which can be reduced or expanded in respect to the initial wound area. Planimetry is the term used for measuring surface area, and the most popular procedures include drawing scar borders on clear plastic film and planimetry through photography.
- ✓ Pliability/texture/stiffness- A mechanical characteristic of skin stiffness and extensibility called pliability reflects the biochemical and anatomical characteristics of the scar. Pliability is described by adjectives like texture, suppleness, rigidity, scar flexibility, suppleness, and the amount of pressure needed to stretch the skin.
- ✓ Colour- The skin's vascularity and pigmentation dictate scar colour, which can be changed by healing time.

- Cosmetic Defects- Cosmetic imperfections can cause victims bodily and psychological distress. Scar deformation is most disfiguring effects, especially on exposed skin areas like forearms or face. The presence of a shiny surface and/or hatch marks from prior staples or sutures are further considerations.
- Symptoms of patient

Itching, discomfort are the main signs of scar healing. However, no long-term prospective studies have been carried out to document their nature and extent. The word "tender" is used to describe scar-related pain the most. Patients also frequently use the terms "shooting," "sharp," "aching," and "heavy" pain as additional descriptors.[45]

Scar assessment Rating scales [46]

- ➢ “Vancouver Scar Scale”

“The VSS is also known as Burn Scar Index. Four physical characteristics scored are: height, pliability, vascularity and pigmentation”. “Each of these variables include ranked subscales that are added to obtain a total score ranging from 0 to 13, with 0 representing normal skin”.[46,88]

Vascularity	Normal	0
	Pink	1
	Red	2
	Purple	3
Pigmentation	Normal	0
	Hypopigmentation	1
	Hyperpigmentation	2
Pliability	Normal	0
	Supple	1
	Yielding	2
	Firm	3
	Ropes	4
	Contracture	5
Height	Flat	0
	<2 mm	1
	2-5 mm	2
	>5 mm	3
Total score		**13**

- Manchester Scar Scale

The MSS includes six items: contour, texture, colour, distortion, shiny surface and overall patient's opinion. Each of the first four parameters is given a score between 1 and 4. Whether a scar is matte or shiny

is recorded (1 and 2 points, respectively), and the patient's overall opinion is measured on a 0-10 VAS. The total score is obtained by summing the six items; higher values indicate worse scars. [47]

Category	Visual analog scale descriptor	Poor
Color	Perfect	1
	Slight mismatch	2
	Obvious mismatch	3
	Gross mismatch	4
Matte *vs* shiny	Matte	1
	Shiny	2
Contour	Flush with surrounding skin	1
	Slightly proud/indented	2
	Hypertrophic	3
	Keloid	4
Distortion	None	1
	Mild	2
	Moderate	3
	Severe	4
Texture	Normal	1
	Just palpable	2
	Firm	3
	Hard	4

- Patient and Observer Scar Assessment Scale

It made up of two numerical scales: The Patient Scar Assessment Scale (patient scale) and the Observer Scar Assessment Scale (observer scale) (observer scale). Both the patient and the observer must fill

out the patient and observer scales. The consistency, reliability, and feasibility of the patient and observer scales were evaluated. [48,78]

Observer component*	Normal skin					Worst scar imaginable				
	1	2	3	4	5	6	7	8	9	10
Vascularity	○	○	○	○	○	○	○	○	○	○
Pigmentation	○	○	○	○	○	○	○	○	○	○
Thickness	○	○	○	○	○	○	○	○	○	○
Relief	○	○	○	○	○	○	○	○	○	○
Pliability	○	○	○	○	○	○	○	○	○	○
Surface area	○	○	○	○	○	○	○	○	○	○
Overall opinion	○	○	○	○	○	○	○	○	○	○
Patient component	**No**					**Yes**				
	1	2	3	4	5	6	7	8	9	10
Is the scar painful?	○	○	○	○	○	○	○	○	○	○
Is the scar itching?	○	○	○	○	○	○	○	○	○	○
Is the color of the scar different?	○	○	○	○	○	○	○	○	○	○
Is the scar more stiff?	○	○	○	○	○	○	○	○	○	○
Is the thickness of the scar different?	○	○	○	○	○	○	○	○	○	○
Is the scar irregular?	○	○	○	○	○	○	○	○	○	○
Overall opinion	○	○	○	○	○	○	○	○	○	○

*In observer component, all parameters consisted of additional category: Vascularity: pale, pink, red, purple or mix; Pigmentation: hypopigmentaion, hyperpigmentaion or mix; Thickness: thicker or thinner; Relief: more, less or mix; Pliability: supple, stiff or mix; Surface area: expansion, contraction or mix.

- Stony Brook Scar Evaluation Scale

Singer et al. created the Stony Brook Scar Evaluation Scale (SBSES) in 2007. It takes into account five scar indicators: width, elevation or depression, colour, suture or staple marks, and overall appearance.[89] Each indicator is given a score ranging from 0 to 5. The sum of these points yields the final score. SBSES has consistently showed evaluator dependability ranging from 0.73 to 0.85. It did not, however, include subjective factors in its scar assessment. [49]

Scar category		Score
Width	>2 mm	0
	≤2 mm	1
Height	Elevated or depressed	0
	Flat	1
Color	Darker than surrounding skin	0
	Same color or lighter than surrounding skin	1
Suture marks	Present	0
	Absent	1
Overall appearance	Poor	0
	Good	1
Total score	(Out of 5)	

- Southampton wound grading system

One of the most often used wound rating systems is the Southampton wound grading system. It allows surgical wound healing to be assessed based on particular criteria and assigned a numerical value, providing a more objective assessment of wounds. [50]

SOUTHAMPTON WOUND GRADING SYSTEM

GRADE	APPEARANCE
0	**Normal healing**
I	**Normal healing with mild bruising or erythema**
Ia	Some bruising
Ib	Considerable bruising
Ic	Mild erythema
II	**Erythema plus other signs**
IIa	At one point
IIb	Around sutures
IIc	Along wound WWW.OPENMED.CO.IN
III	**Clear or haemoserous discharge**
IIIa	At one point only (< 2cm)
IIIb	Along wound (>2 cm)
IIIc	Large volume
IV	**Pus**
IVa	At one point only (< 2 cm)
IVb	Along wound (>2 cm) WWW.OPENMED.CO.IN
V	**Deep or severe wound infection with or without tissue breakdown; hematoma requiring aspiration**

SUTURE MATERIAL [51]

- The word suture originates from the Latin sutura, which would be translated as "a stitched seam." Various materials have been used to simulate wounds and serve as ligatures, including cotton, linen, horsehair, animal tendons, and precious metal wire. The extremely complicated items that we presently use in our practise are the result of several adjustments made over time.
- Suture Characteristics

Sutures feature a number of well-established benefits, such as the greatest predicted tensile strength within size restrictions, improved handling characteristics, and safe knot tying. A surgeon gradually develops suture preferences unique to their practise based on their understanding of tissue healing, the physical and biological properties of surgical sutures, as well as variables including infection, biofilm development, and multi-resistant bacteria. A number of chemicals are applied to contemporary suture materials to enhance their visibility, maneuverability, and antibacterial qualities. [52]

Size and Tensile Strength

Stitches are used to approximate tissues without applying too much tension, minimising tissue damage and ischaemia. The wound strength gradually rises over many weeks or months as the wound heals, reaching the tissue's initial tensile strength. No matter how many layers are present in the wound, utilise the smallest suture size or diameter necessary to complete the work at hand to lessen the amount of foreign material left behind and tissue strain brought on by each needle passage. A balance among suture size and tissue reapproximation must be struck since smaller-diameter sutures have lower tensile strength.

Multi- and Monofilament Sutures

A suture's composition is crucial to take into account whether it has one or more strands, especially when weighing the necessity for higher tensile strength against the danger of bacterial adherence. Monofilament sutures are less likely to tolerate organisms, present a reduced barrier to tissue flow, and tend to tighten up more quickly. [53]

When multiple threads are woven together to create the multifilament suture, more tensile strength, elasticity, and flexibility are delivered.

TYPES OF SUTURE MATERIAL: [54]

SILK-

Silk was commonly utilised as a suture material in the 1890s. Silkworm larvae manufacture it as protein fibres, resulting in braided material.

Silk absorbs slowly and takes two years to disintegrate in tissue. Silk possesses superior knot-tying and handling characteristics when compared to other suture materials. It has a poor tensile strength and a strong tissue reactivity. As the braided material becomes penetrated by cells, suture removal is really challenging and painful

NYLON-

In 1940, it was the debut of the first synthetic suture material. It comes in monofilament and multifilament varieties.

When opposed to multifilament forms, which have no tensile strength, monofilament forms maintain up to two-thirds of their initial strength.

The multifilament variant provides superior handling qualities and tissue responsiveness.

POLYPROPYLENE-

A monofilament artificial suture called polypropylene was first utilized in 1962. It has poor handling and knot security qualities because to its rigidity. It has a large memory. Polypropylene has an exceptionally low tissue reactivity. For proper knot security, an additional throw is required. Polypropylene can be utilised for long-term cutaneous support via buried suture.

CYANOACRYLATYE-

Airdis was the first to synthesise it in 1949. Later on, Coove et al.detailed the adhesive qualities and suggested applications for them medical adhesives Cyanoacrylates are synthetic, solvent-free adhesives. They are monomer liquids that polymerize on the surface where it is applied, resulting in a persistent polymer film . It has an antibacterial and water-resistant layer and produces a superb cosmetic result. As a result, no postoperative visit is required. It is sprayed as a thin layer on top of the entire wound and bond creation generates heat on the skin. [55]

"ADHESIVE GLUE"

Cyanoacrylates are used commercially as a fast-acting glue with a high bonding capacity. In 1949, Airdis was the first to synthesise it. Cyanoacrylates have been described as an adhesive and in surgical procedures by Coover et al. Cyanoacrylates were widely used by US forces in Vietnam and saved many lives. It was later approved by the FDA for wound management.

To make cyanoacrylates, alkyl cyanoacetate is combined with formaldehyde to form a prepolymer. When heated, this prepolymer becomes a liquid monomer. The monomer can be changed to produce compounds with varying side chain lengths by modifying the alkoxycarbonyl (-COOR) group. When the monomer is exposed to living tissues, it undergoes exothermic hydroxylation, which results in glue polymerization. Shorter chain derivatives have higher tissue levels. [56]

N-Butyl Cyanoacrylate

It is a cyanoacrylate ester of 2-cyano-2-propenoic acid butyl ester. It has a strong, unpleasant smell and is clear and colorless. It is not soluble in water. This chemical is mostly used as an ingredient in medical sticky glues. Isobutyl cyanoacrylate and octyl cyanoacrylate are two more compounds used in medicine. They are bacteriostatic and are typically painless to use. The relationship Butyl esters are both stiff and powerful. It is soluble in acetone, nitromethane, and methylene chloride. When the monomers are exposed to moisture, blood, or tissue fluid, they polymerize very fast.[57]

Other unique properties of butyl cyanoacrylateb are[58]

- Best for surgical incision closure, the tensile strength is excellent.
- Bacteriostatic property
- Quick application
- It can also be used to embolize arteriovenous malformations in the brain.
- It is degraded by the body, which aids in the development of nano medicines with sustained release patterns.
- They're also used to treat esophageal, duodenal, gastric, and colonic varices by use of endoscopy.

“Adhesive tapes”

Adhesive tapes or strips have been used to seal surgical wounds since the 1500s. In France, Pare was the first to describe adhesive tapes. Following trauma, he utilised adhesive plaster strips to patch up face wounds. As a result, the wound's margins were joined and splinted. Much study has been done since then. They are now porous paper tapes that ensure appropriate wrapped edge apposition. They also give strength once sutures or sticky glue have been applied. Benzoin tincture is commonly used to improve tape adherence.

Laparoscopic surgery

Laparoscopic surgery is a surgical method in which small (less than one centimetre) incisions are used to insert short, narrow tubes (trochars) into the belly. Long, slender instruments are introduced via these trochars. These instruments are used by the surgeon to manipulate, cut, and suture tissue. [59]

One needs to get used to such a new set of techniques and tools, as well as know when to employ these and when to switch to an open method, in order to become a good laparoscopist.

- **Patient Considerations**

Patient Selection

The initial step in each surgery is to select the best operation for the patient. Because all abdominal laparoscopic surgery done under general anaesthesia, patient should have capacity to tolerate anaesthesia. Patients with reduced exercise tolerance or a history of shortness of breath will needs fitness from cardiologist or pulmonologist prior to surgery.

Patients with history of carbon dioxide retention can be challenging to handle intraoperatively as using carbon dioxide for pneumoperitoneum worsens the problem. One can achieve this by lowering the CO2 pneumoperitoneum from 15 to 10 mmHg.

We can utilise nitrous oxide for peritoneal dialysis in order to reduce hypercarbia without preventing combustion (as does carbon dioxide),Nitrous oxide (N2O) has been found to assist combustion no more than air.

When determining if a patient is fit candidate for a laparoscopic surgery, it is important to consider any procedure or patient factors can make procedure take longer than expected, negating any benefits of laparoscopy. It is not advisable to proceed laparoscopically if the procedure takes noticeably longer than the open counterpart or poses a greater risk. Access to the abdomen may be challenging if there is a history of one or more open procedures.

In the surgical field, adhesions and scarring from previous operations might also be exceedingly challenging and may call for the deployment of numerous unique and dissecting instruments. Operating on people who are extremely obese is problematic in particular because surgeon fatigue is caused by twisting on transabdominal ports and decreases surgical skill. Laparoscopic surgery may be difficult to perform due to the extended distance from the abdominal wall to the abdominal organs. To get around this challenge, there are specialised long ports and tools available. [60]

Laparoscopic surgery is not possible in the absence of a suitable operating room.

