

Dissertation on
“ENHANCED RECOVERY AFTER SURGERY(ERAS) IN
ELECTIVE LAPARATOMY”

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In partial fulfillment of the regulations For the awards of the degree of

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GOVERNMENT MOHAN KUMARAMANGALAM MEDICAL
COLLEGE , SALEM

MAY 2020

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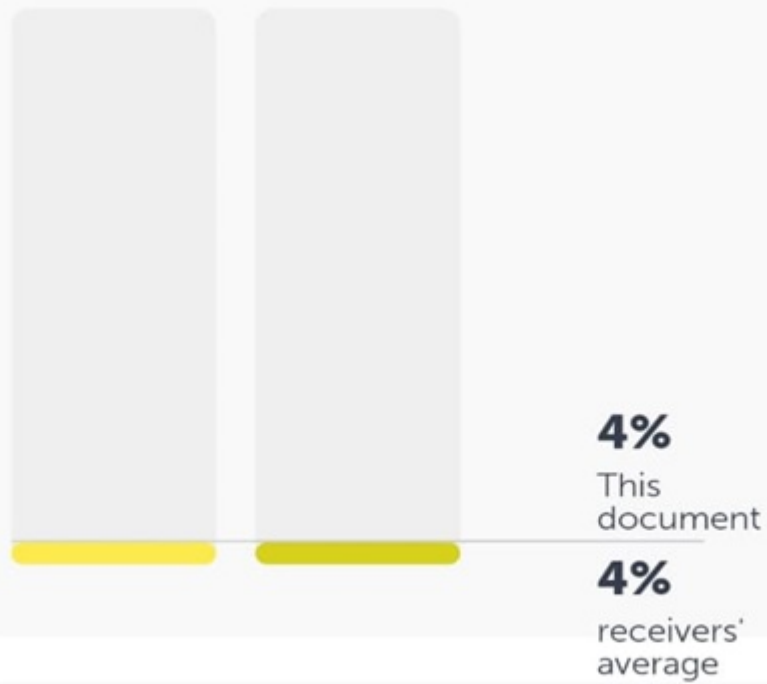
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Dr.V.VIJAYBHAASKAR

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ABSTRACT

Introduction

This aim of reducing stress and promote faster return to function has led to the formulation of an evidence-based multimodal perioperative protocol called Enhanced Recovery After Surgery (ERAS). Touted as an evidence-based protocol for perioperative care, ERAS (Enhanced Recovery After Surgery) is effective in lowering the recovering time and post-operative complication rates. The following study aimed to show the usefulness of ERAS in Length of hospital stay, Decrease in major morbidity, Post-operative recovery, Reduction of surgical stress response and Cost effectiveness.

Methods

From July 2017 to June 2019, a prospective study was undertaken among 50 cases purposively chosen and admitted to GMKMC hospital Salem for elective laparotomy and ERAS protocol was implemented.

Results

The mean age of the patients is 47 years with a standard deviation of 13.08 years ranging between 28-75 years. Majority of them (n=15, 30%) were in the age group of 36-45 years. Majority of them (n=15, 30%) were in the age group of 36-45 years. Females were large in number (n=26, 52%) while the rest were males (n=24, 48%). Out of 50 patients, around 20% (n=10) had cholelithiasis while 12% (n=6) had carcinoma of caecum. The mean number of days of hospital stay is 5.10 days with a standard deviation of 0.931 days ranging between 4 to 6 days and a median of 5 days. The most commonly admitted

duration is six days. Majority of them were ambulated on the first post-operative day (n=27, 54%) while the rest were ambulated on the day of surgery (n=23, 46%). Out of 50 patients, 25 of them (50%) were started on oral diet on 2nd post-operative day and the rest were started on oral diet on the 4th post-operative day. Out of 50 patients, majority of them (n=29, 58) removed the drain on 4th postoperative day. None of the patients had complications or readmission within the next six weeks.

Discussion and conclusion

Following established benefits are seen in ERAS; shorter length of hospital stay, low postoperative pain, low need for analgesia, increase return of bowel function, decreased complications, low readmission rates, increased patient satisfaction.

Introduction

Operation can induce various types of injury and stress to the patient through pain, stress-induced catabolism, decreased pulmonary function, elevated cardiac demands, risk of thromboembolism, ileus, nausea and vomiting. These post-operative events may further lead to complications, require hospitalisation, increase fatigue and delay convalescence. The recent advent of short-acting anaesthetics, that are safe are known to cause better pain relief though the mechanisms of early intervention coupled with multimodal analgesia (stress reduction using regional anaesthetic techniques, blockade and glucocorticoids). These are instrumental for providing enhanced recovery¹. The following image summarise the multimodal management.

When surgical injury is succeeded by these multimodal management principles, there is an enhanced recovery with decrease in postoperative pain and duration of stay in the hospital. Even major operations can be handled effectively through these. The enhanced recovery should be attempted by a multidisciplinary team comprising of surgeons, anaesthetists, nurses and physiotherapists. The following image summarises the process of enhanced recovery in surgical patients post operation¹.

