“A PROSPECTIVE STUDY OF A COMMONLY OVERLOOKED CAUSE OF SURGICAL SITE AND INFECTION-LOW HDL ” IN GRH, MADURAI

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CERTIFICATE BY THE GUIDE

This is to certify that the dissertation entitled "**A PROSPECTIVE STUDY OF A COMMONLY OVERLOOKED CAUSE OF SURGICAL SITE AND INFECTION-LOW HDL"** is a bonafide research work done by **Dr . J. KARTHICK,** M.S. Post graduate student in the Department of General Surgery, Madurai Medical College & Hospital, Madurai, in partial fulfillment of the requirement for the degree of M.S. in General Surgery from August 2018 – August 2019.

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I, **Dr. J. KARTHICK** solemnly declare that the dissertation titled "**A PROSPECTIVE STUDY OF A COMMONLY OVERLOOKED CAUSE OF SURGICAL SITE AND INFECTION-LOW HDL"** is a bonfide and genuine research work carried out by me under the guidance of **Dr. J. AMUTHAN M.S.DLO,** Professor, Department of General Surgery, Madurai Medical College, Madurai.

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CONTENTS

INTRODUCTION

SSI is the infection following surgery at surgical incision and surgical space. SSI can be superficial sometimes involving only skin or it can extend beyond subcutaneous tissue to facial planes and organ space. SSI are responsible for an increased economic burden to health care system including additional postoperative hospital duration and cost, increases morbidity to the patient

Surgical site infection (SSI) is most challenging to every surgeons and each and everybody is trying their methods to reduce the problem.

Before the mid-19th century, surgical patients commonly developed post operative 'incapacitating fever', followed by purulent discharge at the site of surgical incision followed by overwhelming sepsis, and often death would result. It was not until the late 1860s, after Joseph Lister introduced the principles of antisepsis, the postoperative infection associated morbidity decreased substantially. There was a radical change in surgery after Lister's pioneering work which resulted in shift in the surgical outcome from infection, high morbidity and mortality to a procedure that could eliminate suffering and prolong life.

Advances in infection control practices include improved operating room ventilation, sterilization methods, barriers, surgical technique, and availability of antimicrobial prophylaxis. Despite these activities, SSIs remain a substantial cause of morbidity and mortality

among hospitalized patients. There also are increased numbers of prosthetic implant and organ transplant operations performed. Thus, to reduce the risk of surgical site infection, a systemic but realistic approach must be applied with the awareness that this risk is influenced by characteristics of the patient, operation, personnel and hospital.

Factors responsible for SSI include ASA score, types of surgery, surgical wound class, sex, surgeons and last but not least the patient own host factors. The Centre for Disease Control and prevention, National infection survillence system(NNIS), established on 1970, monitors reported trends in nosocomial infectioms in US acute care hospitals. Based on NNIS system reports SSI are the third most frequently reported nosocomial infection accounting for 14-16% of all nosocomial infections among hospitalized patients.

Among surgical patients , surgical site infections were the most common nosocomial infections, accounting for 38% of all such infections. Of these SSI two third were confined to the incision and one third involved organs and space accessed during surgery. When surgical patients with nosocomial SSI died, 77% of the deaths were due to infections and majority (93%) were serious infections involving organs or spaces accessed during the operations

Cholesterol plays amajor role in human body which cannot be

ignored as it the precursor of five major classes of steroid hormones. Cholesterol has its own significance in gluconeogenesis and immune system. Cholesterol either through its lipoproteins or apo lipoproteins, directly or by transport or stimulating cascade of immune system and complement pathway play a major role in infection control.

At present a Surgeon has responsibility in dealing with surgical site infection , while dealing with infection , the knowledge about use of proper aseptic and antiseptic technique and appropriate use of antibiotic prophylaxis and treatment enough monitoring and supportive surgical as well as pharmacological and non pharmacological intervention.

Hence this study was taken to find the association of incidence of SSI in relation to cholesterol level (HDL) in 175 patients admitted for elective hernia repair in Madurai GRH

AIMS AND OBJECTIVE

AIM:

The study was undertaken to assess whether preoperative lower HDL level is associated with increased risk for surgical site infection

PRIMARY OBJECTIVE:

To evaluate HDL level in elective surgical patients

SECONDARY OBJECTIVE:

To follow up the patients in post op period and assess whether low HDL has risk for surgical site infection

REVIEW OF LITERATURE

Historical background

Roman named Marcus varro explained that, Microbes was not until 100, BC certain minute invisible animals carried by air.

First Surgeon in history is ancient man when he dared to cut off his limb, while it was entangled between the jaws of a wild forest animal.

Father of Surgery, Ambrose pare (1500- 1590) – he tells to wounded patient "I dressed him and God cured him" [1]

Dr. Susuruta 6th century BC – Father of Indian surgery mention made regarding cleanliness of surgeon and maintenance amply stressed in the ancient Hindu text "Susuruta Samhita". He wrote on the subject of wounds, its process of repair and management.

1683 – Antony Van Leeuwenhock – credit for having first person observed and reported about the microorganisms, bacteria.

Joseph Lister (1826 – 1912) - he was the Father of modern surgery, great contribution to surgery by Antiseptic technique , that prevent the wound from infection, by demonstration [1]

1865 – Lister began applying pure carbolic acid into wounds.

1871 – Lister also began using carbolic acid spray to decrease contamination of the operating room atmosphere.

William Stewart Halsted (1852 – 1922) introduced the rubber gloves for his nurse, Caroline Hampton because the corrosive sublimate used to sterilize instrument mercuric chloride, which irritated her skin. [1]

Joseph Blood good –he began the regular use of gloves by the whole operative team.

1928 – Alexander Fleming – discovery of antibiotic drug, penicillin from penicilliumnotatum fungus.[1]

1940 – Howard Florey first clinically uses the penicillin to the patient.

Robert Koch (1843 -1910) – laid down the first definition of infective disease (Koch postulates)

1876 – Identify the bacteria Anthrax bacillus 1882 – Identified Mycobacterinm tuberculosis 1883 – Identified Cholera bacillus

Louis pasteur – clearly explained the relationship of microorganism to purulent discharge, pus formation – propounded the germ theory of diseases.

Von bergmann, 1866 – who first introducing steam sterilization of surgical instrument.

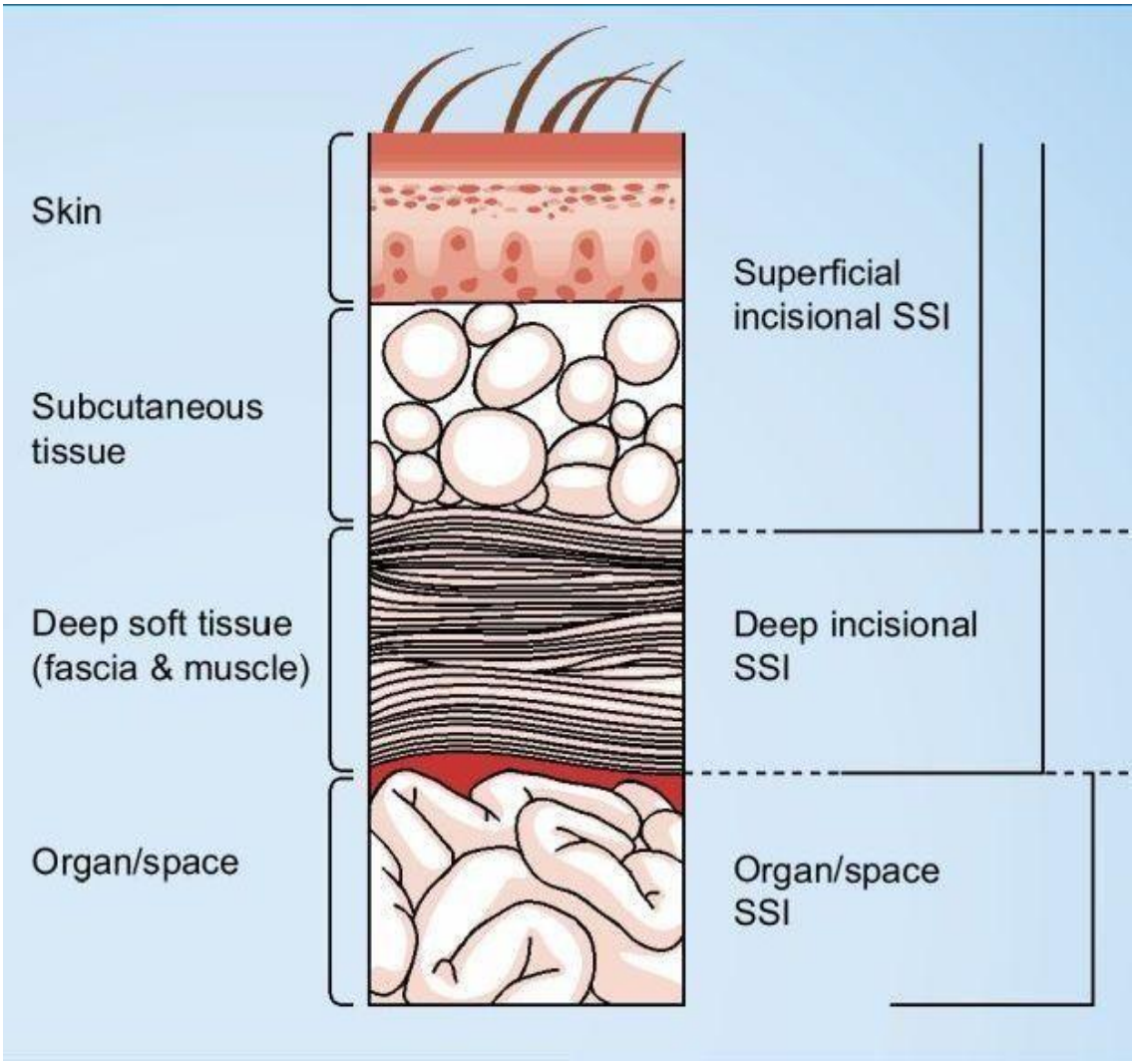
1944 –Streptomycin was discovered followed by chloramphenical, tetracycline, aminoglycosides and beta lactum agent

John Hunter – who explained the wound healing by first intention and second intention

Ignaz Semmelweis (mid 19th century) – gynecologist, initiate hand washing with hypochlorite solution decreases puerperal infection rate dramatically.[2]

Ernst bergmann had said “today we wash our hand before an operation” [3]

CLASSIFICATION OF SURGICAL SITE INFECTIONS (SSI) [11]



A. ACCORDING TO THE DEPTH OF THE WOUND INFECTION

Superficial Incisional SSI

- It developed within 30 days of operative intervention
- SSI‟s occur in skin and the sub-cutaneous fascia only and one of the following,
- pus drainage , microorganisms isolated from discharge fluid/ tissue of superficial incision site, atleast one sign‟s of inflammation,
- Wound is deliberately by the surgeon,
- Surgeon or the attending physician declares that the operative wound is infected with microorganisms.

Deep Incison SSI

- It developed within 30 days of surgical intervention or 1 year if an any foreign body (implant) is present
- Occur in the deep soft tissues of the incision site and at least 1of the following –
- Pus discharge from deep surgical incision site without organ or interspace involvement,

- Fascial sepration or deliberate separation by the surgeon deep abscess identified by re surgery/ histopathology/ radiological investigation, surgeon or the attending physician declares deep infection present.

Organ space infection

- It developed within 30days or 1 year if an any foreign body (implant) is present,
- Occurs in anatomic structures not opened or handled during surgery and

One of the following –

- Purulent drained from the external drain kept in the visceral organ or organ space,
- microorganism identified by method of culture,
- presence of pus by direct examination/ re surgery/ histopathological examination/ radiological investigation,
- Identified by surgeon or attending physician.

CLINICAL PRESENTATION OF SSI'S

Clinically surgical wound infection unidentified upto fifth post operative day, but this kind of patients present with rise temperature starts prior in the post operative duration.

Local manifestations

1. Active inflammation in the surrounding tissues (cellulitis)
2. Pus formation in the wound site
3. Necrotising soft tissue infection- less commonly myonecrosis by the bacterium, clostridia. More dangerous non clostridial infective tissue gangrene, Meleney‟s ulcer in the postsurgical synergistic infection myonecrosis
4. Infection of the Intraabdominal organ and space.