Patient Positioning

In order to provide exposure, we rely on the abdominal contents retracting due to gravity. As with open surgery, care is taken to avoid nerve problems or neuropathies following laparoscopic surgery. Sometimes this calls for abrupt positioning changes.

Before the treatment begins, patients must be appropriately positioned, with all pressure points cushioned. When the patient is being held in place by a retractor as the table is "airplaned" to the side, lateral pressure at the knee might induce perineal nerve damage. In that they are brought on by compression, femoral and sciatic neuropathies are comparable. By cushioning the retractor arms and attaching the patient to the table, these neuropathies can be prevented.

The arms should be tucked during the bulk of laparoscopic procedures so that the surgeon may easily move up and down the table to place instruments and target tissue. This is critical for pelvic surgeries since the surgeon will want to line with the opposite thorax. When extending the arms on arm boards, one must exercise extreme caution to avoid injury to the brachial plexus, which occurs when the arm is extended beyond 90 degrees at the shoulder. Typically, the arm position is stable at the start of a procedure but may change as the patient descends onto the table.

When reverse Trendelenburg is anticipated, we put footplates there. This stops patient from slipping on the table and does not make the patient uncomfortable because it is similar to standing. In order to prevent the ankles from "twisting" during the treatment, we also bind them. When working on the upper legs of split-leg tables, footplates are accessible.[61]

Patient Preparation

After laparoscopic surgery, deep venous thrombosis may occur more frequently, which may be caused by blood pooling in the lower extremities' venous system. The compression of the iliac veins caused by the pneumoperitoneum's increased intraabdominal pressure reduces venous return. Furthermore, positioned patient in a steep reverse “Trendelenburg position”, which has positional implications that cause the venous system to become even more dilated.

Sequential compression devices should be placed before all patients undergoing laparoscopic surgeries in reverse Trendelenburg, especially brief procedures like laparoscopic cholecystectomy. This, however, does not fully restore femoral blood flow. Patients at high risk of developing deep venous thrombosis should be given subcutaneous anticoagulants such as fractionated or unfractionated heparin. Patients undergoing extensive procedures, those who are obese, those who have a history of deep vein thrombosis or pulmonary embolism, and those who have a difficulty with delayed postoperative ambulation should all be aware of this.

Postoperative nausea and vomiting are quite common after laparoscopic surgery. According to a recent study, serotonin receptor antagonists such as ondansetron appear to be the most effective and should be considered for regular prophylaxis. Another prospective, blinded, randomised study found that giving low-dose steroids to all patients improves postoperative nausea and vomiting. [62]

- **ABDOMINAL WALL ANATOMY**
-

Pathology-related basic anatomy and function

The bulk of the complex tissue that makes up the abdominal wall is made up of muscle, bone, and fascia. Its major function is to protect the gastrointestinal and urogenital systems, but it also serves a secondary function in mobility by allowing it to bend, lengthen, rotate, and alter capacity. Flexibility requires stretch and elasticity, which weakens the abdominal wall.

The diaphragm, which separates the abdomen from the thoracic cavity below with positive pressure, forms the roof of the abdomen. Much of the bowel may be pulled into the chest through this pressure

gradient if the diaphragm is weak. “The perineum, a muscular core section of the pelvis, may weaken and cause the rectum, bladder, and gynecological organs to bulge downwards, a condition known as prolapse. The bony pelvis serves as the cavity's floor”.

“A transverse computed tomography (CT) scan through the mid abdomen is the most effective way to visualize the general structure of the abdominal muscles. The spinal column, ribs, and pelvis provide additional support for the posterior muscles, which are strong. Areas of weakness that can result in uncommon lumbar hernias are represented by two areas known as the posterior triangles”.

Three small muscle layers cross laterally, providing flexibility and strength. Surgeons can use these layers to enhance girth and assist closure of defects in the middle of the abdomen by making release incisions, dividing the layers, and then sliding one layer on top of another, as in the "Ramirez slide" employed in major incisional hernia repair.

Strong rectus abdominus muscles run anteriorly from the ribcage to pelvis anteriorly. They are powerful muscles that do not typically herniate, but the Linea alba, the area of weakness at the center of the muscles, is what causes paraumbilical and epigastric herniation. When the two rectus muscles separate, the linea alba expands laterally, causing divarification of the recti. Middle-aged, chubby men experience it in the upper abdomen, but it can also develop below the umbilicus in females as a result of birth trauma. [63]

- **Abdominal pressure**

When drains are implanted, the surgeon creates a pressure gradient inside the abdomen that permits blood, pus, bile, bowel contents, and urine to flow outside. [64]

- **Laparoscopic access**

The market has a diverse variety of ports, each with its own set of characteristics. The bladed trocars cut the fascia of the abdominal wall upon entrance. Because they do not pierce the abdominal wall as deeply, non-bladed trocars generate fewer abdominal wall defects and may be less prone to encourage hernia development in the future. The shield on the most often used bladed ports retracts as the blade is forced through the fascia of the abdominal wall before engaging once within the belly. The shields were previously known as safety shields, however, that designation has since been discontinued owing to the lack of protection the shields provide. Non-bladed trocars come in a variety of styles. The Step method employs a single non-bladed.

A blunt port is put into the membrane that dilates radially to guide the port once the Veress needle has been withdrawn from the abdomen. The layers of the abdominal wall are twisted and punctured by the rough edge of the plastic on the Ethicon non-bladed trocar. None of these developments have been proven to

be any more secure than the reusable, non-shielded trocar systems that most of instrument producers sell for less money.

There is less chance of abdominal gas leaking out during the treatment ecause the abdominal wall defect is smaller when a port is introduced using a non-bladed trocar.

Other factors to take into account when selecting a port include the external component's size, the ease with which instruments and specimens enter and exit, and external reducer cap required. [65]

- **First Port Access or Placement**

The optimum and safest entry technique has not yet been identified. Direct puncture and an open-access are two methods for gaining access to the abdomen technique. Direct trocar or direct puncture can be used for the direct-puncture procedure. Insertion is done without pneumoperitoneum or after first creating it. Trocar is then inserted immediately using a Veress needle.

The best location to place Veress needle is through the umbilicus's central scar. Stabilizing abdomen wall is necessary for the safest method (in non-obese patients, we prefer penetrating towel clips). Controlling the power and depth of the needle's entry is crucial. One should perform an aspiration test after inserting the Veress needle by attaching, syringe with saline to the top of the Veress needle and aspirating.

Aspiration of air, blood, or bile indicates poor positioning and may raise considerable concern about an unanticipated injury. If no aspirate is available, saline should be supplied and should flow freely. As a qualitative test, the saline should easily cascade down the Veress needle and into the peritoneal cavity. [66]

Difficult Access

Access, regardless of technique, might be the most challenging component of treatment for some people. This is especially true for fat persons. First, due of the flexible panniculus, determining the site of the central scar is sometimes difficult since the umbilicus is at a caudad position. The skin's detachment from the abdominal wall fascia has also increased. The abdominal wall may act as a barrier to the Veress needle's penetration. It may be difficult to access the abdominal wall through a minor incision if an open-access surgery is performed.

The abdominal wall of obese people with deteriorated fascia will bounce against the needle or finger, making diagnosis difficult. Raising the skin with penetrating towel clips does not make identifying the fascia simpler and instead affects the structure. A modified version of the Vakili and Knight technique may be useful on occasion. A minor skin incision is made utilising a mix of open and Veress methods to treat obese individuals.[67]

Port closure

Laparoscopic use of tissue glues, surgicell, or other clot-promoting strips can also help to promote hemostasis. For the sake of the patient's safety, conversion to open surgery should take place as soon as bleeding cannot be stopped laparoscopically. To close bleeding port sites, transabdominal sutures can be applied using tools like the EndoClose under direct laparoscopic vision. [68]

Fascial Closure

Port-site hernias must be avoided at all costs since they can cause bowel obstruction, imprisonment, and/or Richter's hernias. Even if using a few of the more current non-bladed trocars, which result in less fascial defects, is not necessary. A 10-mm or bigger edged trocar should be used to create no more than one flaw at a time.

The smallest port should always be used since there is a constant chance that a hernia at the port site will develop. There could be a larger-than-expected fascial defect following severe port manipulation or many port replacements that needs to be closed.

“Equipment”

1. **“Telescope”**

Laparoscopic and thoracoscopic telescopes come in a variety of sizes and shapes, with a variety of viewing angles. A standard laparoscope is made up of a 24 cm long metal shaft with a number of quartz-rod lenses that transport images from the scope's focus point to the eyepiece.

Furthermore, the telescope has parallel optical fibres that allow light from the light source to pass through a cable linked to the telescope's side and into the stomach. Telescopes can give a direct view at 0 degrees or an inclined view at 25-30 or 45-50 degrees.

The most common telescope, with a diameter of 10 mm, provides the best light and visual acuity. The 5-mm laparoscope, which may be placed via one of the working ports for a different perspective, is the second most commonly used telescope. Laparoscopes with a 1.1-mm diameter are also available and are usually used on children. [69]

2. "Video Camera"

The picture that will be shown on the monitor is received by a high-resolution camera linked to the telescope's eyepiece. A video unit receives the video image across a cable and converts it to digital or analogue format. An analogue electrical signal has a continually changing waveform or shift in intensity or frequency. A digital signal may be understood by a computer.[70]

3. "Light Sources"

High-intensity light bulbs made of mercury, halogen, or xenon are employed. The bulbs are available in two wattages—150 and 300—and should be chosen based on the process. Because blood absorbs light, any procedure that includes bleeding may necessitate greater lighting. We use stronger light sources for all sorts of advanced laparoscopy. If the abdominal area is considerable, access to light might be difficult in many bariatric surgeries. A fiberoptic wire transmits light to the laparoscope's fiberoptic bundles.[71]

4. "Insufflators"

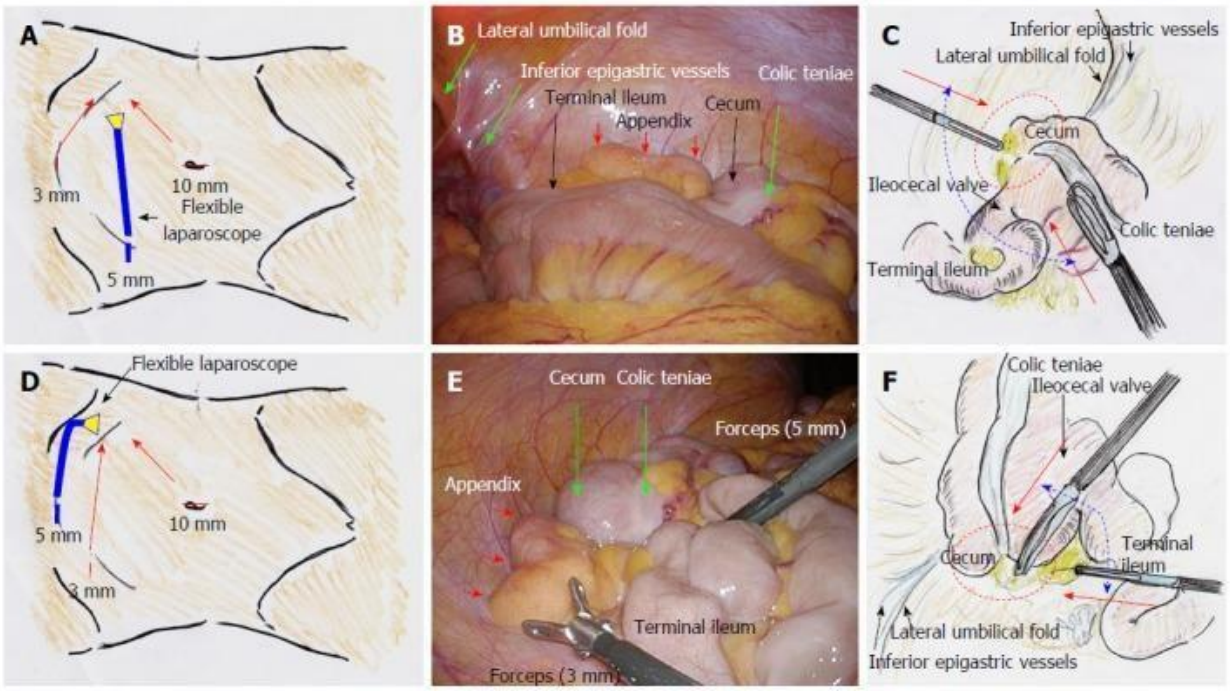
An insufflator delivers gas to the patient from a high-pressure cylinder at a quick rate and low, carefully regulated pressure. Some insufflators contain an inbuilt filter that keeps the insufflator from becoming contaminated with stomach gas and filters any particulate matter that might escape from an old gas cylinder. Others call for the use of filter-equipped disposable insufflator tubing. [72]

5. Video Monitors

To display the image, high-definition video monitors are employed. The ideal monitor size varies but is often between 19 and 21 inches. If they are located close to the operating field, smaller monitors may be employed. The favored display type is fast being replaced by flat-panel (digital) screens with excellent hue and spatial resolution over cathode-ray monitors. If these monitors are suspended from the ceiling using light booms, they may be positioned appropriately. [73]

Laparoscopic Appendectomy [74]

Appendectomy is a surgical treatment that removes the appendix when it becomes inflamed; appendicitis is the medical term for an inflamed appendix. Emergent laparoscopic appendectomy (LA) is the primary line of treatment for acute appendicitis. Less discomfort, better cosmetics, a shorter hospital stay, faster recovery, less wound infection, and a reduced cost are some of the advantages of LA over traditional open surgery. Furthermore, postoperative complications are fewer in LA than in standard open surgery.