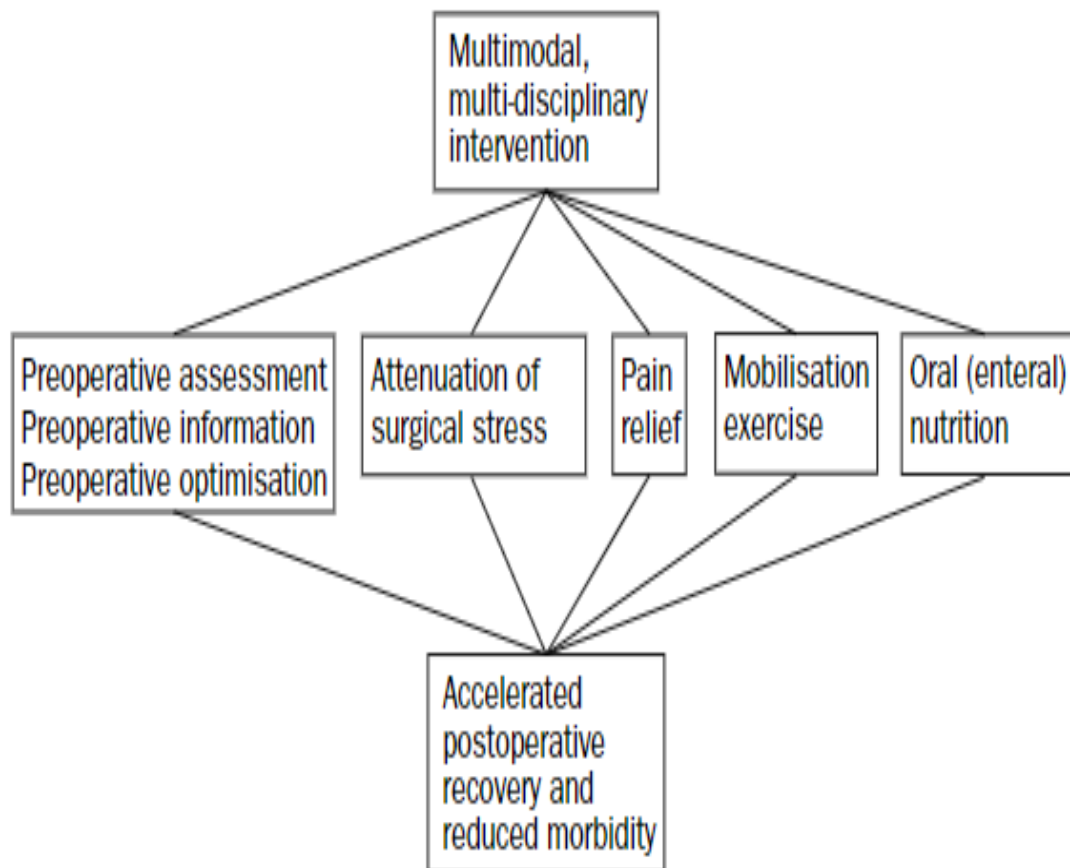


Image: Multimodal management

- **Panel 1: The process of postoperative recovery**

Preoperative period Preoperative assessment Preoperative optimisation
Perioperative period Anaesthesia Surgery Organ dysfunction
Early postoperative period Surgical stress response Pain Nausea, vomiting, ileus Fluid management Mobilisation Nutrition Fatigue and sleep disturbances
Late postoperative period Pain Fatigue and sleep disturbances Convalescence

All stages can be improved by interventions from the anaesthetist(except surgery) and the surgeon (except anaesthesia)

Image: Process of post-operative recovery

There are several factors that determines the recovery post-operatively that include;

1. stress-induced organ dysfunction
 - a. gastrointestinal paralysis
 - b. cardiopulmonary
 - c. thromboembolic complications
2. fatigue^{2,3}

The response to surgical stress is liable to reduction using minimally invasive techniques like laparoscopic surgery⁴. Afferent neural blockade are also known to reduce post-surgical stress⁵. These are capable of reducing the morbidity post-operatively and lead to enhanced recovery⁶. Apart from the relief from pain given by epidural blockade, this method has a positive impact on post operative ileus as well⁷. A conventional open colonic surgery demands a hospital stay of around 8 to 10 days. Also, conventional procedures warrants weeks of convalescence and reduced functionality. Enhanced recovery procedures help in early post-operative recovery and reduced hospital stay with reduction in post-operative pain and ileus^{8,9}.

All these advantages of having a better protocol has led clinicians to devise the ERAS protocol.

ERAS Protocol¹⁰

Touted as an evidence-based protocol for perioperative care, ERAS (Enhanced Recovery After Surgery) is effective in lowering the recovering time and post-operative complication rates. ERAS is currently used effectively in colorectal surgeries and from 2014, in gastric surgeries as well. Many centers have started implementation in liver surgery as well though pancreatic surgeries still lack large scale randomised trials from multiple centers. Different studies show that ERAS shortened the duration of stay in the hospital with lower incidence of post-operative complications. The following figure shows the key components of the ERAS protocol.

This aim of reducing stress and promote faster return to function has led to the formulation of an evidence-based multimodal perioperative protocol called Enhanced Recovery After Surgery (ERAS). An important feature of ERAS is that it shortened the duration of stay in the hospital with lower incidence of post-operative complications in addition to the cost-effectiveness of the entire procedure.

The origin of ERAS can be attributed to the Danish Surgery Professor Dr. Henrik Kehlet. He developed the ERAS protocol to question the traditional method of perioperative care giving to patients in the surgical wards including¹⁴;

Enhanced Recovery After Surgery Key Components

Active Patient Involvement		
Pre-operative	Intra-operative	Post-operative
<ul style="list-style-type: none"> •Pre-admission counselling •Early discharge planning 	<ul style="list-style-type: none"> •Active warming •Use of multi-modal pain management 	<ul style="list-style-type: none"> •Early oral nutrition •Early ambulation
<ul style="list-style-type: none"> •Reduced fasting duration •Carbohydrate loading •No/selective bowel prep 	<ul style="list-style-type: none"> •Surgical techniques •Avoidance of prophylactic NG tubes & drains 	<ul style="list-style-type: none"> •Early catheter removal •Use of chewing gum •Defined discharge criteria
<ul style="list-style-type: none"> •Venous thromboembolism prophylaxis •Antibiotic prophylaxis •Pre-warming 	<ul style="list-style-type: none"> •Use of multi-modal anti-emetic prophylaxis •Use of goal directed peri-operative fluid therapy 	
Audit of compliance & outcomes		
Whole Team Involvement		

Image: Key components of ERAS protocol

prolonged fasting; mobility limitations; mechanical bowel preparation and routine use of drains. He was the first to hypothesize that the unnecessary stress to the patient with longer duration of stay can be avoided by¹⁵;reducing the stress faced by the body metabolically; Fluid overload; and Insulin resistance.

Subsequently, OlleLjungqvist and Kenneth Fearon improvised the ERAS protocol by including postulates. This led to the founding of ERAS study group in the year 2001 and subsequent creation of the ERAS society in 2010. The main stakeholders of the study group were surgeons and anesthesiologists who did a systematic review and meta-analysis to gather evidence in support of this ERAS protocol¹⁴.

The ERAS protocol comprised of 20 items along with a database that could support these principles. The protocol divided the perioperative period on the basis of aggregation of marginal gains theory as;pre-operative, intraoperative and postoperative.

The entire protocol is designed to seamlessly facilitate and manage right from preadmission, admission. pre-operative and operative till discharge and rehabilitation¹⁶. The utilisation and dissemination¹⁶ of the protocol demanded the creation of the ERAS society. This included the creation of a global network with national and regional expert centers for the smooth facilitation of the ERAS protocol¹⁵. Right from its inception, the

beneficial effects of ERAS has been seen in several disciplines namely¹⁷⁻²⁰; colorectal, gastric, pancreatic, esophageal bariatric and non-gastrointestinal specialties.

The ERAS protocol has the following components; counseling preoperatively, optimizing nutrition, standardizing analgesia without opioid use, minimizing electrolyte and fluid imbalance, use most minimally invasive approaches and promote early ambulation and feeding.

The goal of maintaining the physiological equilibrium in the post-operative period and optimise the outcomes in the patient led to the development of ERAS.

This should be cost-effective with minimum post-op complications or recurrence.

In order to maintain this equilibrium and help reduce the effects of surgery, a combination of multiple elements are packed into this ERAS protocol

The basic aspect of ERAS is to give attention to the following elements; preoperative counseling, nutritional strategies, avoidance of prolonged perioperative fasting, focus on regional anesthetic and nonopioid analgesic approaches, fluid balance, maintenance of

normothermia, focus on postoperative recovery strategies, early mobilization and appropriate thromboprophylaxis.

Following established benefits are seen in ERAS; shorter length of hospital stay, low postoperative pain, low need for analgesia, increase return of bowel function, decreased complications, low readmission rates and increased patient satisfaction.