Systemic manifestations

1. Postoperative increase in body temperature
2. Spreading of microorganisms in the blood and septicemia

⇩

Systemic inflammatory response syndrome (SIRS)

⇩

Multiple organ dysfunction syndrome (MODS)

⇩

Multiple system organ failure

Risk factors to Surgical Site Infection includes 3 main determinants.

1. Bacterial factors

- Total number of Bacterial load, effectiveness of causing infection (virulence) and resistance of bacterial to the body
- Duration of preoperative stay of patient in hospital
- Remote site infection
- Time duration for surgical intervention
- Emergency surgery
- Type of wound class
- inappropriate antibiotic therapy for infection
- improper Pre operative shaving or clipping

2. Local wound factors [9]

- operative techniques
- hematoma /seroma formation in wound
- necrosis

- sutures materials
- drains
- foreign bodies in wound

3. Patient factors [9]

- age –extremes of age
- immunosuppression status [10]
- drugs, prolonged steroid use
- carcinoma
- obesity
- hypocholesterolemia
- diabetesmellitus
- undernutrition
- blood transfusion
- smoking

- low oxygen tension
- Temperature
- Poor Glycemic control
- Vascular disorders

COMPLICATIONS

1. Wound dehiscence

A. Incomplete

   Superficial- wound gaping

   Deep- Late incisional hernia

B. Burst abdomen

2. Local stitch sinuses and abnormal connection between two epithelial surface
3. Collection of discharge after the use of antibiotics in form of antibiomas
4. Ca deposition in the wound site and ossification
5. Regional lymph node infection secondary to local infection
6. Ugly keloid scar tissue result of poor healing

VARIABLES THAT INFLUENCE SSI SENIC RISK INDEX [4,5,6]

VARIABLES THAT INFLUENCE SSI	POINT
An abdominal surgery	1
Duration of Operation for more than 2 hours	1
Surgical wound site classified as contaminated or dirty / Infected	1
Operative intervention on a patient with >3 discharge Diagnosis	1
TOTAL INDEX	4

- SENIC risk index, which was replaced by the American society of anaesthisiologist (ASA) preoperative assessment score which was validated in a large study containing 44 hospitals from 1987 to 1990.

  The wound infection rate among ASA class 1 or class 2 - 1.9% The wound infection rate among ASA class 3to class 5 - 4.3%

AMERICAN SOCIETY OF ANAESTHIIOLOGISTS (ASA)

Pre operative assessment score

- Class I

A patient in normal health status.

- Class II

A patient with mild systemic disease resulting in no limitations to their function

- Class III

Systemic disease of the patient is severe that limits activity but not to incapicititating

- Class IV

Systemic disease of the patient is severe, that is a constant threaten to survive

- Class V

A diseased patient not likely to live 24 hrs

THE NATIONAL NOSOCOMIAL INFECTION SURVEILLANCE AS BASIC SSI RISK INDEX [7]

NNIS SYSTEM	POINT
Operation contained as class3 and class4 surgical wound	1
The patient has an ASA preoperative score of 3,4, or5	1
Duration exceeds 75th percentile of „T" Point	1

„T" point defined as length of the time in hours that represents 75th percentile of procedures in NNIS survey

The T point for common surgical procedures,

Operation	T point (hrs)
Coronary artery bypass graft	5
Bile duct , liver or pancreatic surgery	4
Craniotomy	4
Head and neck surgery	4
Colonic surgery	3
Joint prosthesis surgery	3
Vascular surgery	3
Abdominal or vaginal hysterectomy	2
Ventricular shunt	2
Hernioraphy	2
Appendectomy	1
Limb amputation	1
Cesarean section	1

PATHOPHYSIOLOGY SEQUENCE OF EEVNTS (IN SURGICAL WOUNDS)

All operative wounds are contaminated by microorganisms but only a minority actually presents clinical infections. In many of the patients infections doesnot occur because innate host defenses are quiet effective in the elimination of microorganisms at the surgical wound.

The interplay of four important determinants leads to either uneventful wound healing or surgical site infection.

1. Bacteria inoculation in wound
2. Effectiveness of bacteria to cause infection
3. Adjuvant effects of micro environment and
4. Innate and acquired immunity of host defenses mechanisms

    - Initiation of inflammation introduced by cutting, incisions with knife, abrasions, burns wound.

- This process activates inflammatory process by protein coagulation, aggregation of platelet, initiate activity of mast cell, release of factors of complement and cytokines, brady kinin. These total effect result in beginning of phase 1 reaction

- Phase I - inflammation start with dilation of vessels, increased in flow, increased vascularity.

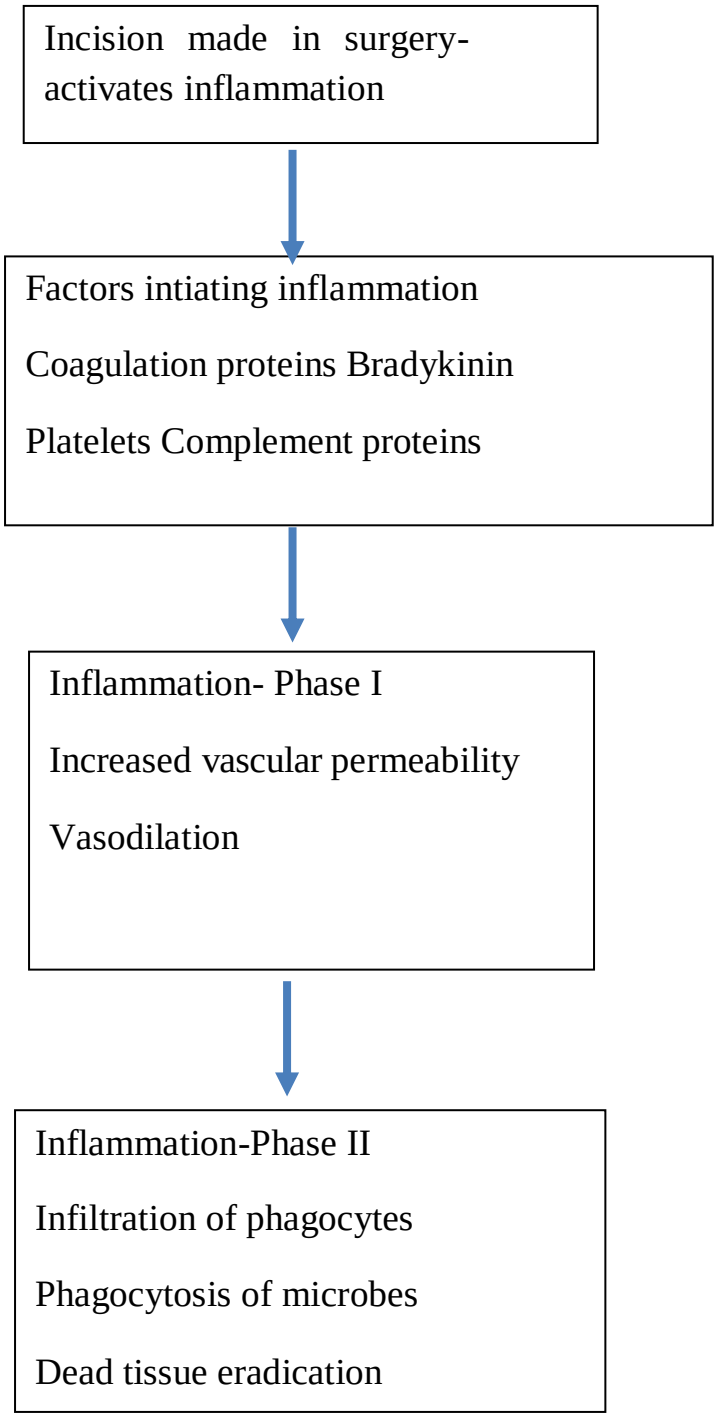
- Phase II inflammation starts with polymorphic neutrophils infiltration and bacterial phagocytosis, removal of dead tissue with release of pro- inflammatory cytokines. In this circumstances neutrophils and monocyte reach the wound site before the inoculation of microorganisms, so the host is ready to act against the bacteria priorly. If contamination of bacteria is controlled, monocytes initiate to regulate wound healing process using myo-fibrocytes and collagen materials.

- If microorganisms contamination is uncontrolled, pro inflammatory cells release tumour necrosis factor-α to stimulate polymorphic for phagocytosis.

- At the sametime it causes release of reactive O2and acid hydrolases from lysosomal vacuoles.

- Which result in lipid peroxidation leading to release of cytokines, and initiate acute inflammatory response by creation of cavity containing purulent materials which contains dead tissue, polymorphic neutrophils, bacteria and proteinaceous rich fluid with all signs of inflammation – rubor, dolor, calor, tumour. It is typical suyrgical site infection (SSI).

Flow chart


Incision made in surgery- activates inflammation
Factors intiating inflammation
Coagulation proteins Bradykinin
Platelets Complement proteins
Inflammation- Phase I
Increased vascular permeability
Vasodilation
Inflammation-Phase II
Infiltration of phagocytes
Phagocytosis of microbes
Dead tissue eradication

CLASSIFICATION OF SURGICAL WOUNDS [8]

- Clean wounds

Operation which does not entered into normally colonized visceral organ.

- Clean – contaminated

Operation which enters into colonized organ but entered in elective controlled manner.

- Contaminated wounds

More contamination with microorganisms is occured at the operative site with out of obvious microbial infection.

- Dirty wounds

Surgical operative procedure done when active microbial infection is occurred

A. CLASSIFICATION OF WOUND INFECTION ACCORDING TO THE ETIOLOGY

a. Primary infection where the wound is the primary site of infection.
b. Secondary infection arises following a complication that is not directly related to the wound.

B. CLASSIFICATION OF WOUND INFECTION ACCORDING TO THE TIME

a. An early infection presents within 30 days of a surgical procedure.

b. An intermediate infection occurs 1-3 months after surgery.

c. Late infection occurs in >3 months after surgery.

C. CLASSIFICATION OF WOUND INFECTION ACCORDING TO THE SEVERITY

a. Minor wound infection if there is discharge without cellulitis or deep tissue destruction.

b. Major if discharge of pus is associated without tissue breakdown, partial or total dehiscence of the deep fascial layers of the wound, or if systemic illness is present.

The ASEPSIS wound score

Criterion Points

Additional treatment	0
Antibiotics for wound infection	10
Pus drained under local anaesthesia	5
Wound necrotic materials removal under general anaesthesia	10

Serous discharge from the wound

daily 0–5

Erythema in and around the wound	daily	0–5
Pus discharge daily		0–10
Separation of deeper tissues daily		0–10
Bacterial isolate from the wound		10

Stay in hospital for long duration >14 days as result

of wound infection 5

Wound grading system -Southampton 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 of inflammation

IIa -- At one point

IIb -- Around sutures

IIc -- Along wound

IId -- Around wound

III -- Clear or haemoserous discharge

IIIa --At one point only (not more than 2 cm)

IIIb --Along wound (more than 2 cm)

IIIc -- Large volume

IIId -- Prolonged (more than 3 days)

IV Major complication-- Pus

IVa -- At one point only (not more than2 cm)

IVb -- Along wound (more than 2 cm)

V-Deep or severe wound infection with or without tissue breakdown; haematoma requiring aspiration

Surgical Care Improvement Project (SCIP) Guidelines

SCIP INF 1	Antibiotic prophylaxis within 1 hour before incision
SCIP INF 2	Antibiotic prophylaxis selection for surgical Patients
SCIP INF 3	Antibiotics prophylaxis discontinued within 24 hours after surgery (48 hours for cardiac patients)
SCIP INF 4	Cardiac surgery patients with controlled postoperative serum glucose at 6am
SCIP INF 5	Postoperative wound infection during hospitalization
SCIP INF 6	hair removal of surgical patients with appropriate material and time
SCIP INF 7	Normal temperature postoperatively in Colorectal surgery Patients

NNIS Score and Risk for SSI

Risk Factors

Procedure time >75th

percentile

Contaminated or dirty

wound ASA III, IV, V

Number of positive risk factors	Risk for SSI
0	1.5%
1	2.9%
2	6.8%
3	13%

Comparison of NNIS Score and Wound Classification for Predicting Risk

for SSI

NNIS RISK SCORE

Wound class	**0**	**1**	**2**	**3**	**All**
Clean	1.0	2.3	5.4	-	2.1
Clean-contaminated	2.1	4.0	9.5	-	3.3
Contaminated	-	3.4	6.8	13.2	6.4
Dirty	-	3.1	8.1	12.8	7.1
All	1.5	2.9	6.8	13.0	-

Microbiology of Surgical Site infection :

The degree of bacterial contamination of the surgical site has been well defined. Clean surgical procedures are those where the operation has affected only integumentary and musculoskeletal soft tissues. Clean-contaminated procedures are those where a hollow viscus (eg. Alimentary, biliary, genitourinary, respiratory tract) has been extensive introduction of bacteria into a normally sterile body cavity, but for a period of time too brief to allow infection to become established during surgery (eg. Penetrating abdominal trauma, enterotomy during adhesiolysis for mechanical bowel obstruction). Dirty procedures are those where the surgery is performed to control established infection (eg. Colon resection for complicated diverticulitis).