Laparoscopic view and port placement A-C: A broader angle of working forceps can be produced if the left lateral port is adjusted for laparoscope. However, a 5 mm stab scar remains evident. D-F: Port locations for LA with the best cosmesis utilising an endostaple are demonstrated. LA stands for laparoscopic appendectomy.

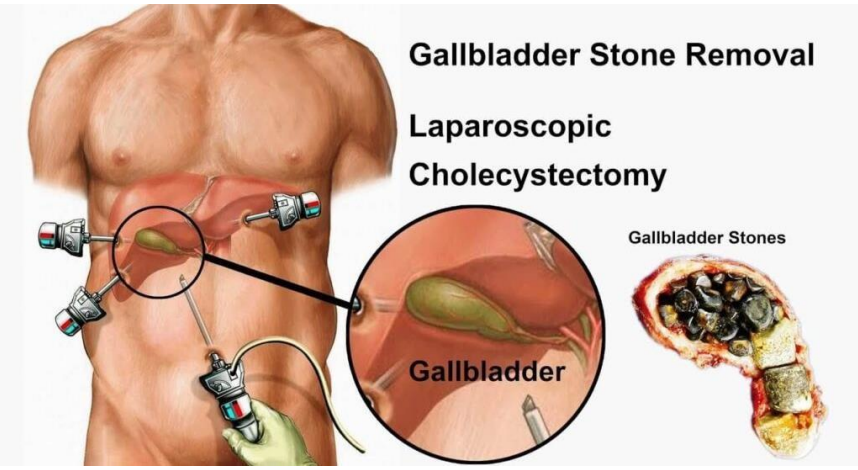
Laparoscopic Hernia Repair [75]

Inguinal hernia repairs are among the most common general surgical procedures performed worldwide. Inguinal hernias are normally diagnosed after a comprehensive history and physical examination, and are characterised by a protrusion in the groin. The Transabdominal Preperitoneal (TAPP) method and the Totally Extraperitoneal (TEP) approach are the two basic approaches for laparoscopic inguinal hernia repair. The two procedures are identical, except that the peritoneum is incised in the TAPP approach, which necessitates closure following mesh insertion. The location of laparoscopic ports differs between the two procedures. The e ports in a TEP procedure are normally put in a line from the pubic bone to the umbilicus. The three ports in the TAPP technique are positioned at the umbilicus and the mid-clavicular line at the level of the umbilicus on the left and right sides of the abdomen. The surgeon can repair bilateral inguinal hernias using either the TEP or TAPP approach with these port placements.

Laparoscopic cholecystectomy[76]

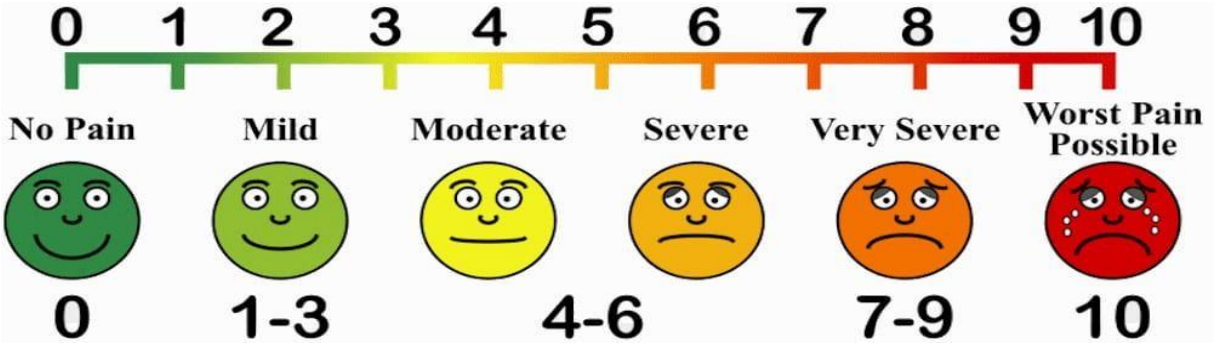
Laparoscopic cholecystectomy is a minimally invasive surgery that is done to remove a damaged gallbladder. This procedure has mainly replaced the open technique for cholecystectomies since the early 1990s. Acute or chronic cholecystitis, symptomatic cholelithiasis, biliary dyskinesia, acalculous cholecystitis, gallstone pancreatitis, and gallbladder tumours or polyps are currently treated with laparoscopic cholecystectomy. The laparoscopic cholecystectomy begins after anaesthetic induction and intubation.

First, carbon dioxide is used to insufflate the abdomen to 15 mmHg. Following that, four tiny incisions in the belly are made for trocar installation (supraumbilical x1, subxiphoid x1, and right subcostal x2). The gallbladder is retracted across the liver using a camera (laparoscope) and lengthy instruments. This allows for the suggested hepatocystic triangle region to be exposed. The gallbladder is then entirely separated from the liver bed using electrocautery or a harmonic scalpel. After allowing the abdomen to deflate to 8 mmHg for 2 minutes, haemostasis should be established. This method is used to avoid missing potential venous bleeding caused by elevated intra-abdominal pressure (15 mmHg). A specimen pouch is used to extract the gallbladder from the abdomen. Under direct visibility, all trocars should be removed. The closure of port locations is determined by the surgeon.



Visual Analogue Scale (VAS) [77]

Hayes and Patterson employed a Visual Analogue Scale (VAS) as one of the first pain rating measures in 1921.[90] It is frequently used in epidemiologic and clinical research to assess the severity or frequency of different symptoms. For example, the amount of pain that a patient experiences might range from none to considerable. It is typically depicted as a 100-mm horizontal line with a point representing the patient's pain intensity between the extremes of "no pain at all" and "worst pain imaginable."[91] The VAS is the best tool for describing pain degree or intensity because of its simplicity, dependability, and validity, as well as its ratio scale features.



SOURCE OF DATA

- All patients coming to "BLDE (Deemed to Be University)'s. Shri B M Patil Medical College, Hospital and Research Centre", admitted to the Department of surgery and undergoing laparoscopic surgery.
- The period of study will be from January 2021 to October 2022.
- Informed consent in written will be taken of patients with a detailed explanation of the procedure going to be performed on them, the risk factors and complications involved, and the advantages and disadvantages of the same.

METHODS OF COLLECTION OF DATA

STUDY POPULATION

- All patients coming to "BLDE (Deemed to Be University) 's. Shri B M Patil Medical College, Hospital and Research Centre", admitted to the Department of surgery and undergoing laparoscopic surgery.

METHODOLOGY

- All the patients admitted to the surgery ward who will be undergoing laparoscopic surgery are in the study samples

- Rrandomly patients were allocated to two groups by the chit-picking so that there will be no bias.
  1) Group A
  2) Group B

- The principal technique for Group A patients to close the skin of the ports will be using cyanoacrylate glue, and Group B will be using conventional sutures.

All patients will be explained in detail about the procedure, and written informed consent will be taken.

PROCEDURE

1] For group A

After the laparoscopic surgery, at the time of skin closure of the wound, the edges are held together using hand or forceps, and cyanoacrylate glue is applied. After the closure of the wound, it is closed with a dry wound dressing.

2] For group B

After the laparoscopic surgery, at the time of skin closure of the wound, they are closed using the conventional suturing method, and after the closure of the wound, it is closed with dry wound dressing.

STUDY DESIGN - COMPARATIVE PROSPECTIVE STUDY.

SAMPLE SIZE

The anticipated Mean ± S.D. of Time closure of the wound in Laparoscopic patients with Glue 3.42±1.13 and in Laparoscopic patients with Suture 14.5±6 resp. (on the study by Sebesta MJ, Bishoff JT. Octyl cyanoacrylate skin closure in laparoscopy [(ref)]) the required minimum sample size is 35 per group (i.e., a total sample size of 70, assuming equal group sizes) to achieve a power of >95% and a level of significance of 1% (two-sided) for detecting a true difference in means between two groups.

$$N = 2\left[\frac{(Z_a + z_\beta) * S}{d}\right]^2$$

Z_a Level of significance=99%

Z_β--the power of the study=>95%

d=clinically significant difference between two parameters

SD= Common standard deviation

STATISTICAL ANALYSIS

- The data obtained will be entered in a Microsoft Excel sheet, and statistical analysis will be performed using a statistical package for the social sciences (Version 20).

- Results will be presented as Mean ± S.D., counts and percentages, and diagrams.

- For normally distributed continuous variables between two groups will be compared using Independent t-test for not normally distributed variables Mann Whitney U test will be used. Categorical variables between the two groups will be compared using the Mann-Whitney test.

- $p<0.05$ will be considered statistically significant. All statistical tests will perform two-tailed.

RESEARCH HYPOTHESIS

Cyanoacrylate is beneficial as it takes less time for laparoscopic port skin closure, has less postoperative pain, and has low rates of surgical site infections.

INCLUSION CRITERIA

1] All the patients undergoing laparoscopic operations in the Department of general surgery.

EXCLUSION CRITERIA

1] Patients who are immunocompromised.

2] Patients with collagen diseases.

3] Patients with a history of keloid formation and hypertrophic scars.

TOOLS FOR DATA COLLECTION

Patient will be given a proforma to fill up and the objectives will be studied in detail by following up the patient for 3 months with periodical follow up.

TIME AND DURATION OF THE STUDY

First 18 months is utilized for taking patient into study group and control group and last 3 months for analysis of data from December 2020 to October 2021.

RESULTS

The present study was carried out at Department of General Surgery, "**B.L.D.E**

(Deemed to be University) SHRI B.M PATIL MEDICAL COLLEGE, HOSPITAL & RESEARCH CENTRE, VIJAYAPURA"

STUDY DESIGN: single centre- comparative prospective study

TOTAL SUBJESTS: A Total of 70 patients were enrolled for the study. They were randomised into two groups.

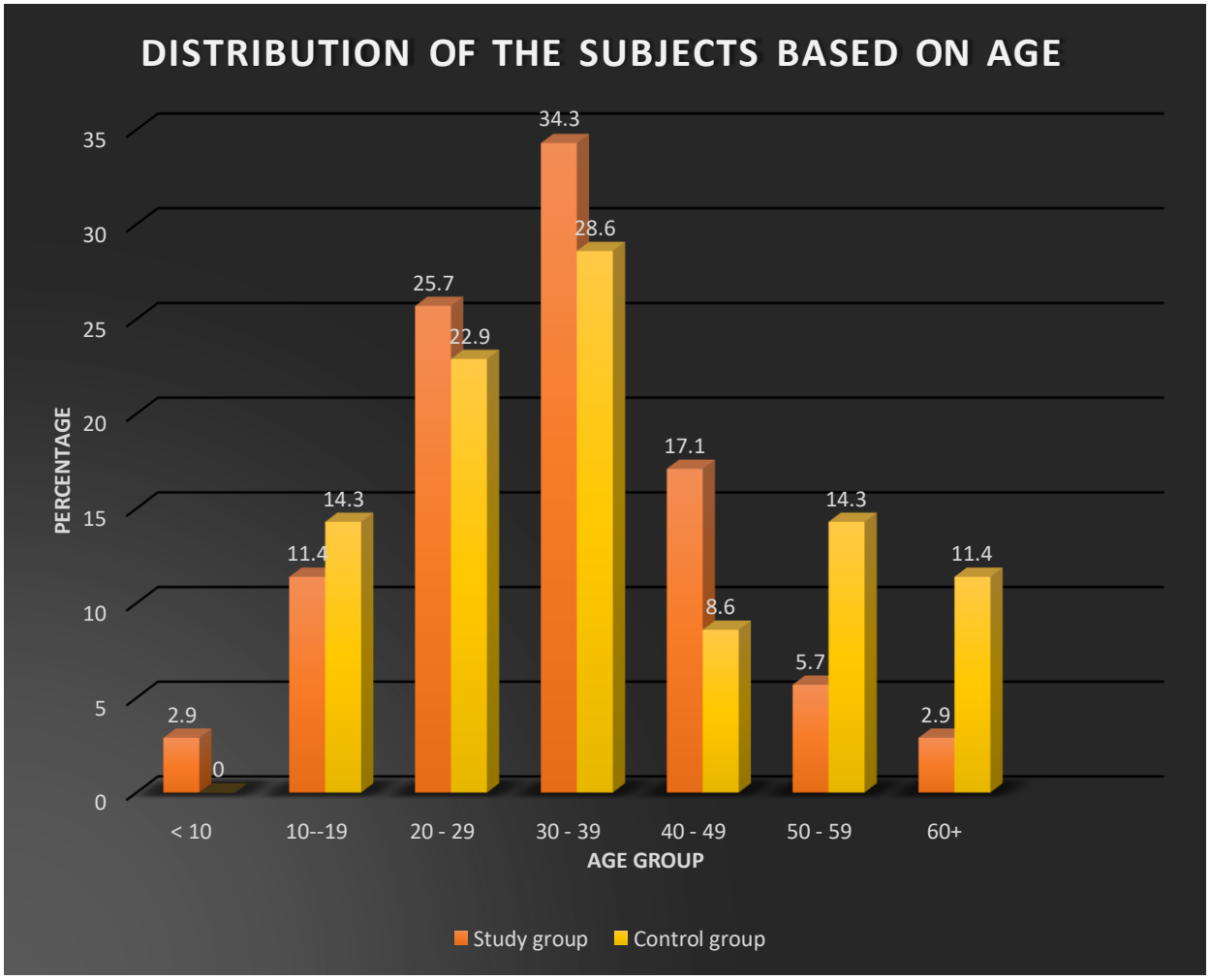
In accordance with the predetermined objectives, all patients included in the study were evaluated in terms of history, physical findings, operative findings, and postoperative complications.