Any institute that wants to adopt the ERAS program must evaluate their own infrastructure and consider the possibilities of using the ERAS protocol. In order to make the program self-sustainable, the protocol should be adopted into the standard method of care in the regular system. Published literature shows success of ERAS when all the key components are addressed. This explains why ERAS pathways are necessary for better institutional management of the patients.

There are not many studies from India that explore the effectiveness of ERAS protocol. This study aims to show the usefulness of ERAS in evaluating; Length of hospital stay; Decrease in major morbidity; Post operative recovery; Reduction of surgical stress response and Cost effectiveness.

Review of Literature

An overview of ERAS

Post-operative period is very crucial for the management of the patients for faster recovery and earlier return to function. This aim of reducing stress and promote faster return to function has led to the formulation of an evidence-based multimodal perioperative protocol called Enhanced Recovery After Surgery (ERAS)¹¹. An important feature of ERAS is that it shortened the duration of stay in the hospital with lower incidence of post-operative complications in addition to the cost-effectiveness of the entire procedure. Also, it helps in keeping the entire post-operative period economical saving millions of rupees in the long term for both the patient and the healthcare industry^{12,13}. This has led to the shifting landscape of the peri-operative care from the surgical wards to the evidence in literature¹⁴.

Operation can induce various types of injury and stress to the patient through pain, stress-induced catabolism, decreased pulmonary function, elevated cardiac demands, risk of thromboembolism, ileus, nausea and vomiting. These post-operative events may further lead to complications, require hospitalisation, increase fatigue and delay convalescence. The recent advent of short-acting anesthetics, that are safe are known to cause better pain relief though the mechanisms of early intervention coupled

with multimodal analgesia (stress reduction using regional anaesthetic techniques, blockade and glucocorticoids). These are instrumental for providing enhanced recovery.

When surgical injury is succeeded by these multimodal management principles, there is an enhanced recovery with decrease in post operative pain and duration of stay in the hospital. Even major operations can be handled effectively through these. The enhanced recovery should be attempted by a multidisciplinary team comprising of surgeons, anaesthetists, nurses and physiotherapists.

History of ERAS

The origin of ERAS can be attributed to the Danish Surgery Professor Dr. Henrik Kehlet. He developed the ERAS protocol to question the traditional method of perioperative care giving to patients in the surgical wards including¹⁴;

- prolonged fasting
- mobility limitations
- mechanical bowel preparation
- routine use of drains

He was the first to hypothesize that the unnecessary stress to the patient with longer duration of stay can be avoided by¹⁵;

- reducing the stress faced by the body metabolically

- Fluid overload
- Insulin resistance

Subsequently, OlleLjungqvist and Kenneth Fearon improvised the ERAS protocol by including postulates. This led to the founding of ERAS study group in the year 2001 and subsequent creation of the ERAS society in 2010. The main stakeholders of the study group were surgeons and anesthesiologists who did a systematic review and meta-analysis to gather evidence in support of this ERAS protocol¹⁴.

The components and salient features of ERAS

The ERAS protocol comprised of 20 items along with a database that could support these principles. The protocol divided the perioperative period on the basis of aggregation of marginal gains theory as;

- pre-operative
- intraoperative
- postoperative

The entire protocol is designed to seamlessly facilitate and manage right from preadmission, admission. pre-operative and operative till discharge and rehabilitation¹⁶. The utilisation and dissemination of the protocol demanded the creation of the ERAS society. This included the creation of

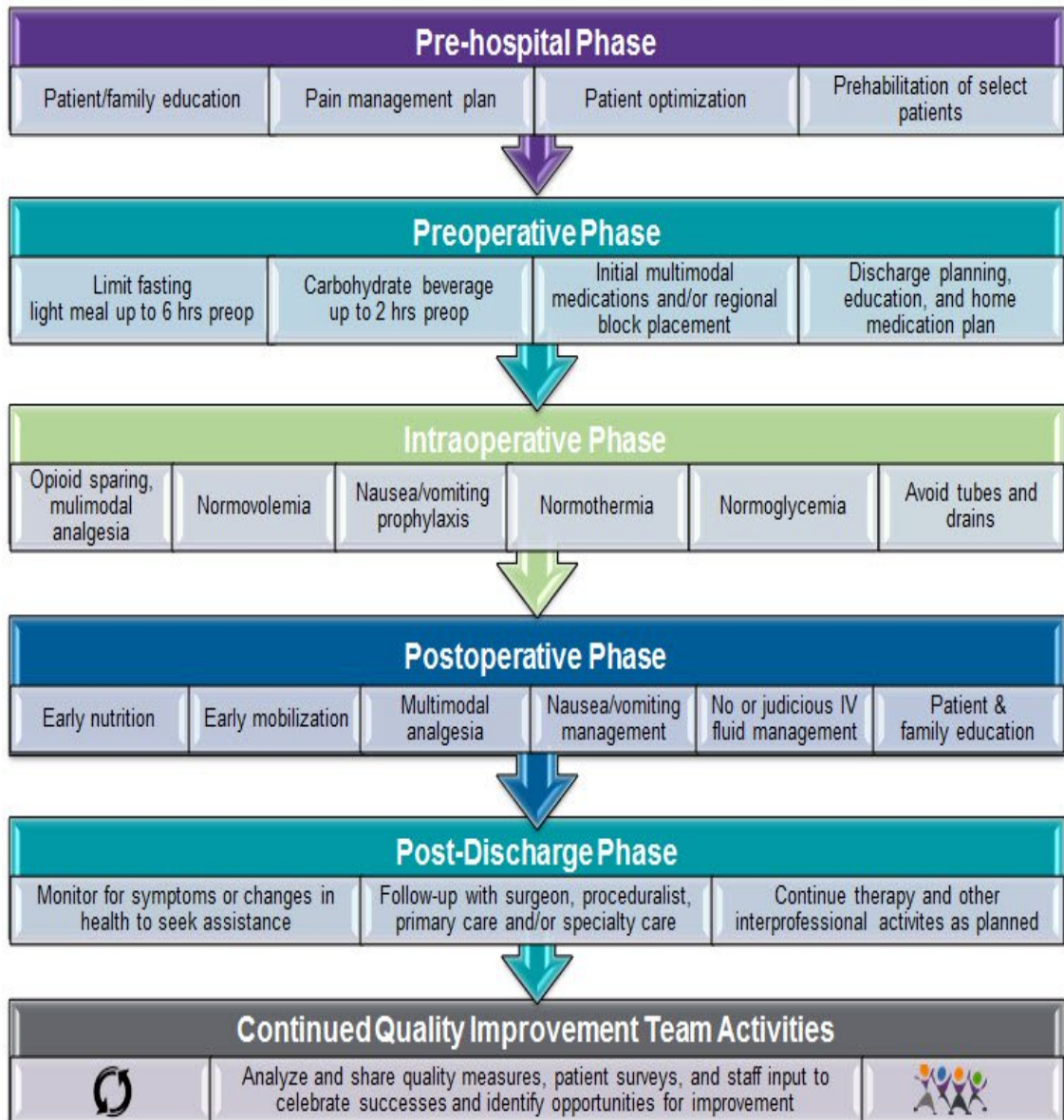
a global network with national and regional expert centers for the smooth facilitation of the ERAS protocol¹⁵. Right from its inception, the beneficial effects of ERAS has been seen in several disciplines namely¹⁷⁻²⁰;

- colorectal
- gastric
- pancreatic
- esophageal bariatric
- non-gastrointestinal specialties

The ERAS protocol has the following components;

- counseling preoperatively
- optimizing nutrition
- standardizing analgesia without opioid use
- minimizing electrolyte
- reduce fluid imbalance
- use most minimally invasive approaches
- promote early ambulation and feeding

Here are the salient features of ERAS as recommended by various committees;



The goal of maintaining the physiological equilibrium in the post-operative period and optimise the outcomes in the patient led to the development of ERAS.