Cellulitis refers to infection related erythema of skin (although other tissues may be affected) without drainage or fluctuance. Abscess refers to localized collections of purulent material within tissue. Necrotizing soft tissue infections (NSTI) invade tissue necrosis. When fascial is involved the infection is referred to correctly as necrotizing fascitis ; myonecrosis refers to involvement of underlying muscle. Necrotizing soft tissue infections are usually community acquired infections that require aggressive surgical debridement in addition to

antibiotic therapy, and further discussion herein is not germane. Most SSIs do not cause extensive tissue necrosis, especially if the gastrointestinal tract has not been entered during surgery. Rare but dangerous exceptions to that rule are SSIs caused by Streptococcus pneumoniae Clostridium perfringens.

Pathogen	Prevalence (%of isolates)
Staphylococcus	19
Coagulase-negative staphyloccus	14
Enterococcus sp.	12
Escherichia coli	8
Pseudomonas aeruginosa	8
Miscellaneous aerobic gram negative bacilli	7
Enterobacter sp	6
Streptococcus sp	6
Klebsiella sp	4
Miscellaneous anaerobic bacteria	3
Miscellaneous aerobic gram positive bacteria	2

HIGH DENSITY LIPOPROTEIN (HDL)

High-density lipoprotein (HDL) contains free or esterified cholesterol, phospholipids, triglycerides, and various proteins, including apolipoproteins, enzymes, and transfer pro- teins. The most abundant HDL apo lipoproteins are apoA-I and apoA-II; less abundant are apoC, apoE, apoD, and apoJ. HDL enzymes include lecithin:cholesterol acyltransferase (LCAT), serum paraoxonase-1 (PON1) [12-14], and platelet- activating factor acetyl hydrolase (PAF-AH) [15]. Transfer proteins include cholesterylester transfer protein (CETP) and phospholipid transfer protein (PLTP). Furthermore, chromatography and mass spectrometry have revealed many other proteins in HDL[16, 17].

HDL particles can be

sub classified into - small discoidal HDL (pre HDL 1 & 2)

Intermediate spherical HDL 3 (a,b,c)

Large cholesterol rich HDL 2 (a&b)

Large HDL particles interact with liver scavenger receptors class B type 1 (SR- B1), which ensures the delivery of cholesterol to the liver [18]. Intermediate HDL induces cholesterol efflux through the ATP-binding cassette transporter G1 (ABCG1) [19]. Small HDL particles

promote cholesterol efflux through the ATP- binding cassette transporter A1 (ABCA1) [20]. Accumulating evidence suggests that in addition to reverse transport of cholesterol from the periphery to the liver, HDL plays a major role in vasodilation and in the reduction of LDL oxidation [21], inflammation, apoptosis, thrombosis, and infection [22]. During infection, both innate and adaptive immunities are involved in the inflammatory process and the immune response. Innate immunity is a nonspecific defense mechanism comprising cellular and humoral responses. The cellular response includes antigen-presenting cells such as macrophage and dendritic cells. The humoral response includes various effectors, such as the complement cascade or soluble pattern recognition receptors (PRRs). Adaptive immunity is an antigen-specific defense mechanism against foreign antigens or pathogens. The principal effectors of adaptive immunity are B lymphocytes (humoral response) and T lymphocytes (cellular response). This paper focuses on role HDL in immune function and infection

HDL CHOLESTEROL AND INNATE IMMUNITY

Innate immunity is an ancient defense mechanism that humans inherited from invertebrates and that they use against a variety of pathogens. The main cells involved in innate immunity are monocyte-derived macrophage and dendritic precursor cells. Additional cells include natural killer cells, neutrophiles, eosinophiles, mast cells, basophiles, and epithelial cells. These cells use PRRs to recognize pathogen-associated molecular patterns (PAMPs). These PRRs include c-type lectins, leucin-rich proteins, macrophage scavenger receptors, pentraxins, lipid trans- ferase, integrins, and inflammasome proteins [24,25]. PAMP recognition leads to activation and production of the complement cascade, cytokines, and antimicrobial peptides [26]. In addition, PAMPs stimulate the differentiation of dendritic precursors into antigen-presenting, mature dendritic cells and trigger the adaptive immune system [26].

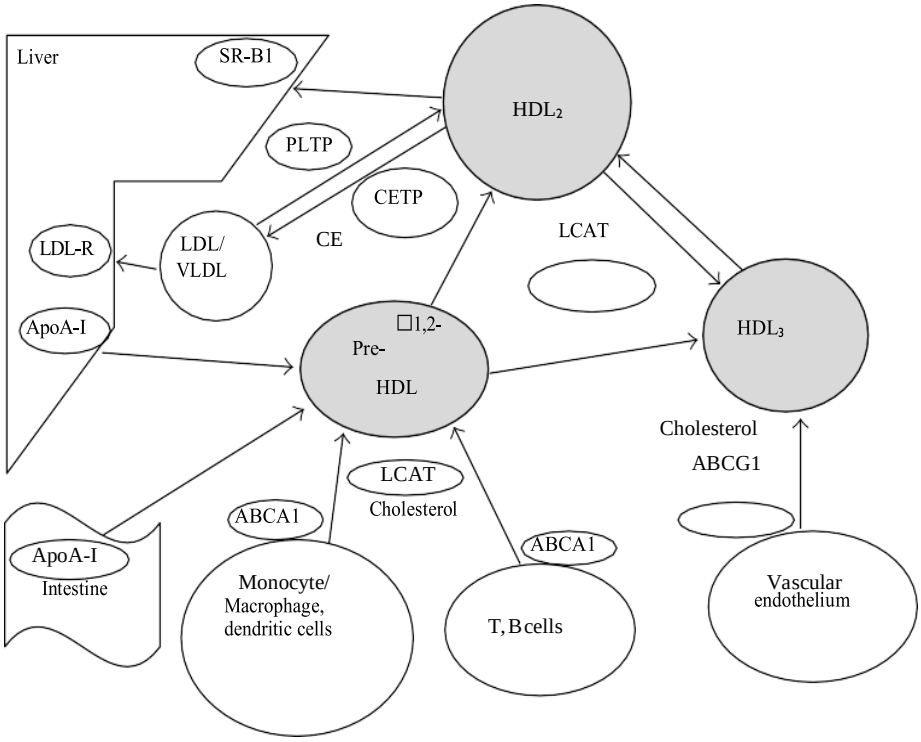


Figure 1: Dynamics of HDL particles and immune cells. SR-BI: scavenger receptor type B1, LDL-R: LDL receptor, CETP: cholesterol ester transfer protein, PLTP: phospholipid transfer protein, LCAT: lecithin:cholesterol acyltransferase, ABCA1: ATP binding cassette transporter A1, ABCG1: ATP binding cassette transporter G1

ACUTE PHASE.

During the acute phase of inflammation mediators such as tumor necrosis factor- (TNF) and interleukin-6 (IL-6) induce serum amyloid A (SAA) and group IIA secretary phospholipase A (sPLA -IIA), which markedly change the composition of HDL apo lipoproteins and lipids [27,28]. ApoA-1 gene expression and plasma half- life decrease [29,30]. SAA rapidly becomes the most abundant protein in association with HDL [31]. PON1 enzyme activity decreases and, thereby, the antioxidant properties of HDL are reduced [32]. PAF-AH is increased, thus leading to increased levels of proatherogenic lipids [33,34]The altered composition of HDL lipids includes decreased levels of cholesteryl ester and phospholipids and increased levels of triglycerides, free cholesterol, ceramides, and glucosylce- ramides [35].

Acute phase HDL is associated with disease activity; a decreased number of small HDL particles is inversely associated with the disease activity score and C-reactive protein (CRP) level [36].

PROTECTION FROM SEPSIS.

Lipopolysaccharide (LPS) is the primary cause of sepsis induced by gram-negative bacteria. LPS, LPS-binding protein, CD14, and the toll-like receptor 4 (TLR4) complex induce macrophage activation [37]. HDL, particularly apoA-I, decreases macrophage activation by binding and neutralizing LPS [38]. The HDL receptor in the liver, SR-B1 also provides important protection against sepsis [39,40]. SR-B1 deficiency results in a reduced rate of survival following sepsis [39]. SR-B1 also modulates TLR4 signaling in macrophages and helps facilitate LPS removal from circulation [39,40]. HDL modulates SR-B1 function by reverse transporting core cholesteryl ester to the liver via SR-B1 enabling the production of pre-HDL which effectively removes cholesterol from macrophages, dendritic cells, and lymphocytes.

In clinical sepsis, a positive correlation is evident between PLTP activity and acute-phase markers such as CRP and LPS- binding proteins. During human experimental endotoxemia, PLTP activity decreases at the time of LPS infusion and tran- siently increases during reconstituted HDL infusion. PLTP can accelerate the disturbance of lipoprotein homeostasis, thereby playing a role in the attenuation of the acute-phase response [41].

Cellular Innate Response.

Macrophages and dendritic cells are antigen-presenting cells that are crucial to innate immunity. The cell surfaces of macrophage and dendritic cells express costimulatory molecules, which are required for stimulation of the adaptive cellular immune system, and lipid rafts, which are microdomains that contain high concentrations of cholesterol, sphingolipids, and proteins integral to signaling, protein transport, and adhesion [42,43]. The shifting composition of lipid rafts particularly decreases in cholesterol, downregulates some cellular functions [44], including the activation, adhesion, spread, and migration of neutrophiles. HDL, or particularly apoA-I, is involved in interaction with ABCA1 or ABCG1 and removes cholesterol from the lipid rafts in macrophages and dendritic cells[45,46](fig 2)

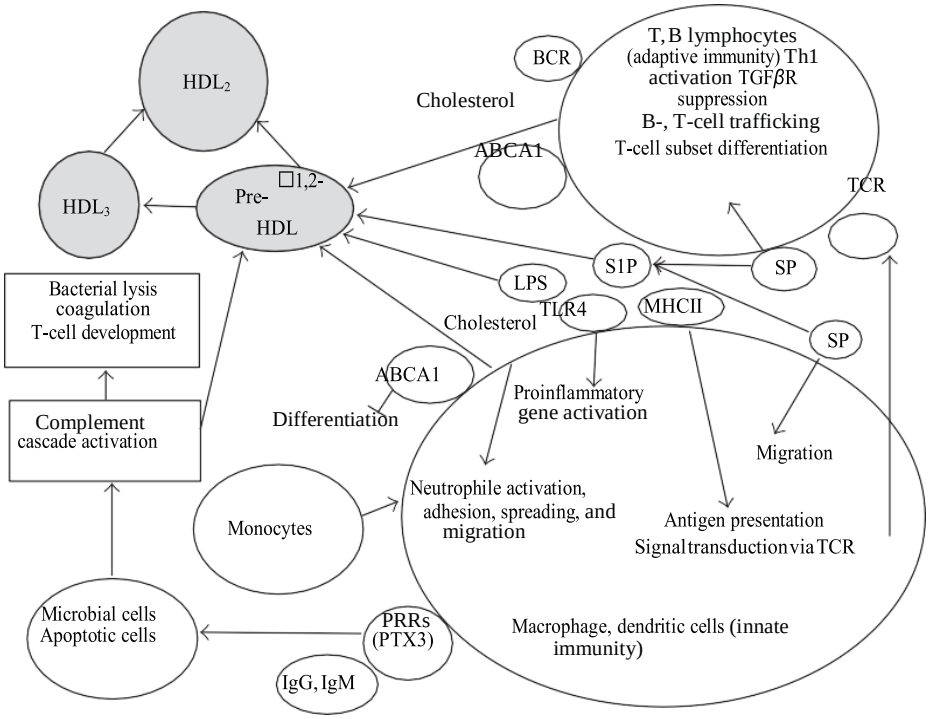


Figure 2: HDL and innate as well as adaptive immune cell functions. LPS: lipopolysaccharide, TLR4: Toll-like receptor 4, MHC II: major histocompatibility complex class II, SP: sphingolipid, S1P: sphingosine-1-phosphate, PRRs: pattern recognition receptors, PTX3: pentraxin 3, TCR: T-cell receptor, BCR; B-cell receptor.