The Observations made during the course of the study were as follows.

Demographic Data

TABLE 1: DISTRIBUTION OF THE SUBJECTS BASED ON AGE

AGE	Study group		Control group	
	No. of patients	Percentage	No. of patients	Percentage
< 10	1	2.9	0	0
10 - 19	4	11.4	5	14.3
20 - 29	9	25.7	8	22.9
30 - 39	12	34.3	10	28.6
40 - 49	6	17.1	3	8.6
50 - 59	2	5.7	5	14.3
60+	1	2.9	4	11.4
Total	35	100.0	35	100.0



Age ranged between <10 years to >60 years in both the groups. In both the groups, the patients from age group of 30-39 years were found maximum.

COMPARSION OF THE MEAN AGE BETWEEN THE GROUPS

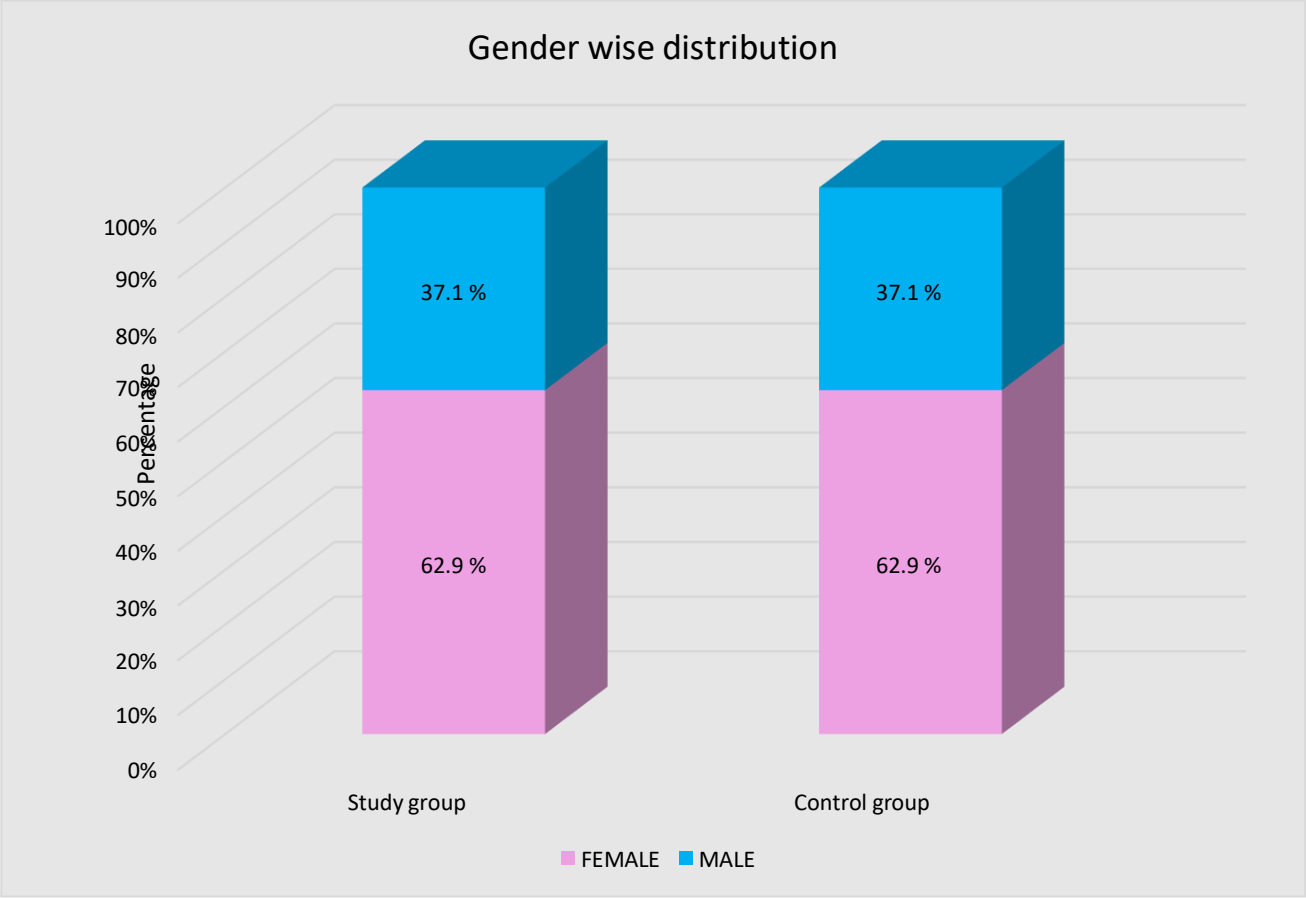
USING Mann-Whitney U test

	Study group		Control group		Mann-Whitney U test	P value
	Mean	Std. Deviation	Mean	Std. Deviation		
AGE	32.34	12.405	37.57	15.502	513.000	0.242

The mean age in study group was 32.34 years and that in the control group was 37.57 years. Mann Whitney U test was performed and P value of 0.242 was obtained. It was found that there was no significant difference between the mean age of study and control group.

- **Gender wise distribution of patients observed in a study**

Gender	Study group		Control group	
	No. of patients	Percentage	No. of patients	Percentage
FEMALE	22	62.9	22	62.9
MALE	13	37.1	13	37.1
Total	35	100.0	35	100.0



The present study consisted of both male and female patients in both the groups. An equal number of males and females were enrolled in both, the study group and the control group and there was no difference in the gender wise distribution of patients enrolled in the study.

group.

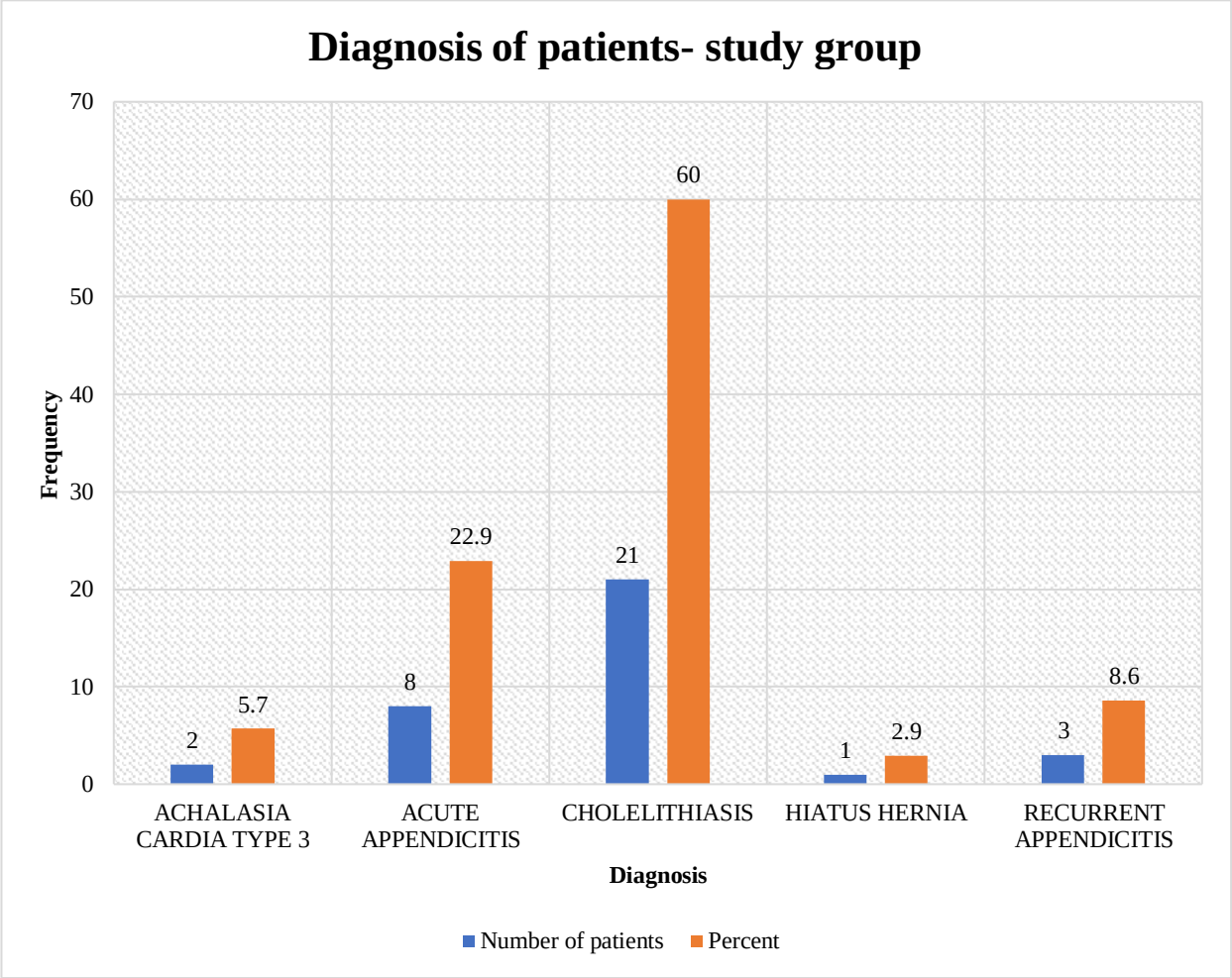
COMORBIDITY

It was found that none of the patients enrolled for the study had any co-morbid condition.

DIAGNOSIS

In the study group, the patients enrolled were diagnosed as given in the table-

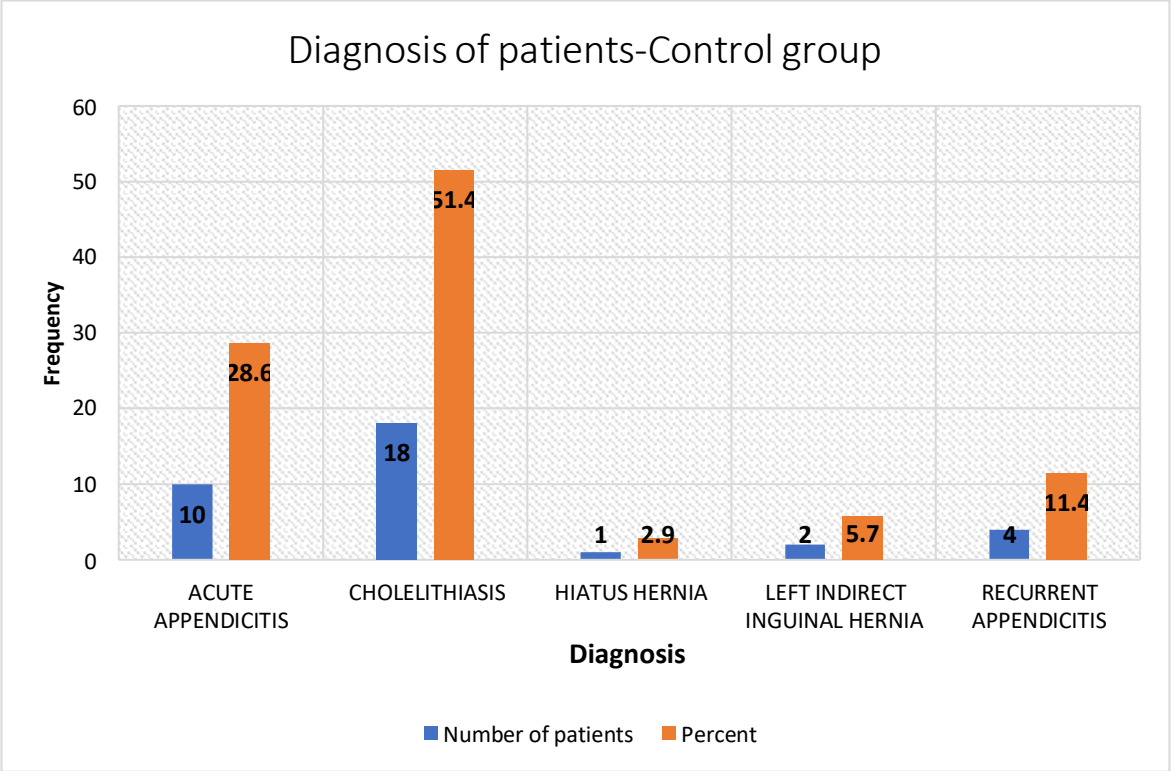
Diagnosis of patients in study group		
DIAGNOSIS	Number of patients	Percentage (%)
ACHALASIA CARDIA TYPE 3	2	5.7
ACUTE APPENDICITIS	8	22.9
CHOLELITHIASIS	21	60.0
HIATUS HERNIA	1	2.9
RECURRENT APPENDICITIS	3	8.6
Total	35	100



The maximum number of patients were diagnosed as Cholelitiasis(60 %) followed by Acute appendicitis(22.9%), recurrent appendicitis(8.6%), achalasia cardia type 3(5.7%) and hiatus hernia(2.9%).