This should be cost-effectively with minimum post-op complications or recurrence.

In order to maintain this equilibrium and help reduce the effects of surgery, a combination of multiple elements are packed into this ERAS protocol.

The basic aspect of ERAS is to give attention to the following elements;

- preoperative counseling
- nutritional strategies
- avoidance of prolonged perioperative fasting
- focus on regional anesthetic and nonopioid analgesic approaches,
- focus on nonopioid analgesic approaches
- fluid balance
- maintenance of normothermia
- focus on postoperative recovery strategies
- early mobilization
- appropriate thromboprophylaxis

Following established benefits are seen in ERAS;

- shorter length of hospital stay
- low postoperative pain
- low need for analgesia,
- increase return of bowel function
- decreased complications
- low readmission rates
- increased patient satisfaction

Any institute that wants to adopt the ERAS program must evaluate their own infrastructure and consider the possibilities of using the ERAS protocol. In order to make the program self-sustainable, the protocol should be adopted into the standard method of care in the regular system. Published literature shows success of ERAS when all the key components are addressed. This explains why ERAS pathways are necessary for better institutional management of the patients.

The physiology behind ERAS

When the body is undergoing a surgery, it responds by promoting catabolism through stress hormones. These are mediated by the central nervous system and its constituent mediators²¹. The important aspect of this catabolism is the development of resistance to insulin. This resistance is causative in the prolonged recovery periods and the increased

morbidity post surgically. This resistance is positively correlated to the duration of recovery with higher resistance increasing the duration of stay in the hospital and lower resistance leading to lesser duration of stay in the surgical wards. The resultant hyperglycemia paradoxically reduces the uptake of glucose by fat and muscles. The reduction in lean body mass combined with the low glucose uptake leads to severe loss of function of the muscles. The loss of muscle power in turn leads to the reduction in the mobilisation of the patient thereby delaying rehabilitation. This cycle continues with prolonged immobilisation, increased loss of working days and reduce the quality of life apart from the economic and social costs. In addition to all these, the non-insulin sensitive cells also increase their glucose uptake acting as an instrument in the development of a number of post-operative complications mainly infections and cardiovascular problems²².

The ERAS starts with the pre-operative counseling about the surgical procedure. This helps in reducing the anxiety and unnecessary worry about the illness among the patients which is known to promote recovery and pain control postoperatively. It also helps to show better fidelity to the treatment protocol and enable early recovery and faster discharge with early return to work²³.

The traditional mechanical bowel preparation (MBP) focusses on removing the feces of the body and lower the microbial flora in the intestinal tract. But this practice does not necessarily do that instead increase the liquidity of the feces and increase the risk of spilling the flora surgically. Also, it is known to unaffected the microbial flora of the intestine. Apart from this, it is known to cause the water and electrolyte imbalances through these preparation methods²⁴.

Another aspect of traditional method of preparation includes preoperative fasting which is done to reduce the risk of pulmonary aspiration. No published studies support this claim though. On the other hand, pre-operative fasting is capable of augmenting the metabolic stress found after the surgery²⁵.

This can be counteracted by causing a metabolically fed state through the ingestion of a beverage that is rich in carbohydrate before the midnight and just before two to three hours before surgery. The metabolically fed state is known to reduce thirst, anxiety and hunger preoperatively. Also, studies show that this fed state might reduce the insulin resistance seen in the patients after surgery²⁶. A state of anabolism is reached through this loading of carbohydrates with reduction in the loss of proteins and nitrogen. This ensures a better muscle strength, mass and power leading

to faster recovery and return to work requiring lesser rehabilitation time and physiotherapy²⁷.

Systematic reviews and meta-analysis of published literature shows that LMWH (low molecular weight heparin) can be used in the place of low-dose subcutaneous unfractionated heparin. Low-dose subcutaneous unfractionated heparin was given to reduce the incidence of pulmonary embolism, deep vein thrombosis and have an impact in the overall mortality of the patient. The reason for choosing low molecular weight heparin is due to the ease of giving a single dose per day. Also, it is known to lower the risk of heparin-induced thrombocytopenia²⁸.

Previously published literature is known to have advocated the use of prophylactic antibiotics to control aerobic and anaerobic infections²⁹. The preservation of the body temperature is also implicated in the reduction of the wound infections, transfusion requirements, bleeding and cardiac complications. Therefore, in ERAS, the maintenance of temperature is done by heating the upper body using forced air and administering warm fluids intravenously 2-hours before and after surgery. This helps in reducing the post operative chills and rigor³⁰. This is against the previous protocol of overdosing the fluid requirements based on the expected loss during surgery. The over dosage of fluids are known to cause delayed wound healing, reduction in the rate of healing of anastomoses with

slower return to the functioning of the gut by affecting the tissue oxygenation. These protocols increased the duration of stay in the hospital.

The present literature suggests that post-operative sodium-rich fluid administration should be limited. The IV infusions must be stopped and oral fluids should be started early, as early as the first post operative day. The post operative complications such as ileus is known to reduce because of this thereby reducing the duration of hospital stay³¹.

In-depth analysis of lived experiences of the patients show that pain is less morbid than nausea and vomiting. These post-operative symptoms have certain predisposing factors namely;

- female gender
- non-smokers
- history of motion sickness
- postoperative use of opioids

When individuals are having these issues, they must be administered with

a) In the beginning by dexamethasone sodium phosphate

b) or in the end by serotonin receptor antagonists³²

After uncomplicated procedures, drainage should not be used. These drains are not known for reducing the risk nor severity of the leaks in the

anastomoses³³. The use of ERAS is shown to hasten recovery, reduce pain and lower the incidence of complications. The compression through nasogastric tube should be avoided in the light of atelectasis, fever and pneumonia³⁴.

The recommended procedures are either to completely avoid the nasogastric tube or remove them before the anesthesia gets reversed. This helps to reduce the risk of pneumonia and also aid in the rapid progression of consumption of solid foods³⁵.

The recovery of the patient can be prolonged through the use of long acting sedatives, hypnotics and opioids that might hamper the process of mobilisation and reversion to the normal diet. The early return to the normal diet helps in early mobilisation, increased recovery, rehabilitation and regular activities. Also, it reduces the insulin resistance due to starvation and prevent loss of protein. The earlier the urinary catheters are removed, the earlier the patients are mobilised³⁶.