Thus, HDL negatively regulates T-cell activation and the expression of inflammatory mediators in macrophages and dendritic cells. In macrophages, T-cell inactivation is caused by decreased macrophage expression of major histocompatibility complex class II (MHC II), which is a lipid raft component critical to antigen presentation [47-49]. ApoA-I of HDL inhibits the differentiation of mono- cytes to dendritic cells by increasing monocyte secretion of prostaglandin E2 (PGE2) and IL-10

[50]. It also inhibits T- lymphocyte activation by decreasing antigen presentation in differentiated dendritic cells [51].

Receptors from the TLR family are expressed on the surface of macrophages and dendritic cells. TLRs are involved in the innate immune response to infections. In rodent and human atherosclerotic lesions, TLRs, particularly TLR1, TLR2, and TLR4, play a role in T-lymphocyte activation by recruiting and activating leucocytes, regulating foam cell for- mation, and controlling antigen presentation [52,53]. Some phospholipids in HDL function directly in immune regula- tion by modulating dendritic cells for their ability to activate T helper type 1 (Th1) cells [54]. A well-characterized TLR ligand, LPS, up regulates a large number of pro inflammatory genes in macrophages. Through TLR4 interaction, HDL inhibits LPS-induced antiviral response in macrophages [55,56]. Lipid raft integrity is crucial to LPS-induced monocyte activation. ApoA-I and its mimetic peptide deplete choles- terol from lipid rafts of monocytes and thereby reduce TLR4 expression [57].

The other major class of lipid rafts is sphingo lipids, which are metabolized to ceramide and subsequently to sphingo sine a metabolite that becomes phosphorylated by sphin- gosine kinase (SPHK) to generate sphingosine-1-phosphate(S1P) [58]. The S1P receptor 2 (SIP2) inhibits macrophage migration. Free or albumin-bound S1P rapidly degrades in

most tissues, but HDL-bound S1P is less susceptible to degradation [59]. The mechanism by which HDL removes S1P from lipid rafts remains unclear but may involve specific molecules such as ABCA1. HDL-bound S1P is enriched with small, dense HDL and positively correlates with serum levels of HDL cholesterol, apoA-I, and apoA-II [58]. The central role of S1P and SPHK in the pathogenesis of several inflammatory disorders, including rheumatoid arthritis (RA), asthma, and atherosclerosis, is well known [60]; however, additional studies are required to clarify the role of HDL-bound S1P.

HUMORAL INNATE RESPONSE.

Innate immunity consists of a highly regulated immune surveillance system comprising several humoral factors, including soluble PRRs, such as collectins, ficolins, and pentraxins [38,39], and the comple ment cascade [40]. PRRs, Ig G, and Ig M clusters recognize microbial or apoptotic cells and activate the complement cascade, which leads to the assembly of a terminal complement complex, bacterial lysis, and activation of several nonlethal signals that promote opsonization, chemotaxis, and TLR signaling [40] (Figure 2). The complement cascade coordinates the innate defenses and potentiates coagulation to provide a mechanical barrier against bacterial spread. Activation of the complement also modulates antigen-presenting cells, macrophages, and dendritic cells, resulting in the regulation of T-lymphocyte development. Recent proteomic analyses in healthy subjects [16,17] revealed several types of HDL parti- cles, including complement components C4a, C4b, C9, and vitronectin. In contrast, HDL particles detected in patients with coronary artery disease include complement C3 [16].

In vitro experiments on endothelial cells have shown that HDL inhibits the formation of the terminal attack complex of the complement [61,62]. Another study has shown that plasma HDL levels inversely correlate with terminal complex C5b–C9 levels [63]. This evidence

suggests that HDL binds complements and enhances the complement clearance.

A member of the pentraxin subfamily, PTX3, is soluble PRR. PTX3 deficiency leads to invasive pulmonary aspergillosis due to the defective recognition of conidia by alveolar macrophages and dendritic cells. PTX3 deficiency also causes an inappropriate induction of an adaptive type 2 response [64] and some types of cardiovascular disease, including atherosclerosis [65,66]. HDL induces mRNA expression and protein release of PTX3. This HDL effect is dependent on lyso sphingolipid receptors, the PI3K/Akt axis, and is mimicked by S1P [67]. PTX mRNA increase in the aorta of transgenic mice that overexpress human apo A-I, whereas PTX mRNA decreases in the aorta of apo AI knockout mice. HDL injection results in increase in plasma PTX3 levels in C57BL/6 mice [67]. Thus, the anti-inflammatory mechanism of HDL likely involves PTX3 activation.

ADAPTIVE IMMUNITY

The adaptive immune system is found only in vertebrates and is characterized by antigen-specific responses to pathogens. The principle components of adaptive humoral immunity are B lymphocytes that originate in the bone marrow. The principle components of cellular immunity are T lymphocytes that originate from hematopoietic cells and

mature in the thymus. Gene rearrangement generates the antigen-specific receptors expressed in lipid rafts on the surface of T or B cells. Therefore the T and B lymphocytes incorporate specificity and immune memory in vertebrate host defenses.

The key receptor in B cells is the B-cell receptor (BCR), and the key receptor of T cells is the T-cell receptor (TCR). BCR and TCR are located in lipid rafts. Removal of cholesterol from BCR lipid rafts by HDL affects several modes of B-cell activation, including BCR-initiated signal transduction, endocytosis of BCR-antigen complexes, loading of antigenic peptides onto MHC-II, MHC-II-associated antigen presentation to T cells, and detection of helper signals via the CD40 receptor [68]. The HDL-induced cholesterol efflux from macrophages also affects antigen presentation to T cells as well as TCR signaling [69-71] (Figure 2) in regulatory T cells (Tregs) but stimulates the development of Th1 cells [71]. S1P regulates B and T-cell trafficking as well as differentiation of T cell subsets. S1P inhibits fork head box P3 (FoxP3)

S1P controls the dichotomy between these two T-cell lineages by antagonizing transforming growth factor (TGF-) [72]. Apo A-I suppresses the inflammation by stimulating Tregs in the lymph nodes and by inhibiting effectors such as Memory T cells [73].

MATERIALS AND METHODS

METHODOLOGY

This is a prospective cohort study conducted in Govt Rajaji hospital, Madurai Medical college. A study population of 175 patients admitted in GRH in dept of general surgery for elective hernia repair (inguinal, umbilical, para umbilical, incisional hernia) were taken. Patients were selected according to the inclusion and exclusion criteria as mentioned

INCLUSION CRITERIA:

- Patients of age group 20-55 years.
- Patients of both sexes.
- Elective uncomplicated surgical cases(with inguinal hernia,umblical hernia incisional hernia).
- Patient consented for inclusion.

EXCLUSION CRITERIA:

- Patients less than 20 years of age and more than 55 years of age.
- Emergency surgical cases.
- Contaminated surgeries.
- Patients with comorbidities like diabetes mellitus, malignancy, end

stage liver disease, immune compromised state.

- Patient not consented for inclusion in the study.

Detailed information was given to the patients and informed consent was collected from them. The study design was approved by the Ethical committee constituted as per ICMR guidelines.

Patient details were recorded routinely as history, presentation, clinical findings. Routine needed pre op investigations were performed. Most likely variables having a possible relationship whith post-op complications related to this study were considered and evaluated at the time of admission. Blood samples are collected under fasting condition. Keeping these values as range patients were classified as low, normal, high HDL.

HDL LOW - < 40mg/dl

NORMAL - 40 – 60 mg/dl

HIGH - >60 mg/dl

After performing routine investigations needed for diagnosis, management and assessment, patient assessed by the anaesthesia team for hernioplasty. All preoperative preperations are done including bathing, local parts preparation, quit smoking and alcohol, adequate and necessary starvation.

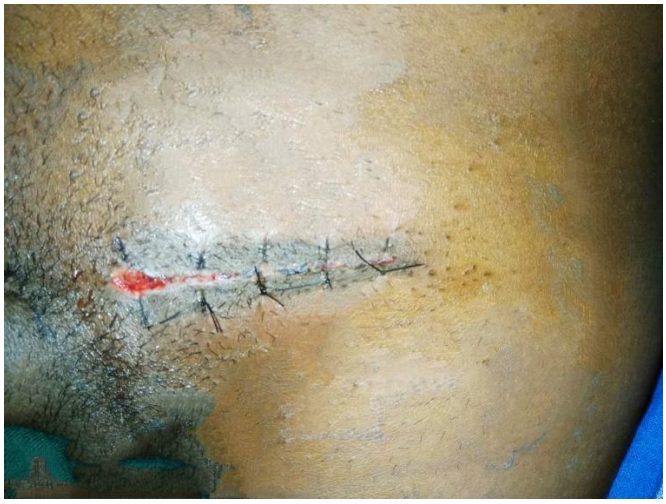
Routine strict aseptic precautions were taken in order to minimize the chance of SSI including standard preparation of a patient before incision like spirit- povidone – spirit sequence, irrigation with normal saline and povidone before closing the wound, changing glove when handling mesh. Antibiotic prophylaxis and post operative coverage were done

All the patients in the study group underwent open hernia repair, no laparoscopic procedures done. Operative wounds were examined on the second, fifth and eighth post operative day for signs of SSI. Incisional SSI both superficial and deep were defined according to CDC criteria and were recorded.

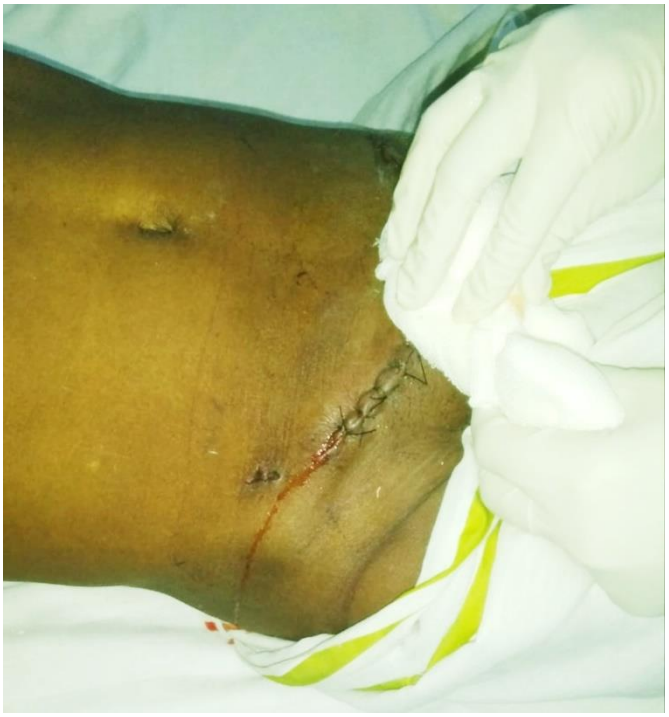
Those who had signs of SSI were recorded and those with superficial SSI are treated meticulously to prevent it to spread to the deep spaces. Patients with serous or sero purulent discharge underwent culture and sensitivity, antibiotics were started accordingly. Culture reports are collected and integrated to have the microbial spectrum and sensitivity. Patients who have wound gapping are treated with proper wound wash and reposted for secondary suturing, once they are free from infection and the wound is healthy. Extended days of hospital stay were recorded for those who had SSI and treated.