In the study group, the patients enrolled were diagnosed as given in the table

Diagnosis of patients in Control group		
Diagnosis	Number of patients	Percentage (%)
ACUTE APPENDICITIS	10	28.6
CHOLELITHIASIS	18	51.4
HIATUS HERNIA	1	2.9
LEFT INDIRECT INGUINAL HERNIA	2	5.7
RECURRENT APPENDICITIS	4	11.4
Total	35	100.0

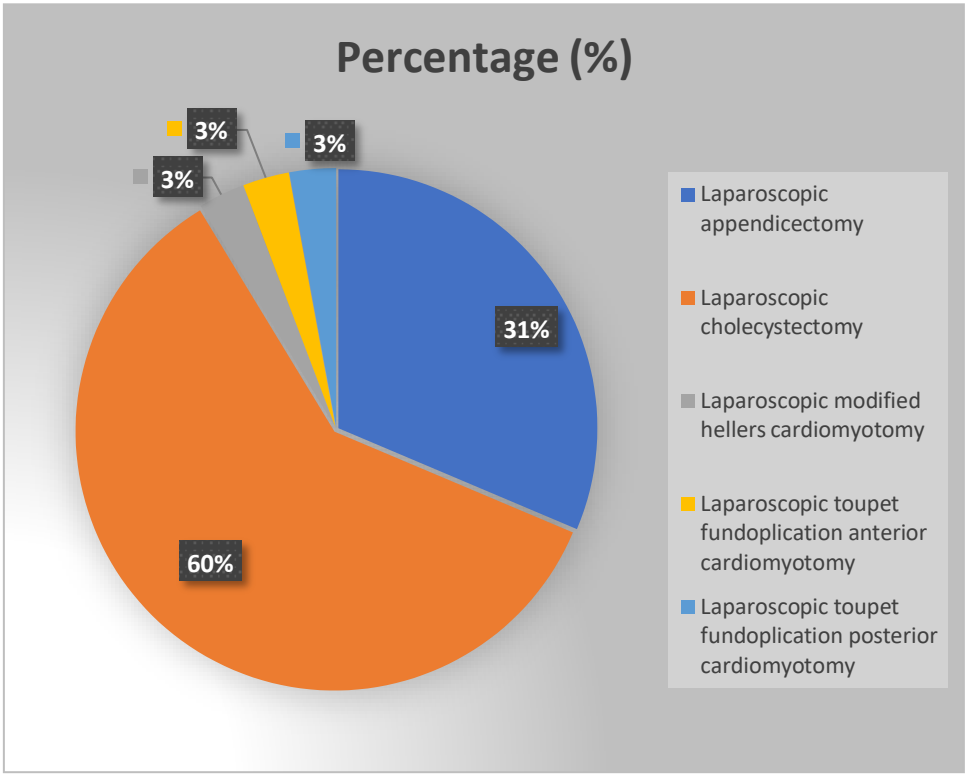


The maximum number of patients were diagnosed as Cholelithiasis (51.4%) followed by Acute appendicitis(28.6%), Recurrent appendicitis(11.4%), Left indirect inguinal hernia(5.7%) and Hiatus hernia(2.9%)

PROCEDURES PERFOMED-

The operative procedures performed on the patients enrolled under control group were as follows-

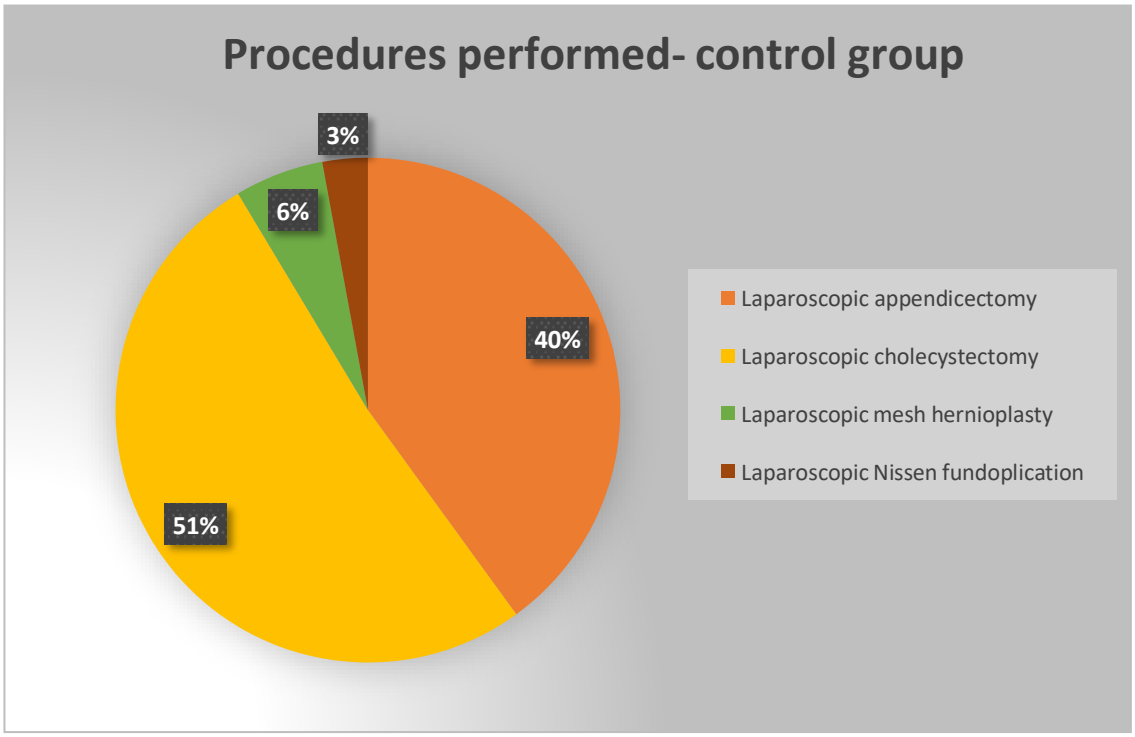
Procedures performed in study group		
Procedure	Number of patients	Percentage (%)
Laparoscopic appendicectomy	11	31.4
Laparoscopic cholecystectomy	21	60
Laparoscopic modified hellers cardiomyotomy	1	2.9
Laparoscopic toupet fundoplication anterior cardiomyotomy	1	2.9
Laparoscopic toupet fundoplication posterior cardiomyotomy	1	2.9
Total	35	100



The maximum number of patients underwent Laparoscopic cholecystectomy (60%) followed by Laparoscopic appendicectomy (31.4%), Laparoscopic modified hellers cardiomyotomy (2.9%), Laparoscopic toupet fundoplication anterior cardiomyotomy(2.9%) and Laparoscopic toupet fundoplication posterior cardiomyotomy (2.9%)

The operative procedures performed on the patients enrolled under control group were as follows-

Procedures performed in control group		
Procedure	Number of patients	Percentage (%)
Laparoscopic appendicectomy	14	40
Laparoscopic cholecystectomy	18	51.4
Laparoscopic mesh hernioplasty	2	5.7
Laparoscopic Nissen fundoplication	1	2.9
Total	35	100



The maximum number of patients underwent Laparoscopic cholecystectomy(51.4%) followed by Laparoscopic appendicectomy (40%) , Laparoscopic mesh hernioplasty(5.7%) and Laparoscopic Nissen fundoplication(2.9%)

TYPE OF ANALGESIC

In our study it was observed that in the Study group, among the 35 patients enrolled, all were prescribed NSAIDS as post-operative analgesic. In the control group, among the 35 patients enrolled, 33 received NSAIS and 2 patients received Opioids as post-operative analgesic.

TYPE OF ANALGESIC		
Analgesic	Study group	control group
NSAID	35 (100%)	33 (94%)
OPIOIDs	0	2 (6%)
Total	35 (100 %)	35 (100 %)

TIME REQUIED FOR CLOSURE OF SINGLE PORT SITE

TIME REQUIED FOR CLOSURE	
	Average time to close port site in seconds (mean)
Study group	**7.94**
control group	**17.80**
Mann-Whitney U test value- zero	
P value- 0.0001*	
*: Statistically significant	

It was found that the average time required for closure of single port site in study group was 7.94 seconds and that in the control group was 17.80 seconds. Mann-Whitney U test was performed, and a P value of 0.0001* was obtained. There was statistically significant difference between the average time required for closure of single port site. It was less in the study group which used cyanoacrylate glue as compared with that of the control group where conventional suturing method was used.

PO PAIN 6 HOUR

Post-operative pain assessment was done by using visual analog scale after 6 hours in both the study group and control group. It is as shown below-

PO PAIN 6 HOUR	
GROUPS	Mean
Study Group	9.00
CONTROL Group	9.17
Mann-Whitney U test value-562.500	
P value- .527	
Statistically insignificant	

Average score of 9 was obtained in the study group and 9.17 in the control group. Mann-Whitney U test was performed and value of 562.500 was obtained with P value of .527. There was no statistically significant difference between the post-operative pain assessment done after 6 hours of operative procedures.

PO PAIN & SSI SCORE

Post-operative pain was assessed on day 1, day3 and day 3 of the surgery using VAS. Surgical site infection was also assessed using the Southampton scoring system. The results obtained are as follows-

PO PAIN & SSI SCORE				
	Mean value			
GROUPS	POD 1	POD 2	POD 3	SSI SCORE
Study Group	6.37	3.03	.57	.00
CONTROL Group	6.40	3.49	.91	.40
Mann-Whitney U test value	595.000	517.500	524.500	525.000
P value	.832	.247	.200	.021

In the study group, the mean post-operative pain value obtained POD1(6.37), POD 2(3.03) and POD3(.57) was compared with the mean post-operative pain value in control group, that is POD1(6.40), POD 2(3.49) and POD3(.91). Statistically there was no significant difference found in the post-operative pain assessment as postoperative pain depends upon the type of surgery, intraoperative tissue handling, and complications.

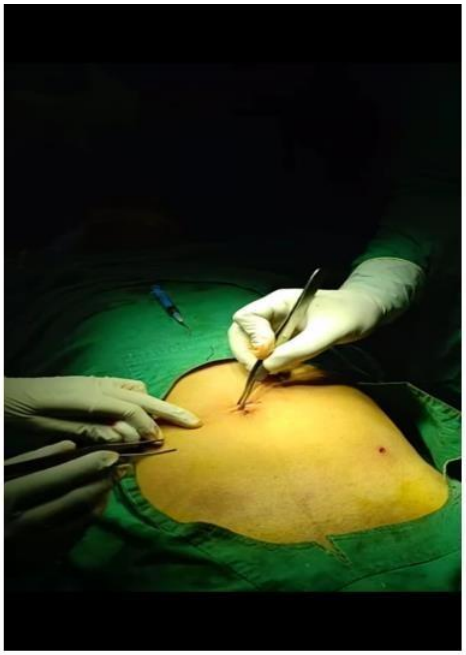
The rate of surgical site infection according to Southampton scoring system was studied and no case was noted in the study group and 5 cases were found in the control group which is significant (P-0.021). Among the 5 cases found,3 are acute appendicitis and 2 are lap chole.

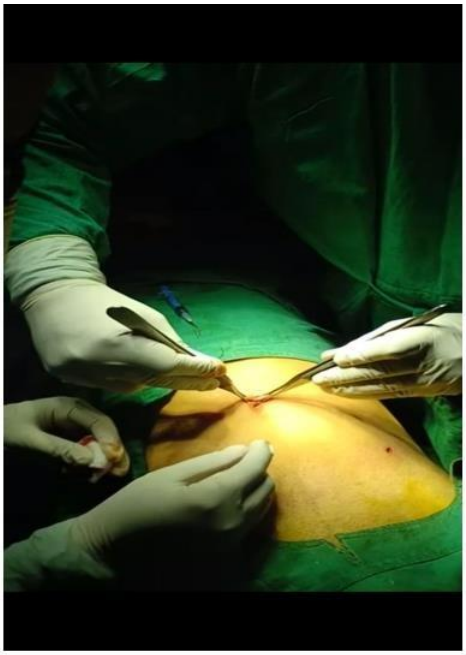
HOSPITAL STAY

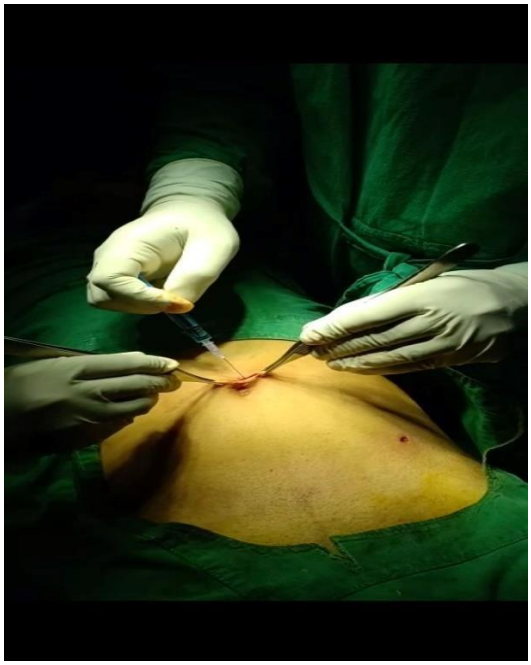
HOSPITAL STAY	
GROUPS	No. of days (Mean)
Study Group	4.89
CONTROL Group	5.46
Mann-Whitney U test value- 475.000	
P value-.098	

The average number of days the patient stayed in the hospital was studied. It was found that the patients in the study group stayed an average of 4.89 days as compared with that in the control group which was 5.46 days. It was found that the average number of days of hospital stay was not significant.