For reducing the incidence of ileus, following strategies are used;

- a) use of epidural analgesia in open surgical procedures
- b) Avoid opioids
- c) Avoid fluid overload
- d) use of oral laxatives early after surgery

The patient should be discharged when³⁷;

- a) Oral diet is initiated
- b) Bowel movements returns
- c) Pain is orally controlled
- d) Presence of enough mobility that the patient can take care of himself or herself
- e) there are no complications requiring hospitalisation

The ultimate aim of ERAS is not early discharge rather to prepare the patient for an early discharge and make him or her self-sustainable once they reach home.

What is probably the most important in ERAS—its aim is not to discharge a patient from hospital as soon as possible. It rather aims to prepare him for early discharge by making him fully capable of going home.

ERAS in abdominal surgeries

The ERAS has been used and studied mostly in the field of colorectal surgeries. This section deals with the major findings and methodologically adopt studies for review. The paramount Dutch study

where a multicentric randomised control trial was done had the following groups³⁸;

Open		Laparoscopic	
With ERAS	Without ERAS	With ERAS	Without ERAS

The group that underwent laparoscopic with ERAS showed better recovery post-operatively than the other groups.

Other studies showed that³⁹⁻⁴¹;

- a) ERAS in colorectal surgery reduced the post operative morbidity by 40% to 50%
- b) The LOS was reduced by two to three days

In these studies, it was concluded that new trials are not necessary rather a procedure to standardise the protocol to implement worldwide should be adopted³⁹. New policies are therefore required for adoption of the ERAS protocol.

One important findings in colorectal surgeries is that ERAS protocol along with laparoscopy can reduce post-operative morbidity and eliminate the risk factors and the complications from surgery^{42,43}. Even in patients with advanced colon and rectal cancer, ERAS can be used with similar effectiveness when the protocols are strictly followed^{44,45}. At present, ERAS is well established in the field of colorectal surgery.

Compared to colorectal surgeries, gastric surgeries have implemented ERAS less and its use and applicability is still under exploration⁴⁶⁻⁴⁸. Yu et al in 2014 did a meta-analytic study of around 400 patients who were on perioperative ERAS care and reported the following⁴⁹;

1. duration of stay in the hospital was reduced
2. the time to first flatus was early
3. economically it was less burdensome on the patient

The ERAS committee for gastrectomies came up with a 25-item long protocol that was evidence-based for patients undergoing gastrectomies⁵⁰. Another meta analysis study in 2015 among 524 patients and seven randomised control trials stated that ERAS gave the following benefits⁵¹;

- lesser postoperative hospitalization
- reduction in hospitalization expenditure
- less pain
- improved quality of life

Another meta analysis study in 2018 showed the following findings for ERAS⁵²;

- lesser time for passing first flatus
- lesser duration of postoperative hospital stay
- highly economical

The use of drains though is not seen with any change in morbidity and mortality among patients, even when they are not in line with the ERAS protocol⁵³.

Finally, the postoperative feeding when initiated early using ERAS is known to be beneficial over the traditional late feeding patterns with a lower duration of hospital stay. Also, the complications are also less incident⁵⁴.

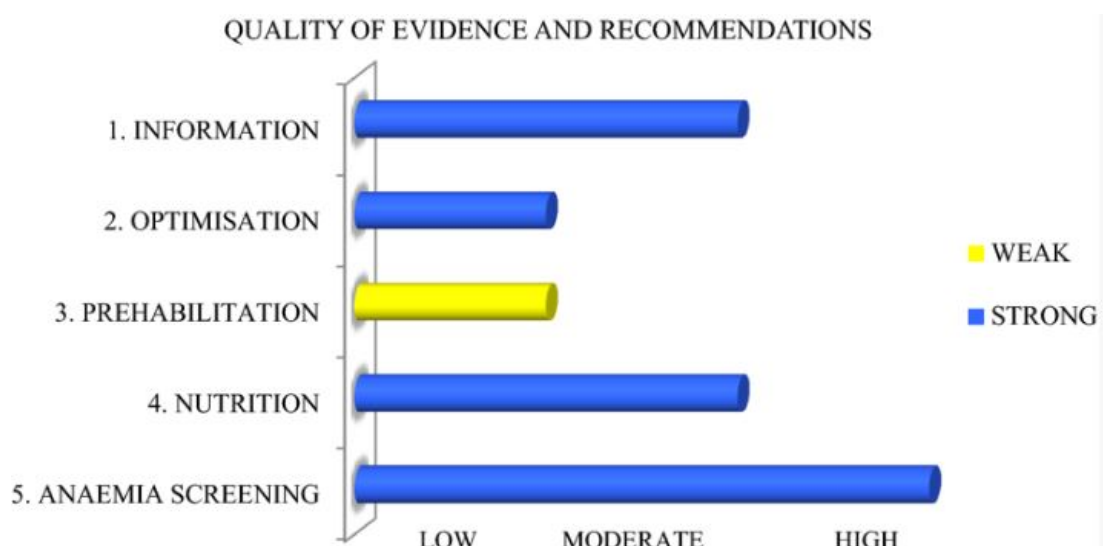
In liver surgeries, ERAS is known to be beneficial and has been implemented in various centers⁵⁵. Wong-Lun-Hing et al in 2014 showed that hepatic surgery protocols already have many of the components of ERAS already implemented⁵⁶. The studies though are less standardised and optimised for broader decision making. This led to the formulation of the recommendations of ERAS society⁵⁷.