PICTURES OF SSI IN OUR S TUDY GROUP

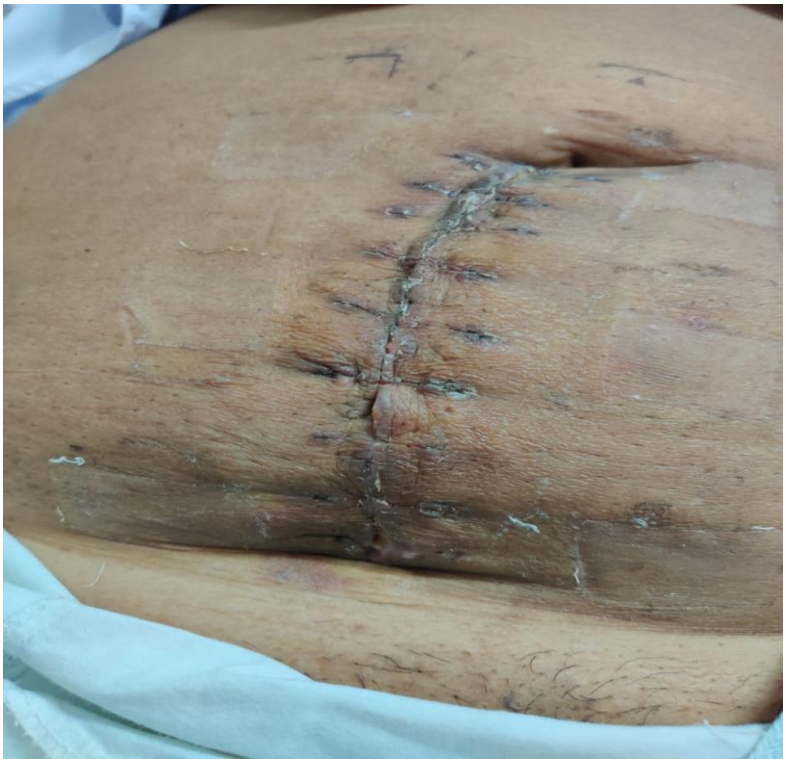
Patient with wound discharge and minimal gapping



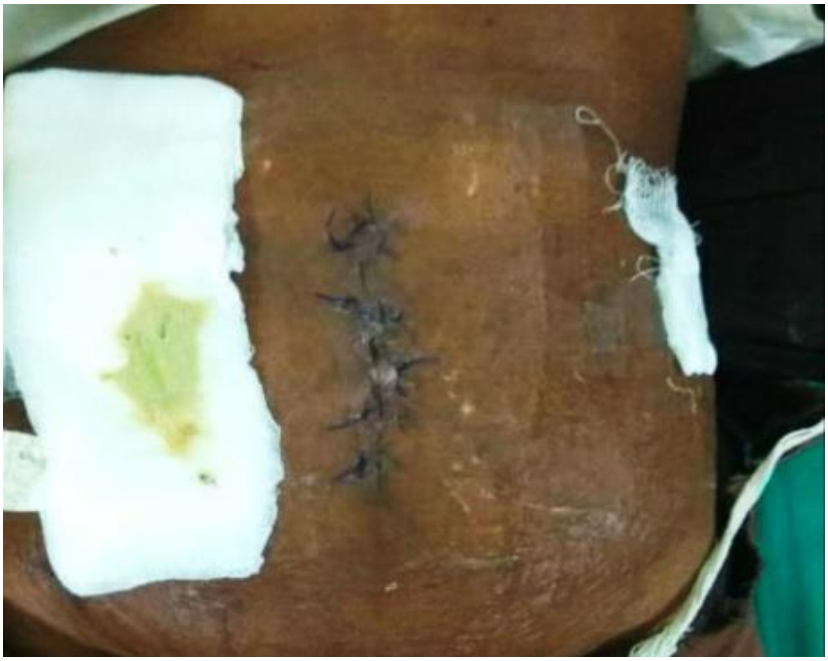
Patient showing serous discharge



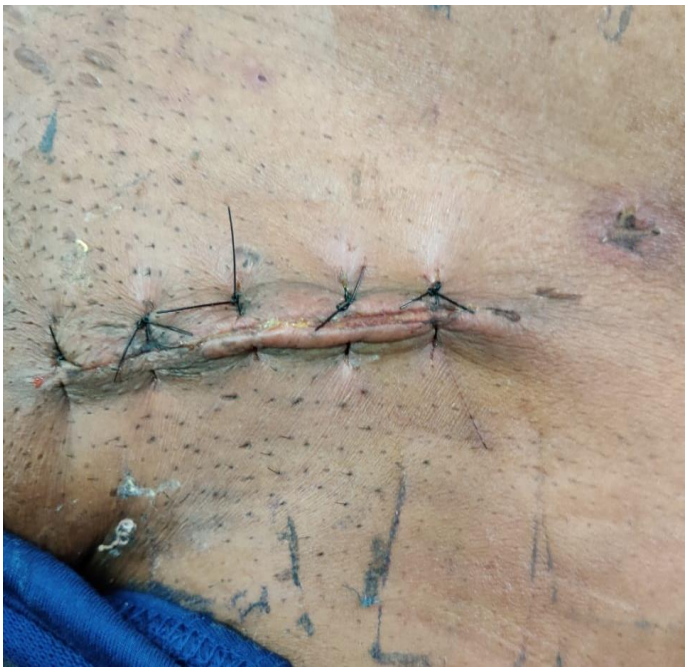
Patient showing SSI with erythema and wound induration with minimal gapping at the lower incisional site



Patient showing SSI with thick purulent discharge from the incision site from day 6



Patient showing SSI that too a superficial SSI with erythema at the lateral end and drain site

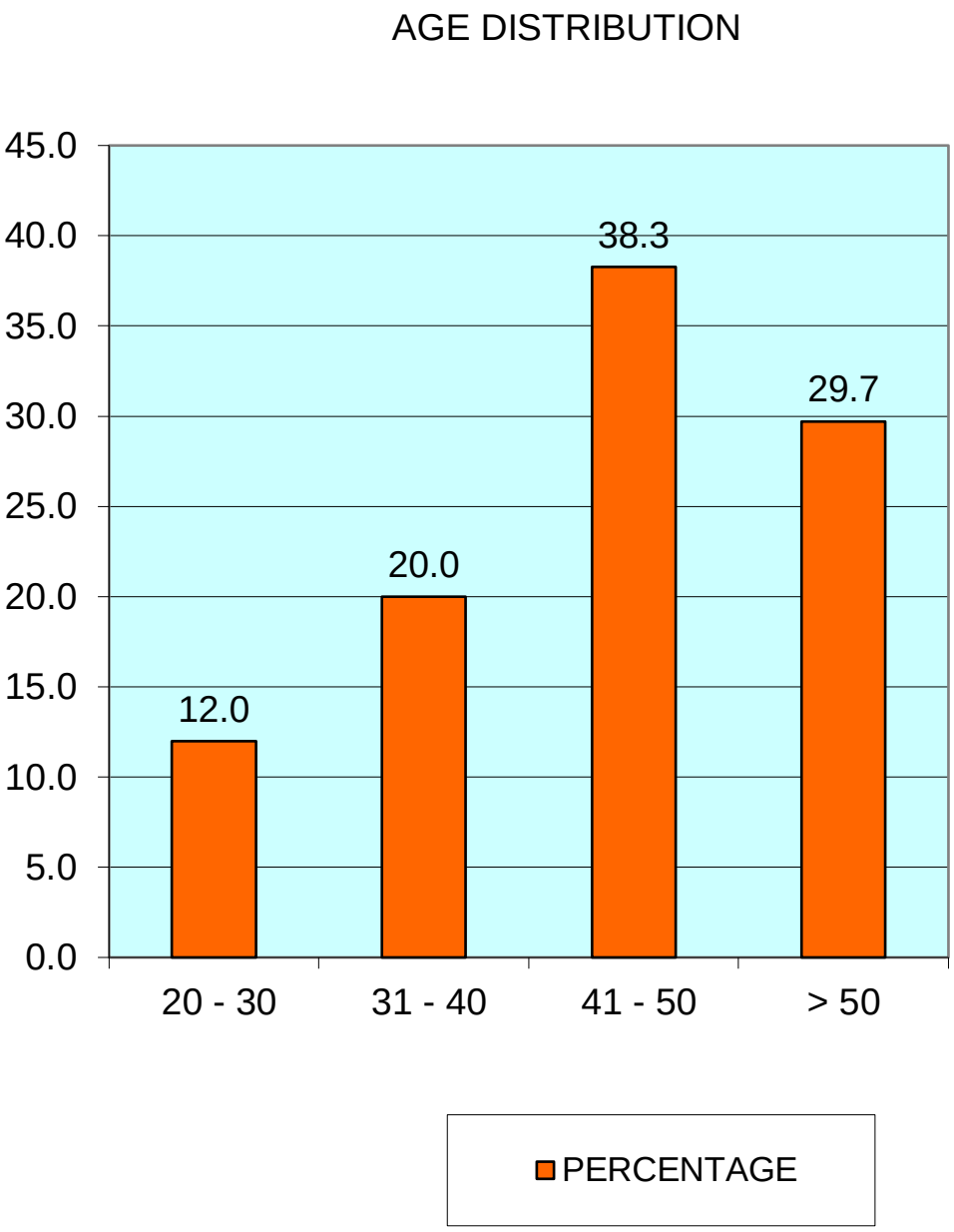


RESULTS

RESULTS

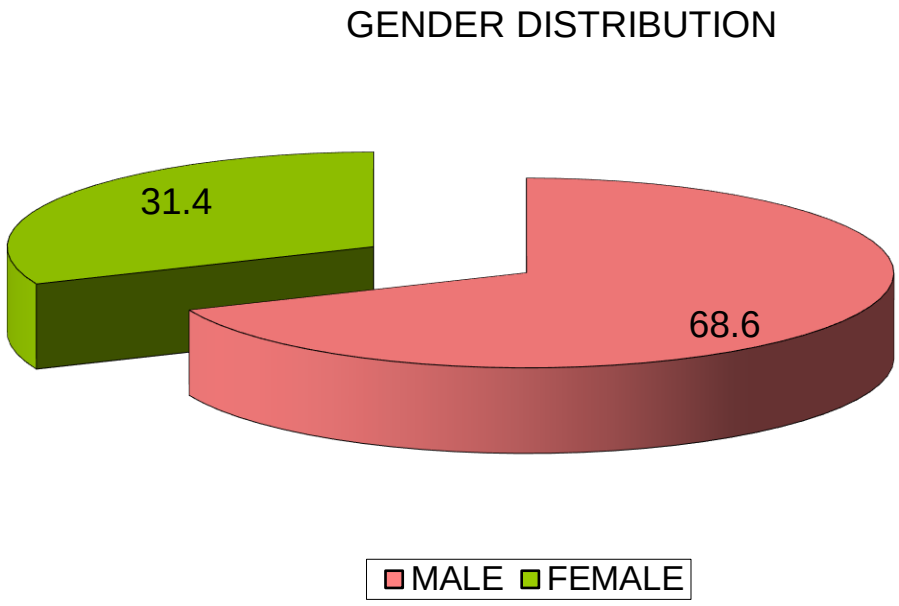
AGE	CASES	PERCENTAGE
20 – 30	21	12.0
31 – 40	35	20.0
41 – 50	67	38.3
> 50	52	29.7
TOTAL	175	100.0

Out of 175 pts studied nearly 38% people falls under the age of 41-50 yrs and nearly 30% of them falls above 50yrs. Remaining 30% patients fall below 40yrs


AGE DISTRIBUTION
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
12.0
20.0
38.3
29.7
20 - 30
31 - 40
41 - 50
> 50
PERCENTAGE

GENDER DISTRUBITION

SEX	CASES	PERCENTAGE
MALE	120	68.6
FEMALE	55	31.4
TOTAL	175	100.0



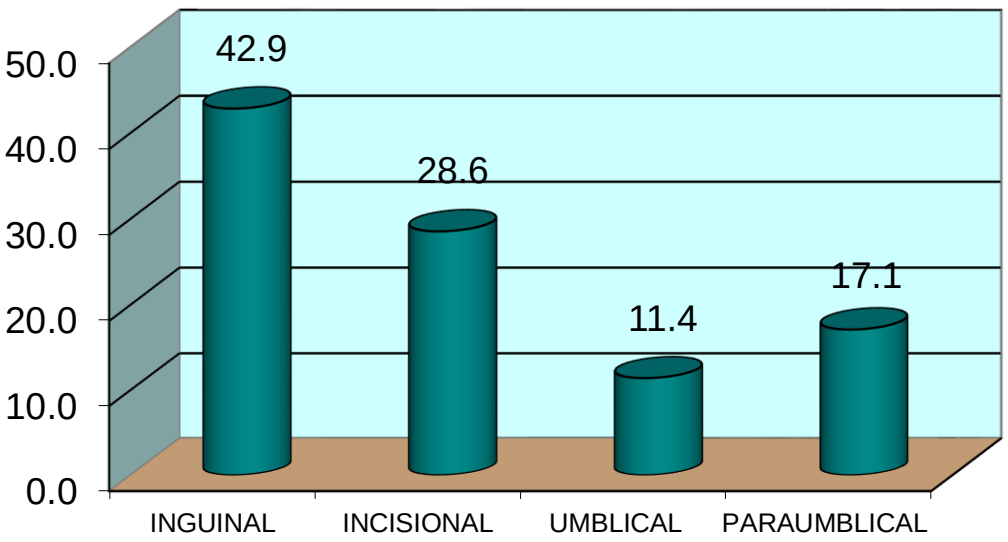
Our study population comprises of 120 males which accounts for 68.6%, as the incidence of hernia is more common in male , which is depicted here also. Female population accounts for 31.4%.