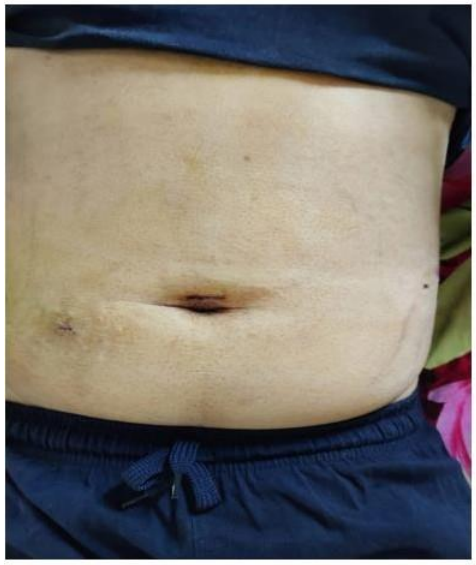
INTRA OPERATIVE PROCEDURE PHOTOS



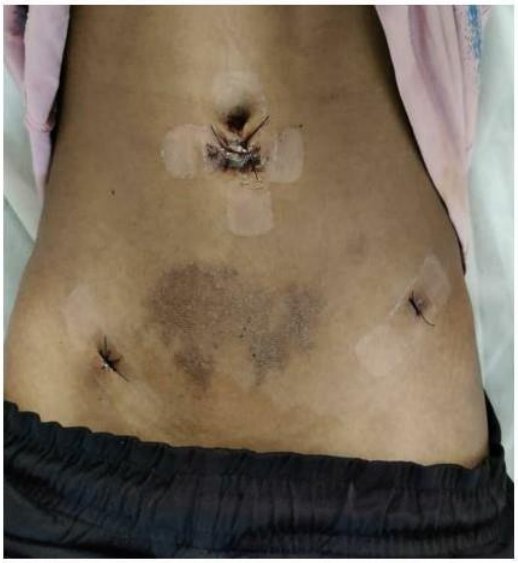




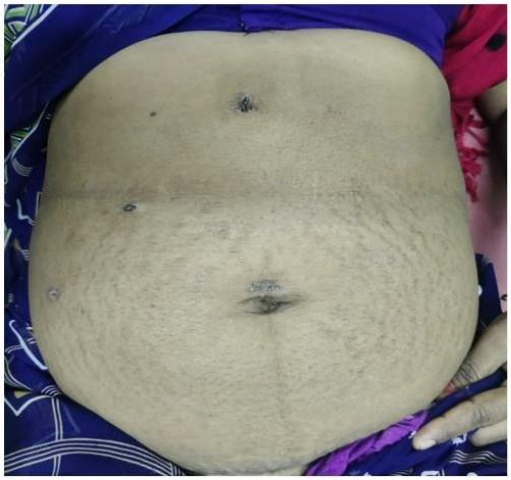
POST-OPERATIVE PROCEDURE PHOTOS



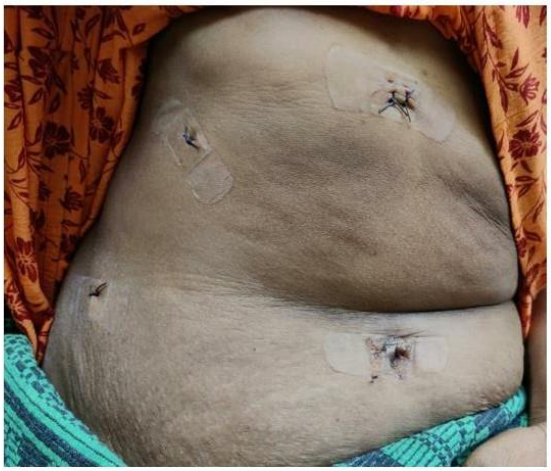
POD 3 OF LAP INGINAL HERNIA (GLUE)



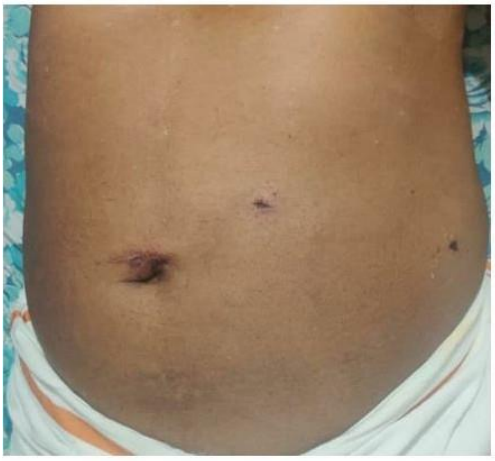
LAP APPENDICECTOMY ON DAY 3 (SUTURE)



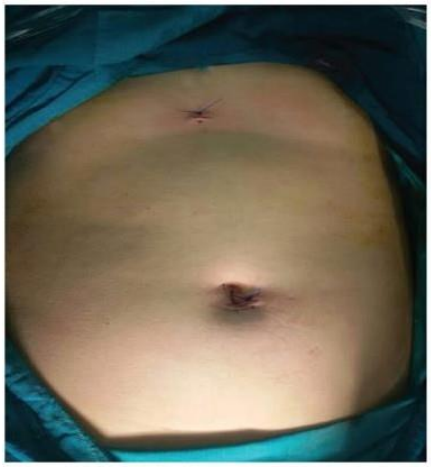
LAP CHOLECYSTECTOMY POD 3 (GLUE)



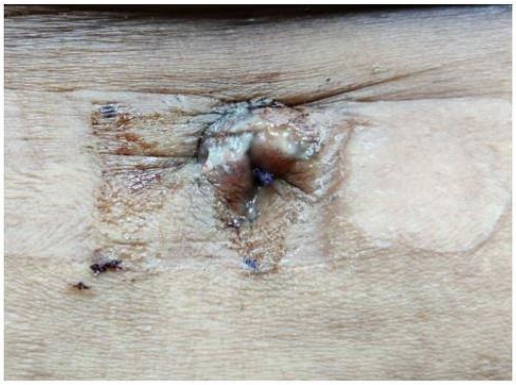
LAP CHOLECYSTECTOMY DAY 3 (SUTURE)



LAP. HERNIOTOMY DAY 1 (GLUE)



LAP APPENDICECTOMY ON DAY 3 (SUTURE)



SSI WITH GRADE 4 IN LAP. CHOLECYSTECTOMY ON DAY 3 (PUS DISCHARGE FROM SUTURE)

SSI WITH GRADE 2 IN LAP APPENDICECTOMY ON DAY 3 (SUTURE)

DISCUSSION

Techniques for suturing can be meticulous and time-consuming[93]. Early removal of sutures can cause dehiscence, which can lead to an increase in the need for a dressing to cover the wound and a suture. Tissue glue was created as a result of these disadvantages. Methyl-2-cyanoacrylate and ethyl-2-cyanoacrylate, are two hazardous forms of cyanoacrylate that are employed for adhesion in non-medical applications.[92] Currently, the optimal non-toxic version for medical application is the longer chain N-Butyl-2 cyanoacrylate and 2-octyl cyanoacrylate.

Applications of cyanoacrylate in various surgical situations and the enclosure of laparoscopic port site closure operations have grown in popularity in recent years.[94] Compared to traditional sutures, cyanoacrylates have a number of useful advantages. The main advantage is how simple and convenient their application is, which leads to quicker wound healing. Without using topical antibiotics, sterility is maintained because cyanoacrylates provide an antibacterial barrier over the incision.[95] They also create a waterproof bandage that enables the patient to bathe earlier after surgery. The patients also benefit from the convenience of avoiding postoperative suture removal.

This study is a comparative study which assessed the superiority of cyanoacrylate glue application over conventional suturing for the skin of laparoscopic port site. Endobags were not used for any surgery. While perfoming the procedures, appendix specimen was removed from telescopic 10 mm port and GB is removed from epigastric 10 mm port.

The mean age in study group was 32.34 years and that in the control group was 37.57 years. There was no significant difference between the mean age of study and control group. In both the groups, the patients ranging in the age group of 30-39 years were found to be maximum. In a similar study done by Tapsi Sharma and et al. it was found that maximum patients belonged to the age group of 45 to 59 years. [96]

The present study consisted of both male and female patients in both the groups. In both groups equal number of males and females were enrolled. In a similar study done by “Tapsi Sharma and et al”. female preponderance was found.[96]

It was found that none of the patients enrolled for the study had any co-morbid condition. In a similar study done by Maniar N. et.al out of 20 patients enrolled 3 had co-morbidity in the form of diabetes mellitus. [97]

This study included patients diagnosed for Cholelithiasis, Acute appendicitis, recurrent appendicitis, achalasia cardia type 3, hiatus hernia and Left indirect inguinal hernia.

The maximum number of patients underwent Laparoscopic cholecystectomy followed by Laparoscopic appendicectomy, Laparoscopic modified hellers cardiomyotomy, Laparoscopic toupet fundoplication anterior cardiomyotomy, Laparoscopic toupet fundoplication posterior cardiomyotomy, Laparoscopic mesh hernioplasty and Laparoscopic Nissen fundoplication. In study conducted by Tapsi Sharma[96] and et al. all patients enrolled were for elective laparoscopic cholecystectomy. In a similar study by Maniar N. et.al most commonly performed surgery was laparoscopic cholecystectomy.[97]

In our study it was observed that in the Study group, among the 35 patients enrolled, all were prescribed NSAIDS as post-operative analgesic. In the control group, among the 35 patients enrolled, 33 received NSAIDS and 2 patients received Opioids as post-operative analgesic

It was found that the average time required for closure of single port site in study group was 7.94 seconds and that in the control group was 17.80 seconds. There was statistically significant difference between the average time required for closure of single port site. It was less in the study group which used cyanoacrylate glue as compared with that of the control group where conventional suturing method was used. Similar results were obtained in study conducted by Tapsi Sharma [96] & et al., Michael J. Sebesta. et. al.[98]

One of the earliest study which was conducted by Quinn J.et.al[99] in 1997 also reported similar results. A Cochrane review done by Dumville JC.et.al[100] it was found that sutures were significantly faster to use when compared to the glue. A plausible reason for the unexpected outcomes is that applying glue is a talent that requires practise, just like suturing. Additionally, working in the surgical sector with fewer tools, sutures, and needles is undoubtedly simpler, safer, and more practical. Additionally, the possibility of a needle stick injury need not be a concern.

Average score of 9 was obtained in the study group and 9.17 in the control group after 6-hour post-operative pain assessment done using VAS. No statistically significant difference between the post-operative pain assessment noted which done after 6 hours of operative procedures. Our results were in line with similar study conducted by Dowson et al.[101]

In the study group, the mean post-operative pain value obtained POD1(6.37), POD 2(3.03) and POD3(.57) was compared with the mean post-operative pain value in control group, that is POD1(6.40), POD 2(3.49) and POD3(.91). “There was no statistically significant difference was found in the post-operative pain assessment as postoperative pain depends upon the type of surgery, intraoperative tissue handling, and complications. Similar results were seen in a study conducted by Ben Safta et al”.[102]

"Rate of surgical site infection according to Southampton scoring system was studied .No case was noted in study group and 5 cases notes in the control group which is significant". This may be because of the barrier properties provided by polymerized adhesive in preventing microorganism infection of the wound site. Similar results were obtained in a similar study done by Andrew Kent.et.al.[103] and Michael J. Sebesta. et. al.[98] In a similar study done by Charlotte C et.al[100] early time points showed that both of the procedures occasionally experienced modest wound issues, with the sutured group experiencing erythema and oedema and the adhesive group experiencing minimal superficial dehiscence.

The tissue adhesive group's issues all surfaced early in the trial, and it was assumed that they were brought on by either procedural blunders that caused the glue to penetrate deeply into the wound rather than only approximate the borders of the skin, or by inadequate wound hemostasis. Furthermore, all of these issues had been resolved by the time of the final wound review, so they had little clinical significance.

The average number of days the patient stayed in the hospital was studied. It was found that the patients in the study group stayed an average of 4.89 days as compared with that in the control group which was 5.46 days. It was found that the average number of days of hospital stay was not significant.

SUMMARY

The first step in each surgical procedure is an incision. The most crucial elements that influence effective wound healing and the surgical success after a surgical approach are appropriate closure and optimal care of the surgical region.

It has been established that the presence of suture material itself makes a person more susceptible to infection. The traditional method of wound closure causes trauma during needle penetration while passing through the tissues and provides a "wick down" through which bacteria can access the underlying tissues. Due to invasion of the underlying epithelium layer, it may also result in problems such stitch abscess, epithelial inclusion cysts, and railroad track scars. Additionally, using a suture to approximate a wound takes time and increases the degree of scarring.

Suture applications demand the passage of a foreign substance through tissue, which results in the highest tissue reaction. Infection is caused by microorganisms that are retained in the tissue by this pathway.

There is always a need for an alternative to sutures in order to get past these challenges. There has long been interest in the use of tissue adhesives as an alternative to or replacement for sutures in the treatment of wound closure. These tissue adhesives include cyanoacrylates in one group.

As a result of its benefits, including immediate and effective hemostasis, bacteriostatic characteristics, and quick adherence to both soft and hard tissues, N-butyl-2-cyanoacrylate has emerged as the industry standard for tissue adhesive. It is used in a variety of surgical procedures, including the fixing of mandibular fractures and the restoration of organs, veins, skin, and mucosa grafts. It can also be used to close lacerations and other lesions.

So, we undertook this study to compare the superiority of Cyanoacrylates glue application over Conventional suturing for the closure of Laparoscopic port sites.

The present study titled "A comparative study to assess the superiority of Cyanoacrylates glue application over Conventional suturing for the closure of Laparoscopic port sites-A Prospective study" was a prospective comparative study conducted for a period from October 2020 to April 2022 after ethics committee approval. In this study, we analyzed the patients admitted in surgery ward who underwent be laparoscopic surgeries and satisfied the inclusion and exclusion criteria.