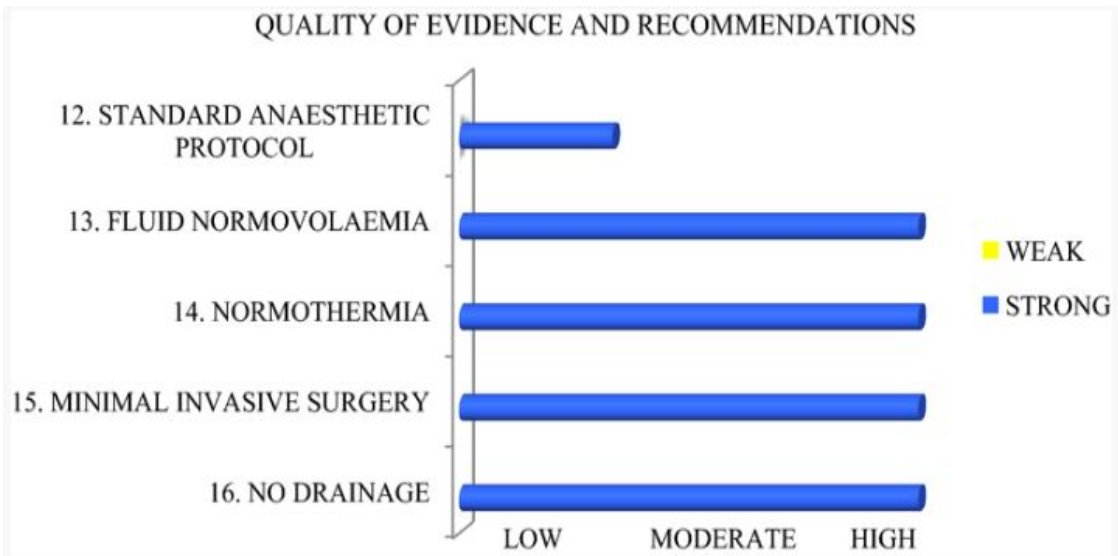
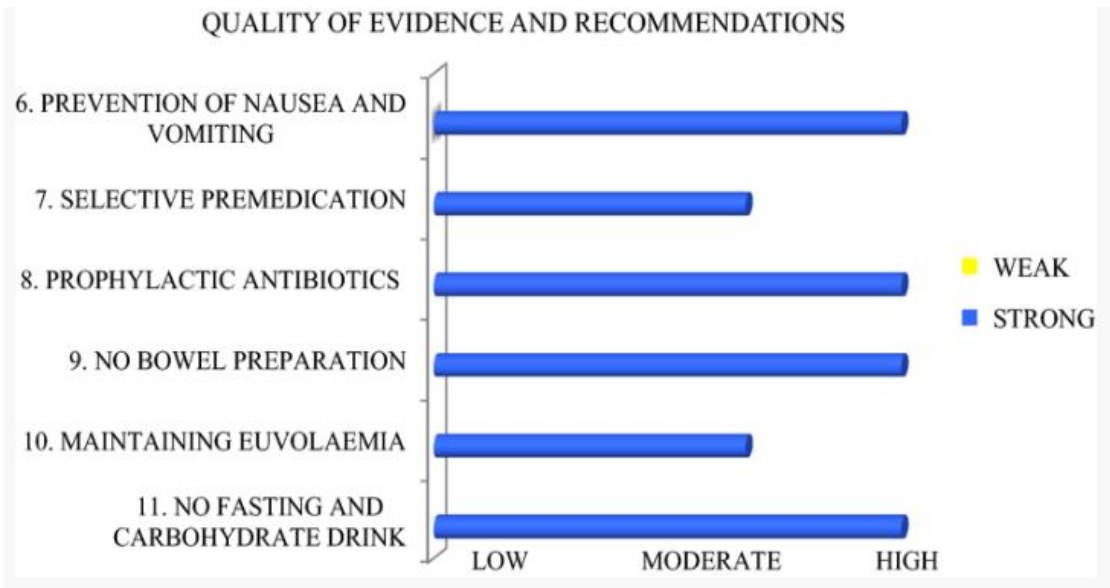
Studies show that there are a number of studies that have been published for ERAS but with methodological limitations like the studies mentioned below, yet they have shown the efficacy and clinical safety of ERAS in major resections to be significant;

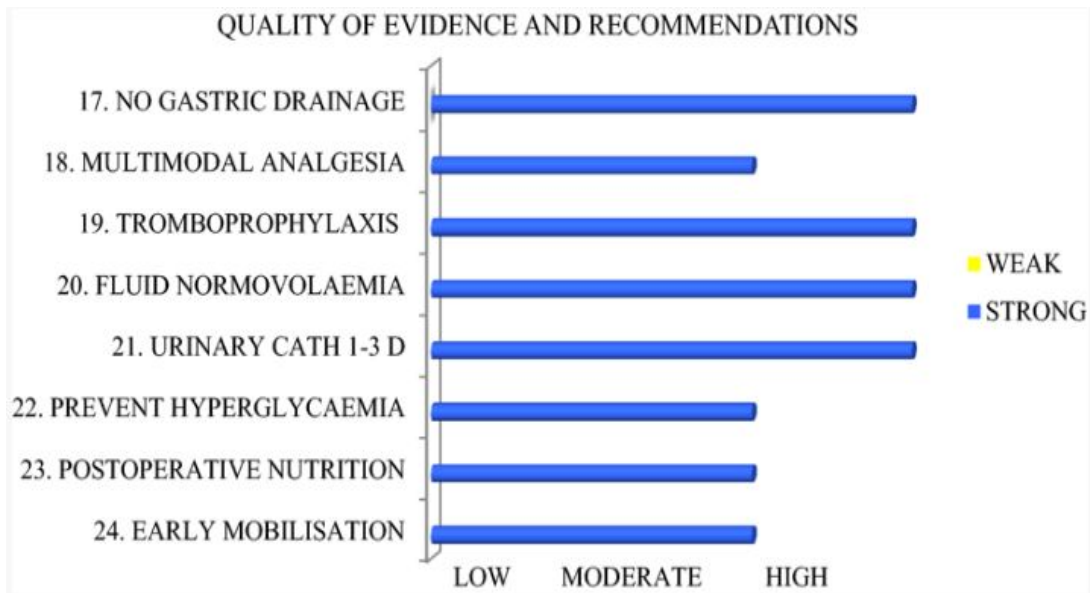
- 62 patients in Kapritsou et al. study⁵⁸
- 160 in Qi et al. RCT⁵⁹

The pancreatic surgeries have used ERAS and have reported findings that are favorable⁶⁰. Multi-centric randomised control trials have been stated as a requirement for getting better insight while keeping in mind the safety of the patients^{61,62}. But the use of laparoscopic surgeries in pancreatic carcinomas is still not well established^{63,64}. There are also studies that show that in pancreatic patients, ERAS can reduce the post operative complications and prevent recurrence⁶⁵. It is essential to understand that pancreatic surgeries have their own complications like fistula which may affect the early initiation of oral feeding and LOS.

The recommendations of the ERAS committee for gastrointestinal surgeries based on evidence are given below in the following images;







How ERAS is done

The following steps enumerates how ERAS is done in elective laparotomy

Preadmission

- Preoperative assessment in a dedicated outpatient session.
- Programme information given.
- Social issues are identified and addressed.
- Preoperative ward visit and orientation.

Preoperative

- Preoperative carbohydrate loading. Four drinks day before surgery and two drinks two hours before surgery.

- Patients admitted to hospital on the morning of their surgery.
- Left sided operations receive a phosphate enema on arrival at the hospital.
- Mechanical bowel preparation is avoided.

Intraoperative

- Thoracic epidural inserted and lidocaine at 2mg/kg/hr.
- Limited intraoperative intravenous fluids(1-2L crystalloids/colloids) blood products as needed.
- Hypothermia prevented using active warming air blanket.
- Insertion of nasogastric tube and urinary catheter
- Intra abdominal drains not used if possible calf stockings applied at the end of the surgery.

Recovery Room

- Vasopressor agents in preference to intravenous fluids to treat epidural related hypotension
- Post operative analgesia with intravenous paracetamol for breakthrough pain.

Day of Surgery

- Initiation of physiotherapy and patients are mobilised to a chair.
- Oral intake of fluids is started 6 hours after surgery, aiming for >500 ml
- Limit intravenous fluid(1L of general maintenance solution)
- Subcutaneous low molecular weight heparin started for thromboprophylaxis.

Day 1

- Urinary catheter removed.
- Nasogastric tube removed.
- Supplement nutritional drinks .
- Active mobilization with nursing and physiotherapy input.