HERNIA DISTRIBUTION

HERNIA	CASES	PERCENTAGE
INGUINAL	75	42.9
INCISIONAL	50	28.6
UMBLICAL HERNIA	20	11.4
PARAUMBLICAL HERNIA	30	17.1
TOTAL	175	100.0

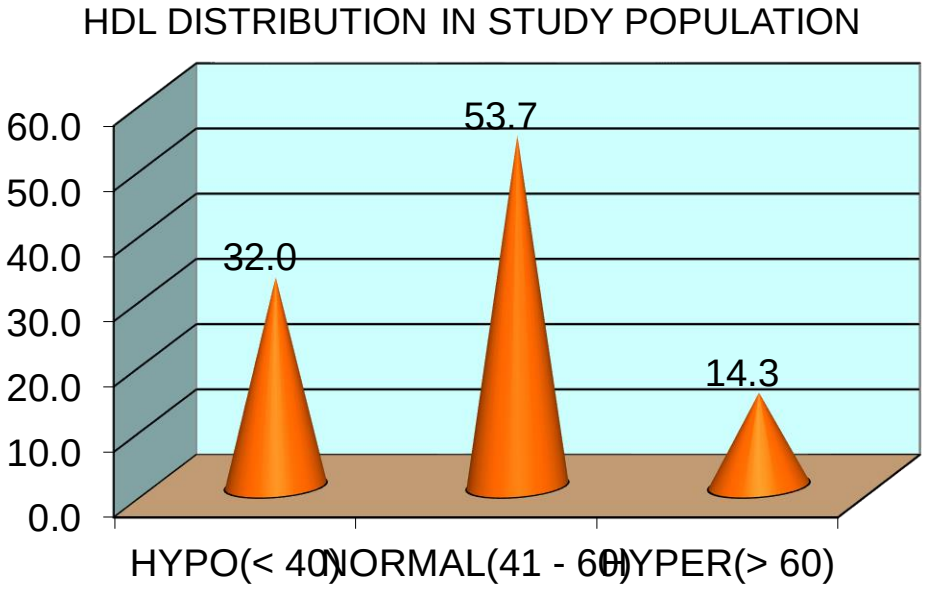
In this study 75 patients were admitted for inguinal hernia repair accounting for 42.9%, 50 patients admitted for incisional hernia (28.6%), umbilical hernia accounts for 11% and para umbilical hernia accounts for 17%. All of them are uncomplicated elective hernias.

HERNIA DISTRIBUTION



HDL DISTRIBUTION IN STUDY POPULATION

HDL	CASES	PERCENTAGE
HYPO(< 40)	56	32.0
NORMAL(41 - 60)	94	53.7
HYPER(> 60)	25	14.3
TOTAL	175	100.0



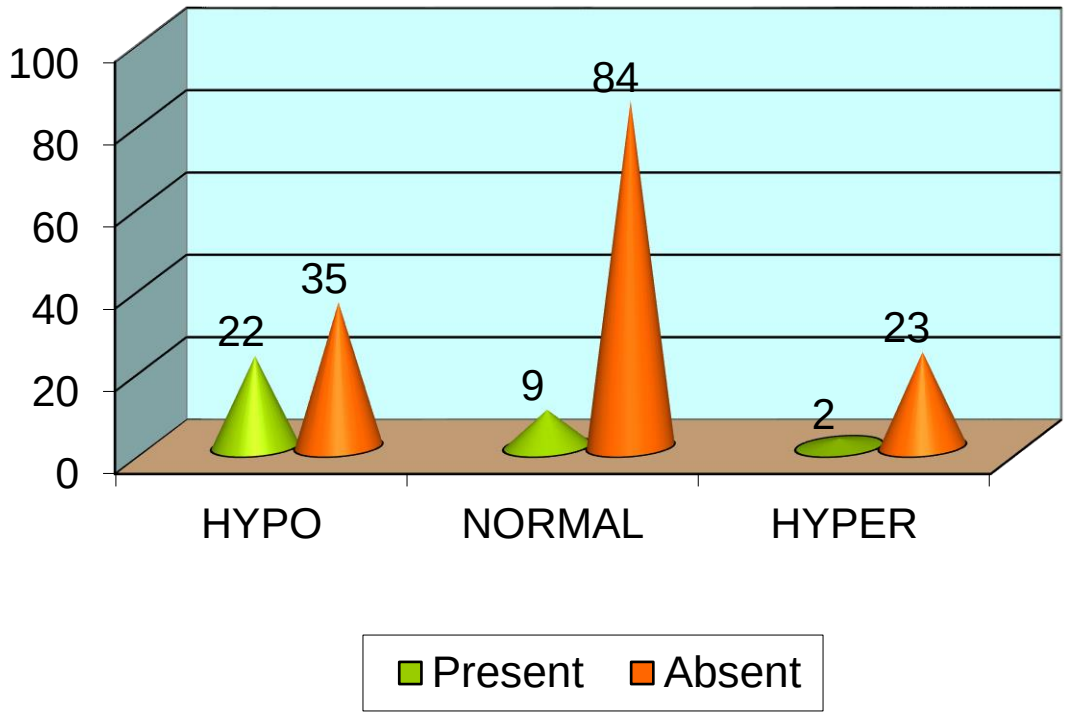
INCIDENCE OF SSI IN STUDY GROUP

Presence of SSI among the Study Group		
HDL Cholesterol Level	**Present**	**Absent**
HYPO	22	35
NORMAL	9	84
HYPER	2	23
TOTAL	33	142

p value< 0.001 Significant

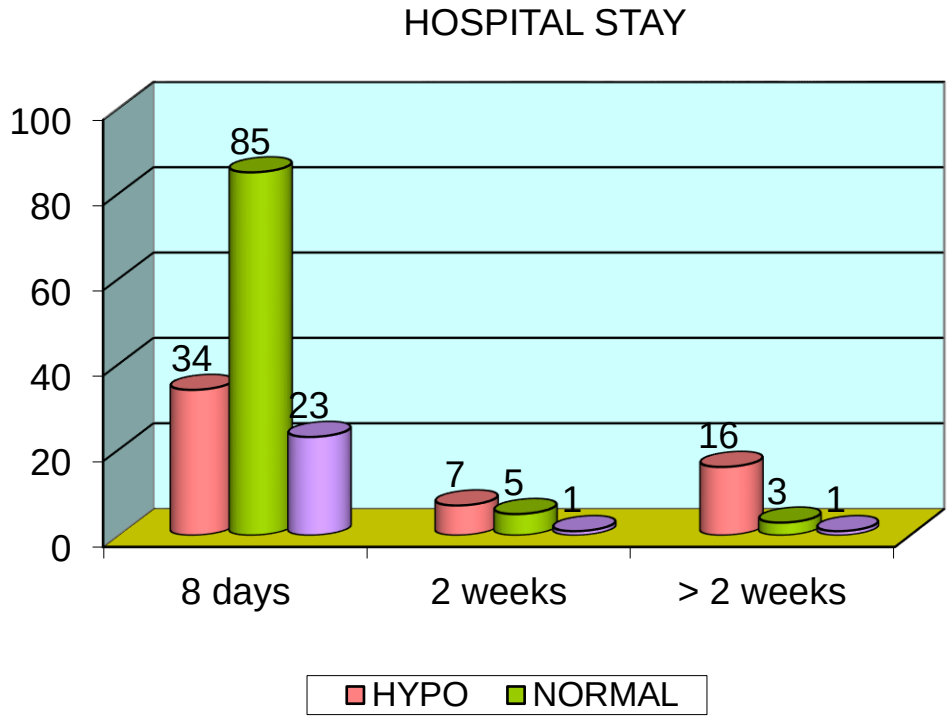
Incidence of SSI in this study is nearly 18.9% out of 175 patients 33 of them developed SSI either superficial or deep infection. Out of this 18.9% , 12.6% falls in the low HDL group and 5.2% falls in normal HDL group. Chi square test is applied and p value is derived, p value of <0.001 which is significant shows positive correlation with low HDL and surgical site infection

PREVELANCE OF SSI IN RELATION TO HDL



SIGNIFICANCE IN DURATION OF HOSPITALISATION

Duration of Hospital Stay			
	8 days	**2 weeks**	**> 2 weeks**
HYPO	34	7	16
NORMAL	85	5	3
HYPER	23	1	1
TOTAL	142	13	20



SIGNIFICANCE OF HOSPITAL STAY DURATION WITH HDL LEVELS

The chart depicts that majority of the study group with normal HDL, nearly 85 patients falls within 8days of hospital stay. Out of 175 patients 142 (81%) were discharged on day 8, 13 patients had hospital stay of 2weeks which accounts for 7% and 20 patients had extended hospital stay of more than 2weeks which accounts for 11.4%. out of this 20 patients who had hospital stay of more than 2weeks, 16 patients belongs to low HDL group which mounts for 80% which directly implies that patients with low HDL suffers more with deep and severe infections which warrants prolonged hospital stay accounting for financial burden, hospital cost and patients morbidity.

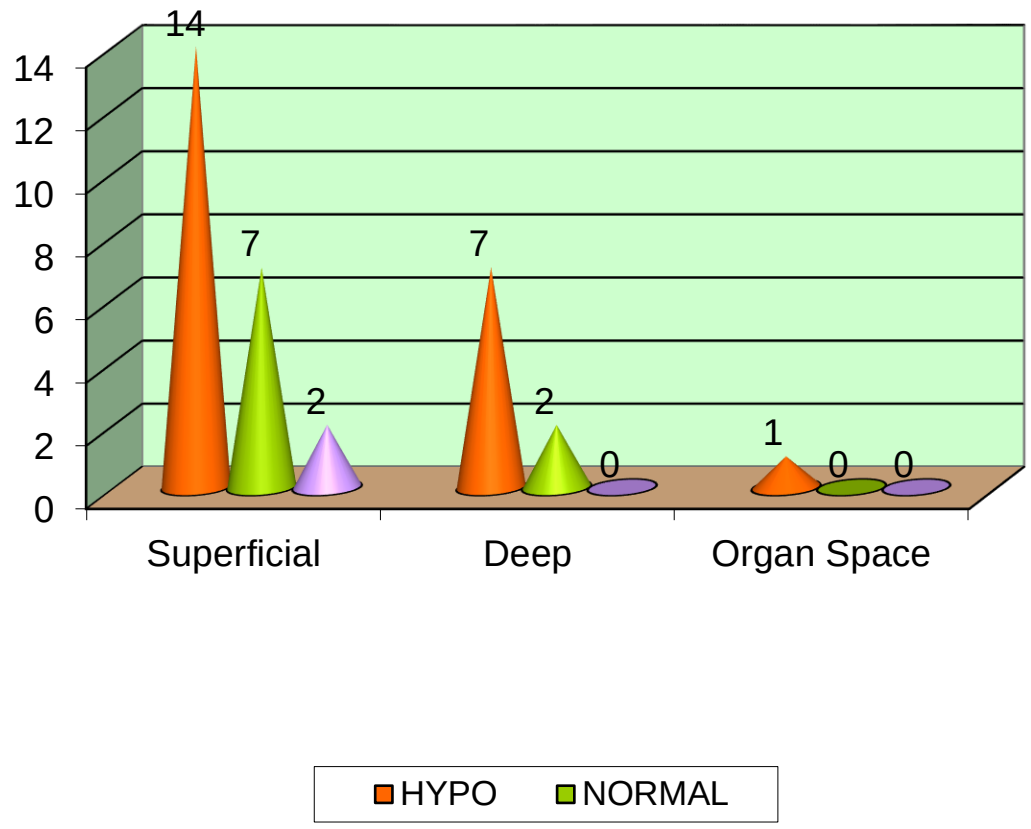
SEVERITY OF SSI IN RELATION TO HDL LEVEL

Severity Of SSI in Study Group			
	Superficial	**Deep**	**Organ Space**
HYPO	14	7	1
NORMAL	7	2	0
HYPER	2	0	0
TOTAL	23	9	1

p value 0.044 Significant

Out of 33 patients who developed SSI nearly 9 developed deep infection which accounts for about 27%, out of that 9 patients with deep infection 7 patients belong to the low HDL group which accounts for 77%. P value for this severity index is 0.044 which is significant, showing that in patients with SSI those who belong to the low HDL group are more vulnerable to develop deep and organ space infection