1) 2 groups made to divide patients

- Group A- Case group (Cyanoacrylates glue application)
- Group B- Control group (Conventional suturing)

2) 70 patients were included in the study and randomly divided into two groups (Group A-35 & Group B-35)
3) majority of the patients belonged to age group of 30-39 years ,Age ranged between <10 years to >60 years in both the groups
4) There was no difference in the gender wise distribution of patients enrolled in the study and an equal number of males and females were enrolled.
5) None of the patients enrolled for the study had any co-morbid condition.
6) The maximum number of patients enrolled in both the groups were diagnosed as case of Cholelithiasis.
7) The maximum number of patients underwent Laparoscopic cholecystectomy (60%) followed by Laparoscopic appendicectomy (31.4%) in both the groups.
8) NSAIDS were the most common analgesic used.
9) Statistically significant difference between the average time required for closure of single port site was noted. It was less in the study group which used cyanoacrylate glue as compared with that of the control group where conventional suturing method was used.
10) Post-operative pain assessment was done by using VAS after 6 hours & there was no statistically significant difference between the postoperative pain assessment.
11) Post-operative pain was also assessed on day 1, day3 and day 3 of the surgery using visual analog scale & statistically no significant difference was found in the post-operative pain assessment.
12) Surgical site infection was assessed using the Southampton scoring system and no case was noted in the study group and 5 cases were found in the control group which is significant (P-0.021). Among the 5 cases found,3 were acute appendicitis and 2 were lap chole.

13) The average number of days the patient stayed in the hospital for study group was an average of 4.89 days as compared with that in the control group which was 5.46 days. It was found that, no significant difference between the average number of days of hospital stay.

CONCLUSION

Tissue adhesive glues provide good wound repair. They act by polymerising rapidly when exposed to a liquid, forming stronger bonds.

Our study demonstrated that the use of N-Butyl-2-cyanoacrylate at laparoscopic port site skin closure is not only faster than traditional suturing but probably less painful too.

It also resulted in less surgical site infection due the bacteriostatic properties of N- Butyl-2-cyanoacrylate with help in better wound healing without any complications and cosmetically better scar as compared to conventional suturing.

It also has an additional advantage of being less expensive. It does not require frequent follow-up visits for suture removal which makes it more convenient to patient, overall less expensive and early return to work

This technique for closure of incision site is easy to learn and not technically demanding which leads to shorter overall operation time and one more step close to minimal invasive surgery. It is however important to apply it correctly and choose the wounds carefully.

Difference in post-operative pain and hospital stay was not significant between conventional suturing and N-Butyl-2-cyanoacrylate glue as it depends upon type of surgery, intraoperative tissue handling and other complications.

By undertaking this study, we can conclude that N-Butyl-2-cyanoacrylate is better than conventional suturing in laparoscopic port site skin closure. More studies should be conducted to compare the effectiveness of N-Butyl-2-cyanoacrylate as compared to conventional suturing in other types of surgeries as well.

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CERTIFICATE OF ETHICAL CLEARANCE

IEC/NO-09/2021
Date-22/01/2021

B.L.D.E. (DEEMED TO BE UNIVERSITY)

(Declared vide notification No. F.9-37/2007-U.3 (A) Dated. 29-2-2008 of the MHRD, Government of India under Section 3 of the UGC Act, 1956)

The Constituent College

SHRI. B. M. PATIL MEDICAL COLLEGE, HOSPITAL AND RESEARCH CENTRE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Institutional ethical committee of this college met on 11-01-2021 at 11-00 am to scrutinize the synopsis of Postgraduate students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected and revised version synopsis of the Thesis has been accorded Ethical Clearance

Title: A comparative study to assess the superiority of Cyanoacrylates glue application over Conventional suturing for the skin closure of Laparoscopic port sites – A prospective study

Name of PG student: Dr Gandhi Darshan Rajeev, Department of Surgery

Name of Guide/Co-investigator: Dr Girish Kullolli, Associate Professor Department of Surgery

DR .S.V.PATIL
CHAIRMAN, IEC

Institutional Ethical Committee
B L D E (Deemed to be University)
Shri B.M. Patil Medical College,
VIJAYAPUR-586103 (Karnataka)

Following documents were placed before Ethical Committee for Scrutinization:

1. Copy of Synopsis / Research project
2. Copy of informed consent form
3. Any other relevant documents.

PARTICIPANT CONSENT FORM

Participant' s name: Address

TITLE OF THE PROJECT: A Comparative Study To Assess The Superiority Of Cyanoacrylate Glue Application Over Conventional Suturing For The Skin Closure Of Laparoscopic Port Sites - A Prospective Study.

The details of the study have been provided to me in writing and explained to me in my own language. I confirm that I have understood the above study and had the opportunity to ask questions. I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s). I have been given an information sheet giving details of the study. I fully consent to participate in the above study.

____ _____

(Participant) (Date)

____ _____

(Witness to signature) (Date)

_____ _____

(Investigator to signature) (Date)

PATIENT INFORMATION SHEET

TITLE OF THE PROJECT: A Comparative Study To Assess The Superiority Of Cyanoacrylate Glue Application Over Conventional Suturing For The Skin Closure Of Laparoscopic Port Sites - A Prospective Study.

NAME OF THE INVESTIGATOR: DR. GANDHI DARSHAN RAJEEV

NAME OF THE GUIDE: DR. GIRISH KULLOLLI

CONFIDENTIALITY

I understand that medical information produced by this study will become a part of this hospital record and will be subjected to the confidentiality and privacy regulation of this hospital. Information of a sensitive, personal nature will not be a part of the medical records but will be stored in the investigator's research file and identified only by a code number. The code key connecting the name to numbers will be kept in a separate secure location.

If the data are used for publication in the medical literature or for teaching purposes, no names will be used, and other identifiers such as photographs and audio or videotapes will be used only with my special written permission.

I understand that I may see the photograph and videotapes and hear audiotapes before giving this permission.

REQUEST FOR MORE INFORMATION

I understand that I may ask more questions about the study at any time. DR. GANDHI DARSHAN RAJEEV is available to answer my questions or concerns. I understand that I will be informed of any significant new findings discovered during the course of this study, which might influence my continued participation.

If during this study, or later, I wish to discuss my participation in or concerns regarding this study with a person not directly involved, I am aware that the social worker of the hospital is available to talk with me.

And that a copy of this consent form will be given to me to keep it and for careful reading.

INJURY STATEMENT

I understand that in the unlikely event of injury to me/my ward, resulting directly to my participation in this study, if such injury were reported promptly, then medical treatment would be available to me, but no further compensation will be provided.

I understand that by my agreement to participate in this study, I am not waiving any of my legal rights. I have explained to the patient the purpose of this research, the procedures required and the possible risks and benefits, to the best of my ability in patient's own language.

Date

DR. GIRISH KULLOLI DR. GANDHI DARSHAN RAJEEV

(GUIDE) (INVESTIGATOR)

REFUSAL OR WITHDRAWAL OF PARTICIPATION

Participation is voluntary and you may refuse to participate or withdraw consent and discontinue participation in the study at any time.

I, DR. GANDHI DARSHAN RAJEEV (Investigator) have explained to the patient in detail about the study in their own language and the written copy of the same will be given to participant.

INVESTIGATOR' S NAME AND ADDRESS:

DR. GANDHI DARSHAN RAJEEV

POST GRADUATE

DEPARTMENT OF SURGERY

SHRI B M PATIL MEDICAL COLLEGE

HOSPITAL AND RESEARCH CENTRE,

VIJAYAPURA-586103

BIODATA

GUIDE:

NAME : DR. GIRISH KULLOLI

DESIGNATION : AS PROFESSOR IN

DEPARTMENT GENERAL SURGERY

B.L.D.E.(Deemed to be University)'s SHRI B.M. PATIL MEDICAL COLLEGE, HOSPITAL, AND RESEARCH CENTER, VIJAYAPURA – 586103.
KARNATAKA.

CONTACT 9482666444

DATE OF BIRTH **:** 22/07/1974

EDUCATION **:** M.S. GENERAL SURGERY, FIAS, FIAGES, FMAS.

PREVIOUS EXPERIENCE **:** ASSISTANT PROFESSOR PRATIMA INSTITUTE OF MEDICAL SCIENCES, NAGANAUR, KARIMNAGAR, TELANGANA.

: SENIOR CONSULTANT, KAMINENI HOSPITAL, KING KOTI, HYDERABAD, TELANGANA.

: EXAMINER FOR UNDERGRADUATES MBBS VARIOUS UNIVERSITIES-RGUHS-NTR University.

INVESTIGATOR

NAME : DR. GANDHI DARSHAN RAJEEV

QUALIFICATION : M.B.B.S
M.M.C. REG. NO : 2019/05/4133
CONTACT 9404669843
ADDRESS : DEPARTMENT OF GENERAL SURGERY,
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B.M. PATIL MEDICAL COLLEGE.
HOSPITAL AND RESEARCH CENTRE,
VIJAYAPURA – 586103
KARNATAKA.

PROFORMA

SL NO

NAME -

AGE - IP NO -

SEX - UNIT -

RELIGION - DOA - / /

OCCUPATION - WARD -

ADDRESS DOD - / /

SOCIO-ECONOMIC STATUS- UPPER/MIDDLE/LOWER CLASS

CHIEF COMPLAINTS:

HISTORY OF PRESENT ILLNESS:

PAST HISTORY:

PERSONAL HISTORY:

FAMILY HISTORY :

GENERAL PHYSICAL EXAMINATION

BUILT: WELL/MODERATE/POOR

NOURISHMENT: WELL/MODERATE/POOR

PALLOR – PRESENT/ABSENT

ICTERUS – PRESENT/ABSENT

CYANOSIS - PRESENT/ABSENT

CLUBBING - PRESENT/ABSENT

PEDAL EDEMA - PRESENT/ABSENT

GENERAL LYMPHADENOPATHY - PRESENT/ABSENT

VITAL DATA:

TEMPERATURE: F

PULSE - BPM

RESPIRATORY RATE - CPM

BLOOD PRESSURE - MMHG

SYSTEMIC EXAMINATION

PER ABDOMEN -

RESPIRATORY SYSTEM -

CARDIOVASCULAR SYSTEM -

CENTRAL NERVOUS SYSTEM -

CLINICAL DIAGNOSIS :

OPERATIVE PROCEDURE :

TOTAL NO. OF TROCAR SITES :

10MM –

5MM -

TIME REQUIRED FOR SKIN CLOSURE OF WOUND - SECOND

AVERAGE TIME REQUIRED FOR 1 PORT - SECOND

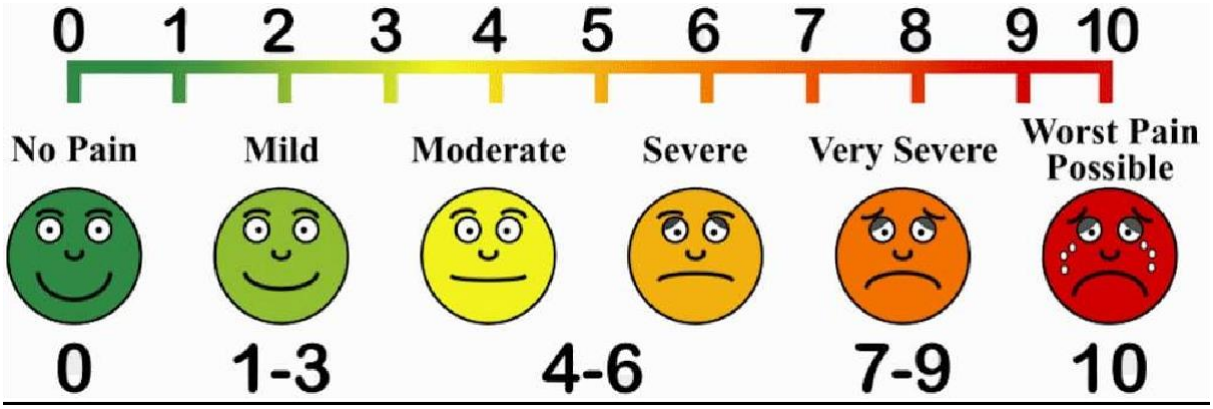
POST-OPERATIVE PAIN ACCORDING TO PAIN SCALE -

AT 6 HOURS -

POD 1 -

POD 2 -

POD 3 -



TYPES OF ANALGESIC - INTRAVENOUS FOR DAYS

ORALLY FOR DAYS

SSI ACCORDING TO SOUTHAMPTON SCORING SYSTEM ON 3RD DAY

HOSPITAL STAY IN DAYS

LABORATORY TESTS

HB% -

TOTAL COUNT -

DIFFERENTIAL COUNT -

N/L/E/B/M

RBS –

HIV - REACTIVE / NON-REACTIVE

HBsAg - REACTIVE / NON-REACTIVE

HCV - REACTIVE / NON-REACTIVE

KEY TO MASTER CHART

SR NO	SERIAL NUMBER
IP NO	IN PATIENT NUMBER
AGE	AGE IN YEARS
SEX	MALE / FEMALE
DOA	DATE OF ADMISSION
DOD	DATE OF DISCHARGE
DIAGNOSIS	DIAGNOSIS OF PATIENT
PROCEDURE	LAPAROSCOPIC PROCEDURE PATIENT UNDERWENT
10 MM	NUMBER OF 10 MILLIMETER PORTS
5 MM	NUMBER OF 5 MILLIMETER PORTS
TIME	TIME REQUIRED TO CLOSE THE SKIN OF LAPARASCOPIC PORT SITE
AVERAGE	AVERAGE TIME REQUIRED TO CLOSE ONE PORT
POP 6	POSTOPERATIVE PAIN AFTER 6 HOURS OF SURGERY
POD 1	POSTOPERATIVE PAIN ON DAY ONE
POD 2	POSTOPERATIVE PAIN ON DAY TWO
POD 3	POSTOPERATIVE PAIN ON DAY THREE
TYPE OF ANALGESIS	ANALGESICS GIVEN TO PATIENT POSTOPERATIVELY
IV	INTRAVENOUS ANALGESIA GIVEN FOR DAYS
ORAL	ORAL ANALGESIA GIVEN FOR DAYS
SSI SCORE	SURGICAL SITE INFECTION SCORE ACCORDING TO SOUTHAMPTON SCORING SYSTEM
HOSPITAL STAY	HOSPITAL STAY OF PATIENT IN DAYS