Day 2

- Epidural infusion is stopped and epidural catheter removed.
- Regular oral multimodal analgesia:paracetamol(1g 6hrly)and tramadol(50 mg 6hrly)
- Continued until discharge.

- Intramuscular opiates for breakthrough pain.

Day 3

Discharged home if following criteria fulfilled:

- Tolerating full solid oral diet.
- Passing flatus or faeces.
- Adequate postoperative pain control with oral analgesia.
- Ambulating independently
- Satisfactory support at home.

Follow-up

- Patients were followed up till their discharge and at periodic intervals

Need for study

Following established benefits are seen in ERAS; shorter length of hospital stay, low postoperative pain, low need for analgesia, increase return of bowel function, decreased complications, low readmission rates and increased patient satisfaction.

Any institute that wants to adopt the ERAS program must evaluate their own infrastructure and consider the possibilities of using the ERAS

protocol. In order to make the program self-sustainable, the protocol should be adopted into the standard method of care in the regular system. Published literature shows success of ERAS when all the key components are addressed. This explains why ERAS pathways are necessary for better institutional management of the patients.

There are not many studies from India that explores the effectiveness of ERAS protocol. This study aims to show the usefulness of ERAS in evaluating; Length of hospital stay; Decrease in major morbidity; Post operative recovery; Reduction of surgical stress response and Cost effectiveness.

Aims and objectives of the study:

The objectives of the study are;

To show the usefulness of ERAS in evaluating;

- Length of hospital stay
- Decrease in major morbidity
- Post operative recovery
- Reduction of surgical stress response
- Cost effectiveness

Study design

Prospective study

Place of study

Department of General Surgery,GMKMC hospital

Study period

July 2017 to June 2019

Sample size : 50

Sample design : Purposive sampling

Study population & Sampling Methodology

- Cases admitted to GMKMC hospital Salem for elective laparotomy will be closely monitored from the day of admission to the day of discharge.
- The patients admitted for elective laparotomy between 2017-2019 were chosen.

Inclusion criteria:

- a. All patients undergoing elective laparotomy for gastrectomy , cholecystectomy, bowel resection & anastomosis , ileostomy/colostomy , hernia repair , Hartmann's procedure are included
- b. Hemodynamically stable patients
- c. Patients with ASA I & II

Exclusion criteria:

- a. Patients not Willing For Study
- b. Pregnant women
- c. Psychiatric patients
- d. Add on surgeries / Relaparotomy cases
- e. Patients with ASA III & IV

Methodology

The material for the study is taken from the cases admitted in the surgical ward and trauma ward of the Department of General Surgery, GMK Medical College & Hospital, who are undergoing elective laparotomy.

- Data was collected with regards to age, demographic characteristics, socio economic status, detailed history and type of injuries including patient's complaints and duration of complaints.
- A detailed general examination was done and hemodynamic stability was ensured

The following data was extracted from the patient's history ,clinical examination and follow up.

- Patient admission
- Pre operative management
- Intra Operative anaesthesia details
- Operative procedures
- Post operative management
- Outcome
- Complications during hospital stay & on subsequent follow up

A detailed general examination was done. Systemic examination and basic investigations were done. All the data were collected using a structured questionnaire.

Investigations

The study requires the following investigations were conducted on patients

- a. HB%, TC, DC, ESR.
- b. Blood urea, Serum creatinine, Blood sugar.
- c. Blood grouping and Rh typing.
- d. BT, CT.
- e. Urine routine examination.
- f. Screening for HIV, Hbs Ag and VDRL after informed consent
- g. Chest X-ray PA view.
- h. x ray abdomen erect
- i. CECT abdomen and pelvis

Procedure

Preadmission

- Preoperative assessment in a dedicated outpatient session.
- Programme information given.
- Social issues were identified and addressed.
- Preoperative ward visit and orientation.

Preoperative

- Preoperative carbohydrate loading. Four drinks day before surgery and two drinks two hours before surgery.
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- Adequate postoperative pain control with oral analgesia.
- Ambulating independently

- Satisfactory support at home.

Follow-up

- Patients were followed up till their discharge and at periodic intervals

Statistical Analysis

Data were analyzed according to history, clinical examination and investigation. Data were entered in excel sheet and analyzed using SPSS v23. Frequencies and percentage analysis were done. Cross tabulation and Chi-square analyses were done to find the relationship and association between various variables.

RESULTS

A prospective study among 50 patients admitted for elective laparotomy with the objectives to show the usefulness of ERAS in evaluating; Length of hospital stay, Decrease in major morbidity, Post operative recovery, Reduction of surgical stress response and Cost effectiveness revealed the following results. Majority of them (n=15, 30%) were in the age group of 36-45 years. The mean age of the patients is 47 years with a standard deviation of 13.08 years ranging between 28-75 years. Majority of them (n=15, 30%) were in the age group of 36-45 years. Females were large in number (n=26, 52%) while the rest were males (n=24, 48%). Out of 50 patients, around 20% (n=10) had cholelithiasis while 12% (n=6) had carcinoma of caecum. Choledocholithiasis was found in 14% (n=7) of the patients. The mean number of days of hospital stay is 5.10 days with a standard deviation of 0.931 days ranging between 4 to 6 days and a median of 5 days. The most commonly admitted duration is six days. The most commonly performed procedure was cholecystectomy with CBD exploration (26%, n=13) followed by right hemicolectomy (24%, n=12). Majority of them were ambulated on the first post-operative day (n=27, 54%) while the rest were ambulated on the day of surgery (n=23, 46%). Out of 50 patients, 25 of them (50%) were started on oral diet on 2nd post-

operative day and the rest were started on oral diet on the 4th post-operative day.

Age distribution

The following tables and figures show the age distribution of the participants of the study. The mean age of the patients is 47 years with a standard deviation of 13.08 years ranging between 28-75 years. Majority of them (n=15, 30%) were in the age group of 36-45 years.

Statistics	Age in years
Mean	47.00
Median	44.00
Mode	38
Std. Deviation	13.081
Minimum	28
Maximum	75