SEVERITY OF SSI

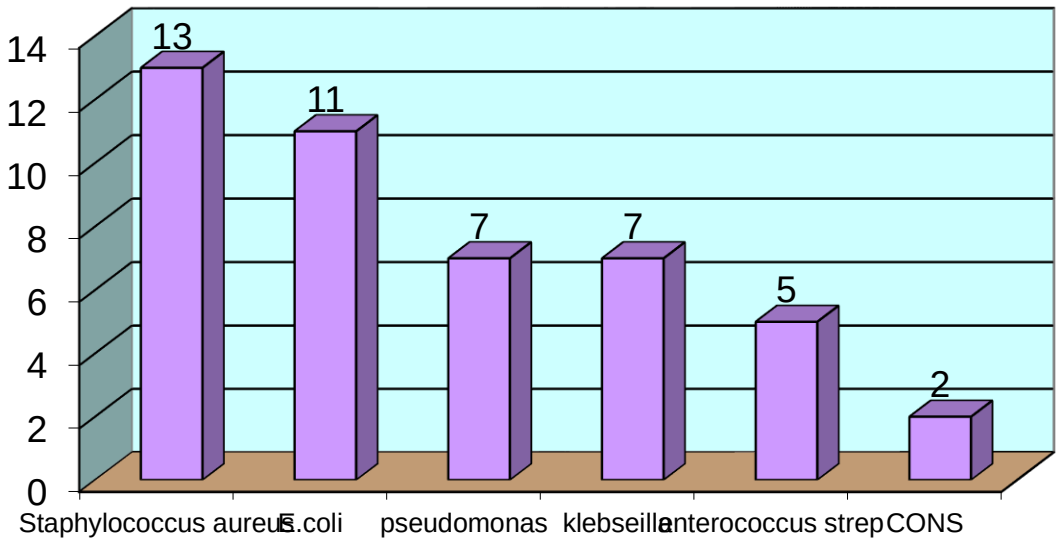


MICROBIOLOGY OF SSI IN OUR STUDY

Distribution of Organism in SSI	
Staphylococcus aureus	13
E.coli	11
pseudomonas	7
klebseilla	7
enterococcus strep	5
CONS	2

In our study out of 33 patients who developed SSI those who have serous or purulent discharge underwent culture and sensitivity. Staph aureus and E coli shows more prevalence among the culture report followed by pseudomonas and klebsiella.

DISTRIBUTION OF ORGANISM



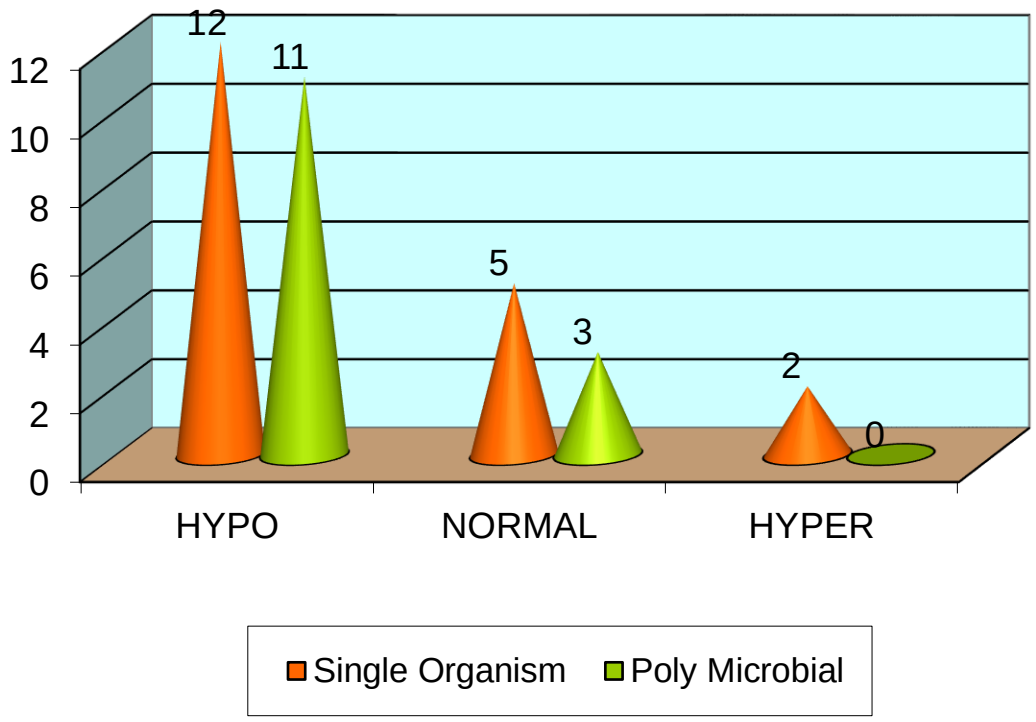
HDL LEVEL AND MICROBIAL PATTERN

	Single Organism	Poly Microbial	Total
HYPO	12	11	23
NORMAL	5	3	8
HYPER	2	0	2
TOTAL	19	14	33

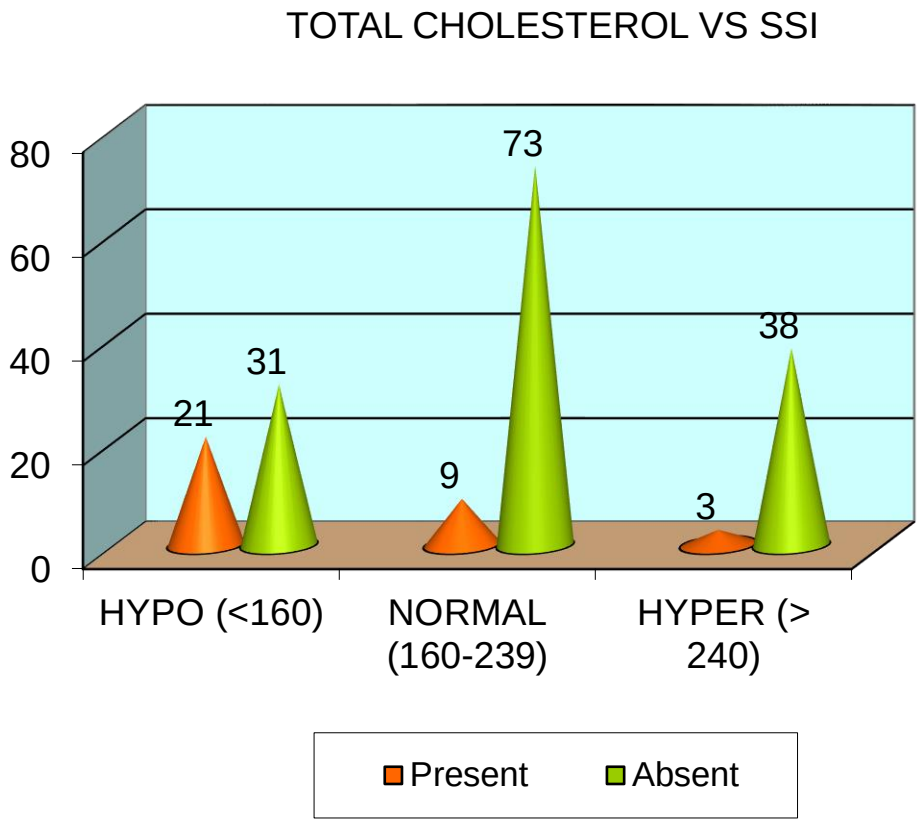
MICROBIAL PATTERN VS HDL CHOLESTEROL

In our study patients who developed SSI and those with wound discharge were subjected to culture and sensitivity. According to the culture report those with single organism and with poly microbial flora are tabulated as above. Out of 33 patients 14 patients were reported to have poly microbial growth which account for 42.4%, in that 11 of them falls in the group of low HDL group which accounts for nearly 78.5 % of poly microbial group. It clearly denotes that patients with low HDL are susceptible for poly microbial infection than patients with normal and high HDL.

MICROBIAL PATTERN VS HDL CHOLESTEROL



Presence of SSI among the Study Group			
Total Cholestrol Level	**Present**	**Absent**	p value < 0.001 Significant
HYPO (<160)	21	31	
NORMAL (160-239)	9	73	
HYPER (> 240)	3	38	
TOTAL	33	142	



DISCUSSION

Surgical site infection (SSI) is a major complication of surgery, associated with prolonged hospitalization, increased costs and increased morbidity and mortality. In recent years, randomized trials have identified a number of preventive measures that can substantially reduce the risk of SSI. These include appropriate perioperative antibiotic prophylaxis, maintenance of perioperative normothermia and control of hyperglycemia.[74,75] The wound healing process involves numerous functions, many of which depend on the presence of oxygen. Collagen production and development influence the strength of the wound which is directly correlated with the partial pressure of oxygen (PO2) of the tissue. Synthesis of collagen, cross-linking and the resulting wound strength depend on the normal function of specific enzymes. The functions of these enzymes are directly related to the amount of oxygen present, e.g. hydroxylation of proline and lysine by hydroxylase enzymes

The stress response to surgery comprises of a number of hormonal changes initiated by neuronal activation of hypothalamic - pituitary - adrenal axis with overall metabolic effect of catabolism of stored body fules. Cortisol a stress hormone synthesized from cholesterol and secreted

from adrenal cortex increases rapidly from a base line of 400 nmol/lit to >1500 nmol/lit in a span of 4-6 hours, feedback mechanism operating for pituitary - adrenal axis becomes ineffective after surgery, so concentrations of both hormones remain high.[76]

Although not many studies or research have been done pertaining to this topic nonetheless various literature quote the incidence of SSI ranging from 1-20% in various case series. In our study/series we found the overall incidence to be 16.12%

In a study conducted by Morimoto M, et al. Serum total cholesterol concentrations <160 mg/dl were associated with an increased incidence of superficial and deep SSI[77].

Similarly, Delgado-Rodriquez et al in a prospective study to access the risk factors associated with nosocomial infections found the both low levels (below 102 mg/dl) and high levels (above 290 mg/dl) of serum total cholesterol were associated with a high risk of SSI and RTI in comparison with the reference group (139-261 mg/dl) whose findings were consistent with the findings in present study[78]

Several non-mutually exclusive explanations for the inverse association between total cholesterol and infections are possible. First, low total serum cholesterol may contribute to the development of

infections. Circulating cholesterol-rich lipoproteins and triglyceride-rich lipoproteins have the capacity to bind and detoxify bacterial lipopolysaccharide (LPS). HDL has been shown to compete with LPS binding protein (LBP) for binding to LPS. The LPS-LBP complex attaches to the CD-14 receptor on cells, which, in turn, stimulates TNF production thus helping in combatting infection[78]

Infection, inflammation and trauma induce marked changes in plasma levels of a wide variety of proteins, and these changes are mediated by cytokines. The host's response to surgical injury also results in dramatic alterations in lipid metabolism and circulating lipoprotein levels (79,80). For example, a decreased production of interleukin-1 (IL-1) and interleukin-2 (IL-2) in patients with obstructive jaundice and an increase of interleukins after biliary drainage were reported (85). Injury and/or cytokines also decrease HDL cholesterol levels (79). There was a positive correlation between HDL cholesterol and production of interleukins. Although there is no recent study in the literature demonstrating this correlation, abnormal lipid metabolism associated with impaired interleukin production may result in an increased susceptibility to infection. The mechanisms underlying these marked and rapid changes in HDL cholesterol level are unknown today. The rapid disappearance of HDL cholesterol may reflect a dramatically increased rate of removal of

HDL cholesterol particles, rather than a decrease in production rate. It is also possible that activation of the reticuloendothelial system will lead to non specific uptake of HDL cholesterol into phagocytic cells (84). Some studies indicate a negative correlation between inflammatory parameters during bacterial infections and total cholesterol and HDL fraction. Considering the plasma lipid pathways, HDL fraction plays a major role in lipid transport and exchanges between lipoproteins. IL-1 and TNF, two cytokines involved in the acute-phase response, have metabolic functions, which could possibly contribute to reduce plasma total cholesterol and HDL fraction. IL-1 also induces lymphocytopenia (81). HDL levels were also reported as one of the risk factors for surgical site infection in patients undergoing herniorraphy (82,83). This data indicate that the decrease in plasma HDL cholesterol level is related with increased incidence of postoperative surgical site and pulmonary infections.