MASTER CHART

SR	NAME	AGE	SEX	IPNO	DOA	DOD	COMORBIDITY	DIAGNOSIS	PROCEDURE	10MM	5MM	TIME	AVERAGE	POPAIN6HOUR	POD1	POD2	POD3	TYPE OF ANALGESIC	IV	ORALLY	SSI SCORE	HOSPITAL STAY
1	VILAS IMMANAD	38	MALE	130211	08-03-2021	12-03-2021	NO	HIATUS HERNIA	LAPAROSCOPIC NISSEN FUNDOPLICATION	2	3	35	7	9	8	6	2	NSAID	2	3	0	5
2	BHOOMIKA KABBALGER	23	FEMALE	133045	04-08-2021	07-08-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	28	7	9	6	0	0	NSAID	1	4	0	4
3	IRRAMMA MATH	35	FEMALE	145909	16-08-2021	20--08-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	36	9	10	7	2	0	NSAID	1	4	0	5
4	MAHADEVI SAJJAN	55	FEMALE	105542	11-07-2021	18-07-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	1	25	8	10	7	5	2	NSAID	2	3	0	8
5	KALAVATI CHAVAN	45	FEMALE	122138	16-08-2021	19-08-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	36	9	8	6	0	0	NSAID	1	4	0	4
6	MUKTABAI HONAKORE	35	FEMALE	1180	24-0	28-0	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	24	8	10	6	2	0	NSAID	1	3	0	5

				15	8-2021	8-2021																	
7	SHARADA BADIGER	36	FEMALE	1204003	07-03-2021	14-03-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	32	8	10	8	4	2	NSAID	1	4	0	7
8	RUKMINI KASHIRASAGAR	40	FEMALE	1487388	19-08-2021	23-08-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	1	24	8	10	8	6	3	NSAID	2	3	0	5
9	VIJAYALAXMI SBANNI	30	FEMALE	6694949	27-06-2021	30-06-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	36	9	10	8	2	0	NSAID	1	4	0	4
10	SHARANAGAUDA PATIL	62	MALE	94244	06-04-2021	10-04-2021	NO	LEFT INDIRECT INGUINAL HERNIA	LAPAROSCOPIC MESH HERNIOPLASTY	1	2	18	6	8	4	2	1	NSAID	1	3	0	5
11	SUHASINI SHAVIR	32	FEMALE	1415922	22-03-2021	31-03-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	36	9	10	10	8	6	NSAID	2	3	0	9
12	KASTURIBAI MANAGULI	43	FEMALE	10274	07-01-2021	12-01-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	35	9	10	6	2	0	NSAID	1	3	0	6
13	SANJEEVKUMAR HIPPARADI	40	MALE	1311511	09-05-2022	11-05-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	36	9	8	6	3	0	NSAID	1	3	0	3
14	MUTTANNA MANNGAL	32	MALE	86095	22-03	25-03	NO	RECURRENT APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	24	8	8	4	2	0	NSAID	1	4	0	4

					-20222	-20222																	
15	BHAGYASHREE KUMBAR	9	FEMALE	399336	31-01-2022	03-02-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	24	8	8	7	2	0	NSAID	2	3	0	4
16	VIVEKANAND SHETTI	32	MALE	286336	21-01-2022	23-01-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	24	8	8	6	2	0	NSAID	1	4	0	4
17	SHILPA TONASHYL	25	FEMALE	660888	21-02-2022	25-02-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	24	8	7	5	3	0	NSAID	1	4	0	5
18	SHABANA SATHACHE	32	FEMALE	832144	07-03-2022	10-03-2022	NO	RECURRENT APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	26	9	8	6	2	0	NSAID	1	4	0	4
19	RENUKA HELAVARE	29	FEMALE	886088	13-03-2022	16-03-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	36	9	8	6	3	0	NSAID	1	4	0	4
20	ABHINANDAN MINAJAGI	29	MALE	131941	08-03-2021	10-03-2021	NO	LEFT INDIRECT INGUINAL HERNIA	LAPAROSCOPIC MESH HERNIOPLASTY	1	2	21	7	7	4	2	0	NSAID	1	3	0	3
21	SIDDANAGAUDA PATIL	41	MALE	280071	12-08-2022	18-08-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	36	9	10	7	5	2	NSAID	2	3	0	7
22	MALLAPPA HOSAKOTI	58	MALE	221378	29-05-	05-06-	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	32	8	10	7	5	2	NSAID	2	3	0	7

					2022	2022																	
23	VIDYA GANJI	30	FEMALE	103057	29-03-2022	04-04-2022	NO	RECURRENT APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	21	7	9	6	2	0	NSAID	1	3	0	5
24	AARTI HOSAMANI	11	FEMALE	190632	06-06-2022	10-06-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	18	6	9	6	3	0	NSAID	1	4	0	5
25	RASHIKALA CHAVAN	33	FEMALE	196739	20-06-2022	22-06-2022	NO	RECURRENT APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	21	7	9	6	3	0	NSAID	1	3	0	3
26	SHILPA CHANDKI	24	FEMALE	238429	12-09-2022	14-09-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	36	9	10	8	6	0	NSAID	2	3	0	3
27	ASHA MADABHAVI	29	FEMALE	198306	11-08-2022	16-08-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	32	8	9	8	3	0	NSAID	1	3	0	7
28	ISMAIL MULLA	49	MALE	140255	23-05-2022	28-05-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	28	7	9	6	4	0	NSAID	2	3	0	6
29	SUHAS KOKATANAUR	18	MALE	181768	15-07-2022	20-07-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	21	7	9	6	2	0	NSAID	1	3	0	6
30	RENUKA PAWAR	38	FEMALE	192514	06-06-22	10-06-22	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	21	7	9	6	3	0	NSAID	1	4	0	5

					02-02-2022	02-02-2022																	
31	GADDENNA PUJARI	15	MALE	168731	20-05-2022	23-05-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	21	7	9	5	2	0	NSAID	1	4	0	3
32	SHIVA HAJERI	14	MALE	707007	09-08-2022	13-08-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	24	8	10	7	3	0	NSAID	1	4	0	4
33	SHALINI PATIL	24	FEMALE	238426	12-08-2022	16-08-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	32	8	9	5	2	0	NSAID	1	3	0	4
34	PUSHAPA HAIYALI	24	FEMALE	207192	17-06-2022	22-06-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	36	9	9	6	3	0	NSAID	1	3	0	5
35	ANIL JALAGERI	22	MALE	346667	03-10-2022	05-10-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	24	8	9	6	2	0	NSAID	1	3	0	3
1	KADAPPA SHIRAGUPPI	32	MALE	131741	03-08-2021	05-08-2021	NO	RECURRENT APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	48	16	9	6	3	0	NSAID	2	3	0	3
2	KASAPPA HANDIGANUR	70	MALE	28280	20-12-2021	27-12-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	60	15	10	8	5	2	NSAID	2	3	0	7
3	KAVERI MATHAPATI	17	MALE	2930	12-12	15-12	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	51	17	9	6	3	0	NSAID	1	4	0	5

				66	-2021	-20211																	
4	SUSHILA PATIL	50	FEMALE	19133	30-12-2021	06-01-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	72	18	9	7	3	0	NSAID	1	4	0	6
5	BHOOMIKA LONARI	19	FEMALE	307103	26-12-2021	01-01-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	51	17	9	7	2	0	NSAID	1	3	0	5
6	BHIMRAY BIRADAR	56	MALE	38212	31-12-2021	06-01-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	80	20	10	7	3	0	NSAID	2	3	4	6
7	SHANKARAYA NAGARE	27	MALE	13066	11-01-2022	15-01-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	72	18	10	7	5	2	NSAID	2	3	0	5
8	ANAND KUDAGI	26	MALE	64715	01-01-2021	05-01-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	48	16	9	6	2	0	NSAID	1	4	0	5
9	NELAWWA CHALAWADI	80	FEMALE	315748	29-12-2021	03-01-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	72	18	9	7	5	1	NSAID	1	4	0	5
10	SHARADA WADDAR	36	FEMALE	25122	09-01-2021	13-01-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	72	18	10	7	4	1	NSAID	2	3	0	5
11	SUJATA PANTOJI	28	FEMALE	52125	11-01-	15-01-	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	80	20	9	6	2	0	NSAID	1	4	0	6

					20/02/22	20/02/22																	
12	LAXMI MADAR	32	FEMALE	23510	20-02-2022	24-02-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	76	19	9	6	1	0	NSAID	1	4	0	5
13	RUCHIKA RUNWAL	37	FEMALE	160779	20-04-2022	24-04-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	80	20	9	7	5	2	NSAID	2	3	0	4
14	BHAGIRATHI CHIMMALAGI	36	FEMALE	419511	11-01-2021	20-01-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	76	19	10	8	7	5	OPIOID	2	3	0	9
15	SHRIMATH BIRADAR	60	MALE	62285	21-05-2021	29-05-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	72	18	9	6	3	0	NSAID	2	3	0	8
16	PRAKASH SHETTI	58	MALE	55640	14-01-2021	18-01-2021	NO	RECURRENT APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	54	18	9	5	2	0	NSAID	1	4	0	5
17	CHETAN NAIK	16	MALE	4533	03-04-2021	08-04-2021	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	51	17	8	4	1	0	NSAID	1	3	0	4
18	MALA RUMALBHAVI	39	FEMALE	72645	27-01-2021	03-02-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	76	19	9	7	3	0	NSAID	1	4	0	6
19	ANNAPURNA GONI	45	FEMALE	11	01-04-2	06-04-2	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	80	20	10	7	5	2	NSAID	2	3	2	7

					02-02-2021	02-02-2021																	
20	NEEJAMMA MADAR	50	FEMALE	9871	02-02-2021	07-02-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	76	19	9	7	5	2	NSAID	2	3	0	5
21	RANI KUMBAR	27	FEMALE	161323	23-03-2021	30-03-2021	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	76	19	10	7	3	0	NSAID	2	3	0	7
22	SHANKARNAG NAGARE	27	MALE	13066	11-01-2022	13-01-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	64	16	9	6	3	0	NSAID	1	4	0	3
23	RATIDEVI KUMBAR	40	FEMALE	221536	28-06-2022	04-07-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	68	17	9	5	2	0	NSAID	1	4	0	5
24	SANGAMMA HELAWAR	50	FEMALE	277073	10-08-2022	20-08-2022	NO	ACHALASIA CARDIA TYPE 3	LAPAROSCOPIC TOUPET FUNDOPLICATION ANTERIOR CARDIOMYOTOMY	2	2	80	20	10	10	8	5	OPIOID	2	3	3	10
25	BHAGYSHREE NYAMAGOUD	32	FEMALE	150352	04-05-2022	10-05-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	68	17	9	5	2	0	NSAID	2	3	0	6
26	PINKIDEVI MAHESHWARI	33	FEMALE	173963	23-05-2022	26-05-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	76	19	10	7	5	2	NSAID	2	3	3	4
27	ANNAPPA BHAJANTRI	18	MALE	2810091	13-08-20	20-08-20	NO	ACHALASIA CARDIA TYPE 3	LAPAROSCOPIC MODIFIED HELLERS CARDIOMYOTOMY	2	2	80	20	10	8	6	3	NSAID	2	3	0	7

					22	22																	
28	SHAMBHULINGA SWAMI	32	MALE	189386	03-06-2022	06-06-2022	NO	RECURRENT APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	51	17	9	5	2	0	NSAID	1	4	0	3
29	MANJULA KAMBLE	37	FEMALE	211961	21-06-2022	25-06-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	54	18	8	5	2	0	NSAID	1	4	0	4
30	MAHANTESH APHAJALPUR	44	MALE	261007	29-07-2022	05-08-2022	NO	HIATUS HERNIA	LAPAROSCOPIC TOUPET FUNDOPLICATION POSTERIOR CARDIOMYOTOMY	2	2	76	19	10	8	5	3	NSAID	2	3	0	7
31	SHARANABAI PATIL	60	FEMALE	332443	24-09-2022	29-09-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	72	18	9	6	3	0	NSAID	1	4	2	6
32	ASWINI KALELAR	27	FEMALE	316660	10-09-2022	15-09-2022	NO	CHOLELITHIASIS	LAPAROSCOPIC CHOLECYSTECTOMY	2	2	54	18	9	7	5	2	NSAID	1	4	0	5
33	GEETA RAJPUT	27	FEMALE	348149	03-10-2022	07-10-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	48	12	8	5	2	0	NSAID	1	4	0	5
34	SHASHIKALA WAGHMORE	28	FEMALE	175798	18-05-2022	24-05-2022	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	45	15	8	4	2	0	NSAID	1	4	0	4
35	ARCHANA MADAR	19	FEMALE	280880	13-08-20	17-08-20	NO	ACUTE APPENDICITIS	LAPAROSCOPIC APPENDICECTOMY	1	2	48	16	8	5	3	0	NSAID	1	4	0	4

					2 2	2 2																	

THANK YOU

A COMPARATIVE STUDY TO ASSESS THE SUPERIORITY OF CYANOACRYLATE GLUE APPLICATION OVER CONVENTIONALSUTURING FOR THE SKIN CLOSURE OF LAPAROSCOPIC PORTSITES.

A Prospective Study

3

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