As is known, HDL cholesterol might have been used for a better assessment of cardiovascular risk. HDL and total cholesterol levels together with other known risk factors may also be used as predictive parameters for surgical nosocomial infections. Screening lipid profiles of patients undergoing general surgery may be useful for ascertaining their risk for postsurgical infections. Routine measurement of HDL and total cholesterol may offer a good opportunity for prediction of people's

infection risk before operation.

In this study out of 175 patients operated for hernia repair 33 developed SSI which stands for 18.9%. In that 12.6% of the patients falls in the low HDL group which is significant. This shows low HDL will have increased incidence for SSI. Moving to duration of hospital stay 11.4% had increased hospital stay for more than two weeks, in which nearly 80% of them belongs to low HDL group. Hence again this shows patients with low HDL are prone for increased hospital stay,as they are susceptible to infection. Coming to severity of SSI out of 33 patients with SSI, 9 of them developed deep infection among them 7 of them lies in the LOW HDL group with bp value of 0.044 which is significant. With all these things in mind, patients with low HDL are more prone for SSI, increased duration of hospital stay and severity of SSI

CONCLUSION

Hypocholesterolemia is one of the forgotten factors which is usually brushed aside whose consideration can lead to significant decrease in this preventable complication, surgical site complication especially in a malnourished population presenting in a government setup. As per the results ,this study concludes that hypocholesterolemia is a significant risk factor for surgical site infection.Simple preoperative cholesterol status evaluation can predict the incidence of SSI and correction of hypocholesterolemia can prevent SSI, thereby reducing the burden to health system and morbidity to the patients by reducing the post op hospital stay.

LIMITATION

Our study was conducted in govt. hospital where patients with low socio economic status and mal nourishment are more. So its hard to match the confounding factors. In this study population selection of patients with pure hypo cholesterolemia is hard. Patients with anemia and hypo proteinemia are either should be excluded from the study or being elective surgery those nutritional deficiency are corrected and then can be taken up for surgery. This is only limitation of the study.

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CONSENT FORM

Title of the project: A PROSPECTIVE STUDY OF A COMMONLY OVERLOOKED CAUSE OF SURGICAL SITE AND INFECTION-LOW HDL

Participant's name : Address :

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.

Signature of the participant : _____ Date : _____

Signature of the witness : _____ Date : _____

Name and address of the witness :

Signature of the investigator:_____Date : _____

PROFORMA

Name :- O. P. No

Age :- Unit

Sex :-

Occupation :-

Address

Phone no :

DIAGNOSIS:

PRESENTING COMPLAINTS

1. Duration of swelling

GENERAL PHYSICAL EXAMINATION

1. General survey

2. Body build and nourishment

3. Appearance

4.Anaemia/Jaundice/Clubbing/

Cyanosis/Lymphadenopathy/ Pedal oedema

5. Pulse

6. Temperature

7. Respiratory rate

8. Blood pressure

LOCAL EXAMINATION OF

1. INSPECTION
2. PALPATION
3. PERCUSSION
4. AUSCULTATION

ULTRASOUND ABDOMEN AND PELVIS Report

BLOOD INVESTIGATION

BLOOD SUGAR

HEMOGLOBIN

TOTAL PROTEINS

TOTAL CHOLESTERAL

HDL

MASTER CHART

AGE	SEX	HERNIA	Total choles	HDL	HOSPITAL STAY	SSI	ORGANISM	S/D/O
21	M	1	150	23	25	P	staphylococcus aureus(1)+e.coli(2) pseudomonas(6)	D
45	M	2	165	46	8	N		
43	F	1	245	70	8	N		
35	M	2	164	30	8	N		
51	M	3	310	74	12	P	CONS(5)	S
53	F	1	170	49	8	N		
42	M	2	115	21	8	N		
44	F	1	158	55	15	P	E.coli(2)+klebsiella(3)	S
55	M	4	105	20	8	N		
52	M	3	182	60	8	N		
23	M	2	160	45	8	N		
33	F	1	108	20	10	N		
34	M	2	184	55	8	N		
44	M	1	315	80	8	N		
22	F	3	106	17	8	N		
48	M	1	198	60	17	P	staphylococcus aureus(1)+e.coli(2)	D
46	F	3	104	16	8	N		
52	M	4	287	78	8	N		
49	M	1	136	28	10	N		
54	M	1	172	50	8	N		
25	F	3	116	30	8	N		

36	M	1	156	45	10	P	CONS(5)	S
48	M	2	278	72	8	N		
40	M	2	134	34	8	N		
27	M	1	176	50	8	N		
51	F	4	186	55	8	N		
42	M	1	129	32	8	N		
43	M	3	320	82	18	P	enterococcus strep.(4)	S
52	F	2	129	28	8	N		
55	M	1	168	47	8	N		
55	M	1	186	48	8	N		
28	M	2	118	32	20	P	staphylococcus(1)+klebseilla(3)	D
32	F	1	164	53	8	N		
42	M	3	315	80	8	N		
52	M	2	142	27	8	N		
34	F	2	160	54	8	N		
48	M	1	167	58	8	N		
51	M	1	136	34	8	N		
44	F	1	314	80	8	N		
43	M	4	102	13	27	P	staphylococcus aureus(1)+e.coli(2)	S
46	M	4	117	28	8	N		
53	F	1	187	56	10	P	enterococcus strep.(4)	S
44	M	3	285	78	8	N		
54	M	1	142	32	18	P	pseudomonas	S
43	F	4	169	46	8	N		
52	M	1	105	20	18	P	staphylococcus(1)+klebseilla(3)	D
48	M	1	324	90	8	N		
34	F	2	145	36	8	N		
22	M	2	166	44	8	N		
35	M	2	178	48	8	N		
51	M	1	184	48	8	N		
28	M	2	154	34	22	P	E.coli(2)+klebsiella(3)	D
53	F	4	162	44	8	N		
34	M	3	308	84	8	N		
54	M	2	128	32	20	P	pseudomonas(6)	S
37	F	1	154	46	14	P	e.coli(2)+pseudomonas(6)	S
45	M	4	121	28	8	N		
43	M	2	318	82	8	N		
48	F	1	132	30	8	N		
50	M	1	168	52	8	N		
24	M	1	122	30	8	N		
33	F	3	296	78	8	N		
53	M	4	184	50	8	N		
37	M	2	103	12	25	P	staphylococcus(1)+klebseilla(	D

							3)	
42	F	1	168	52	8	N		
45	M	1	289	88	8	N		
54	M	4	212	54	15	P	staphylococcus(1)	S
47	F	2	118	24	8	N		
43	M	2	218	56	8	P	pseudomonas(6)	S
55	M	1	226	58	8	N		
42	M	2	178	30	8	N		
21	F	1	326	88	8	N		
53	M	4	196	42	8	N		
44	M	1	221	44	8	N		
33	F	3	126	28	30	P	E.coli(2)+klebsiella(3)	D
54	M	2	168	46	8	N		
46	M	1	284	74	8	N		
40	M	4	296	78	8	N		
52	F	2	158	34	8	N		
48	M	1	254	50	8	N		
42	M	1	231	43	8	N		
53	F	4	164	36	8	N		
46	M	2	181	45	8	N		
27	M	3	215	66	8	N		
48	M	4	201	47	8	N		
54	F	2	107	30	34	P	staphylococcus(1)+klebseilla(3)	O
32	M	1	256	49	8	N		
44	M	1	134	28	8	N		
51	F	2	189	53	8	N		
38	M	1	195	55	8	N		
34	M	1	180	51	8	N		
41	M	3	124	34	18	P	staphylococcus aureus(1)+e.coli(2)	S
52	F	4	156	53	8	N		
43	M	1	142	30	10	N		
36	M	2	160	57	8	N		
51	M	4	198	76	8	N		
45	F	2	187	55	8	N		
28	M	1	136	36	12	P	staphylococcus(1)	S
47	M	2	218	59	8	N		
54	F	1	187	41	8	N		
41	M	4	104	20	8	N		
28	F	3	168	42	8	N		
34	M	1	189	52	8	N		
41	M	4	215	44	8	N		
51	M	2	328	86	10	N		
49	F	2	141	32	8	N		
53	M	1	254	54	8	N		

47	M	1	218	46	8	N		
55	F	2	136	28	25	P	staphylococcus(1)+PSEUDOMONAS(6)	D
36	M	1	242	56	8	N		
43	M	1	230	51	8	N		
51	F	2	156	34	8	N		
45	M	4	168	41	8	N		
31	M	2	106	28	8	N		
53	F	3	218	53	8	N		
47	M	4	317	80	8	N		
34	M	2	164	32	14	P	staphylococcus(1)	S
49	F	1	189	43	8	N		
55	M	1	214	45	8	N		
22	M	1	225	55	8	N		
27	M	4	164	38	8	N		
49	F	3	264	46	8	N		
31	M	2	298	76	8	N		
51	M	4	154	56	8	N		
47	M	1	124	28	18	P	pseudomonas	S
33	F	2	218	48	8	N		
53	M	1	256	58	8	N		
45	M	2	132	32	18	P	staphylococcus(1)	S
55	F	1	187	42	8	N		
43	M	1	227	52	8	N		
40	M	2	118	30	10	N		
52	F	1	224	44	8	N		
29	M	4	144	28	12	P	staphylococcus(1)	S
47	M	3	268	54	8	N		
35	F	1	218	46	8	N		
46	M	4	318	79	8	N		
51	M	1	235	56	8	N		
44	F	2	211	32	8	N		
42	M	1	255	42	8	N		
54	M	2	266	52	8	N		
42	F	1	210	44	8	N		
29	M	4	228	52	14	P	E.COLI(2)	S
44	M	2	290	66	8	N		
34	F	4	241	46	8	N		
46	M	1	146	30	8	N		
52	M	2	169	50	8	N		
48	F	3	187	56	8	N		
54	M	1	119	26	12	P	enterococcus strep.(5)	S
33	M	1	242	54	8	N		
51	M	2	234	44	8	N		
54	F	2	181	32	12	P	enterococcus strep.(5)	S

44	M	1	216	42	8	N		
52	M	4	228	52	8	N		
43	F	1	254	50	8	N		
29	M	4	172	30	15	P	E.COLI(2)	S
51	M	2	214	47	8	N		
45	M	1	132	24	8	N		
34	F	3	254	54	8	N		
47	M	2	218	44	8	N		
36	F	1	264	56	8	N		
27	F	1	162	34	14	P	E.COLI(2)	S
44	M	4	218	54	8	N		
51	F	2	184	44	8	N		
46	M	2	324	84	8	N		
53	F	4	164	48	8	N		
48	M	1	112	28	8	N		
55	M	1	262	58	8	N		
42	F	3	249	50	8	N		
31	M	1	113	30	17	P	enterococcus strep.(5)	S
34	M	1	187	44	8	N		
22	F	1	243	54	8	N		
31	M	1	262	53	14	P	pseudomonas(6)	D
27	F	2	188	45	8	N		
38	M	1	235	50	8	N		
52	M	1	227	47	8	N		

Key to master chart

1 – Inguinal hernia

2 – Incisional hernia

3 – Umbilical hernia

4 – Paraumbilical hernia

ETHICAL COMMITTEE CERTIFICATE

MADURAI MEDICAL COLLEGE
MADURAI, TAMILNADU, INDIA -625 020
(Affiliated to The Tamilnadu Dr.MGR Medical University, Chennai, Tamil Nadu)

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Name of the Candidate	:	Dr.J.Karthick
Designation	:	PG in M.S., General Surgery
Course of Study	:	2017- 2020
College	:	MADURAI MEDICAL COLLEGE
Research Topic	:	A prospective study of a commonly overlooked cause of surgical site and infection – Low HDL in GRH, Madurai
Ethical Committee as on	:	25.04.2019

The Ethics Committee, Madurai Medical College has decided to inform that your Research proposal is accepted.

Member Secretary Chairman Dean / Convenor

Prof Dr V Nagaraajan
M.D., MNAMS, D.M., Dsc.,(Neuro), Dsc (Hon)
CHAIRMAN
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CERTIFICATE II

This is to certify that this dissertation work titled, entitled "***A PROSPECTIVE STUDY OF A COMMONLY OVERLOOKED CAUSE OF SURGICAL SITE AND INFECTION-LOW HDL*** **"** submitted by **DR. J . KARTHICK MS** with registration number **221711110** for the award of **MASTER DEGREE** in the branch of **GENERAL SURGERY** has been personally verified by me in urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows 14% percentage of plagiarism in the dissertation.

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