Table 1: Age distribution of the participants

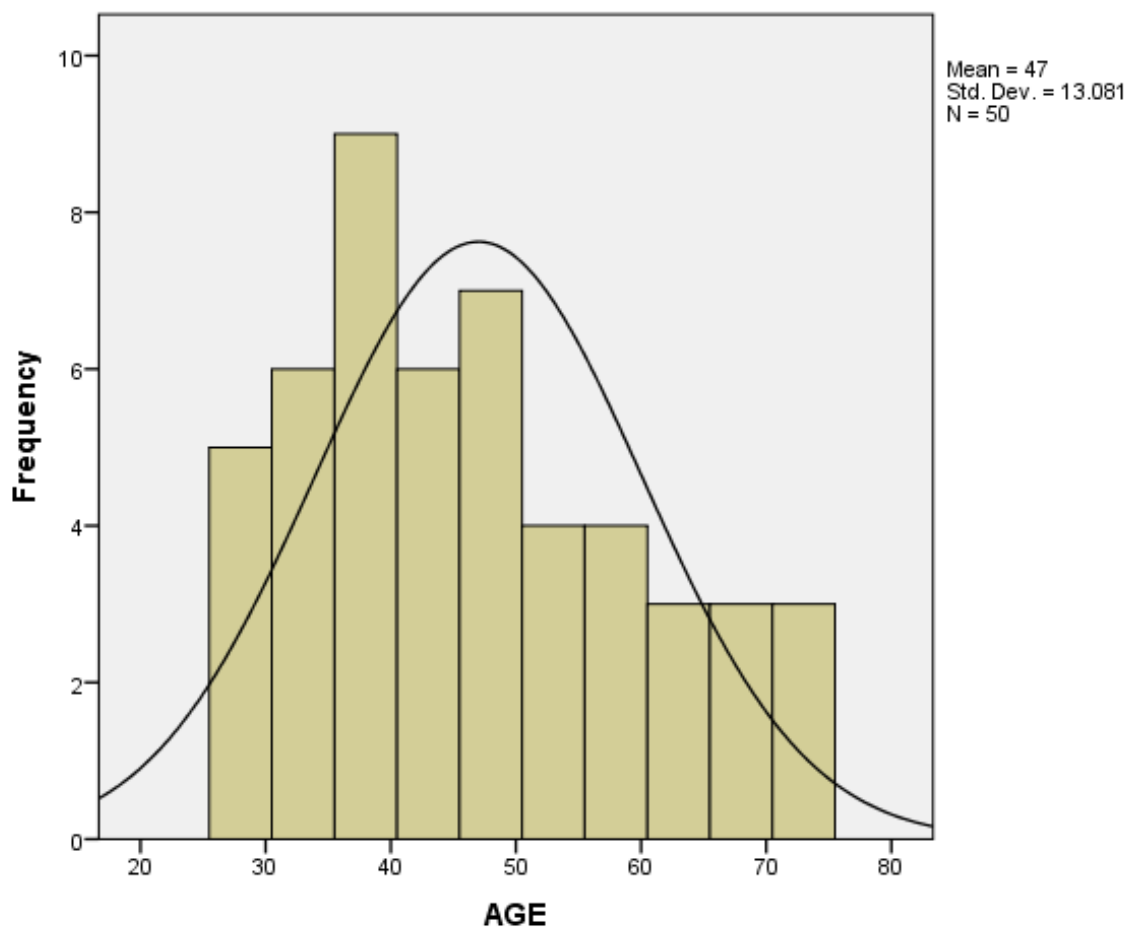


Figure 1: Age distribution of the participants

The patients were then categorised into five groups. The categories are summarised in the table and figures below.

Age in years	Frequency	Percentage
26-35	11	22
36-45	15	30
46-55	11	22
56-65	7	14
66-75	6	12

Table 2: Categorization of age distribution of the participants

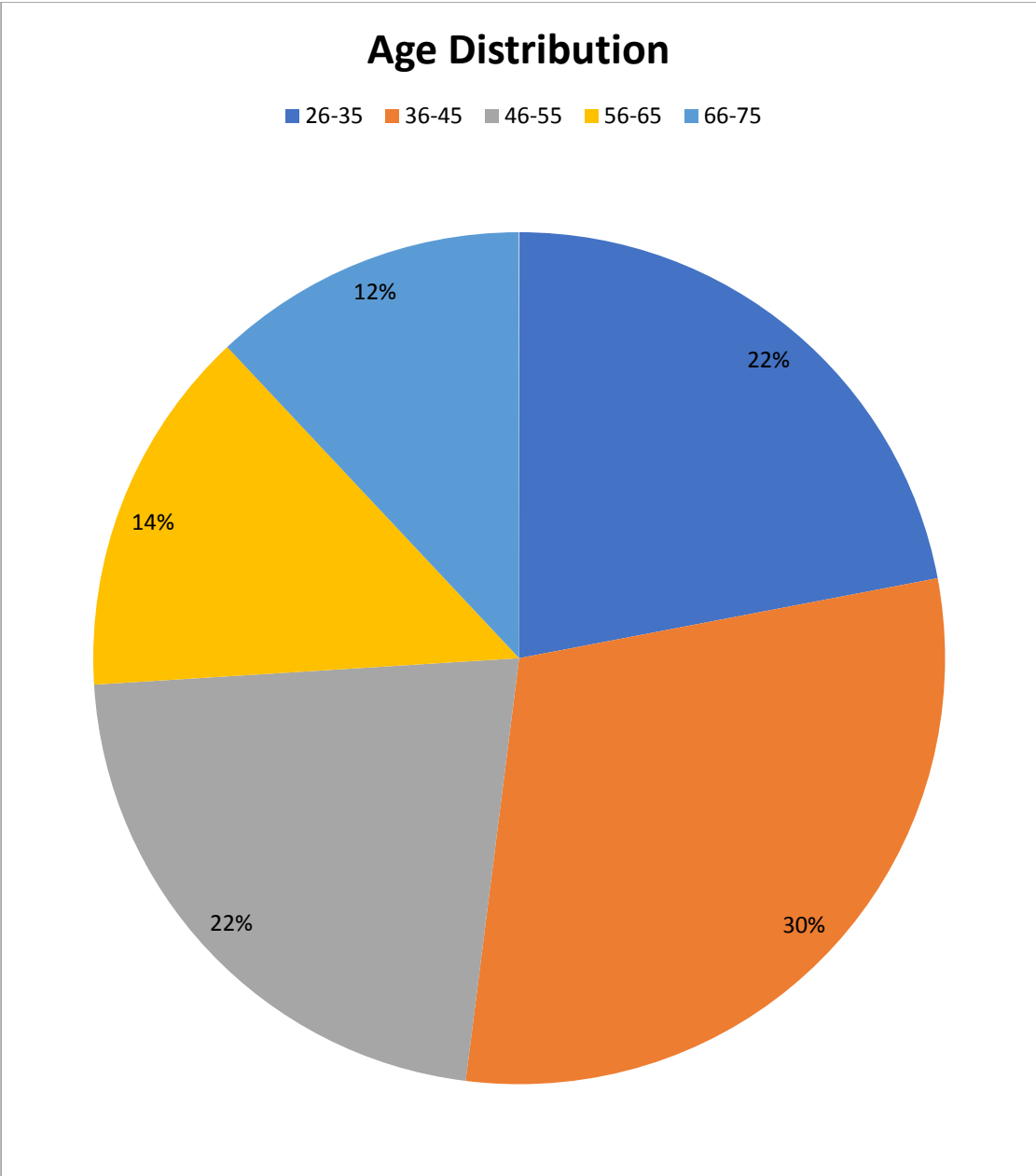


Figure 2: Categorization of age distribution of the participants

Gender distribution of the participants

The following table and figure shows the gender distribution of the participants. Females were large in number (n=26, 52%) while the rest were males (n=24, 48%).

Gender	Frequency	Percent
Males	24	48
Female	26	52

Table 3: Gender distribution of the participants

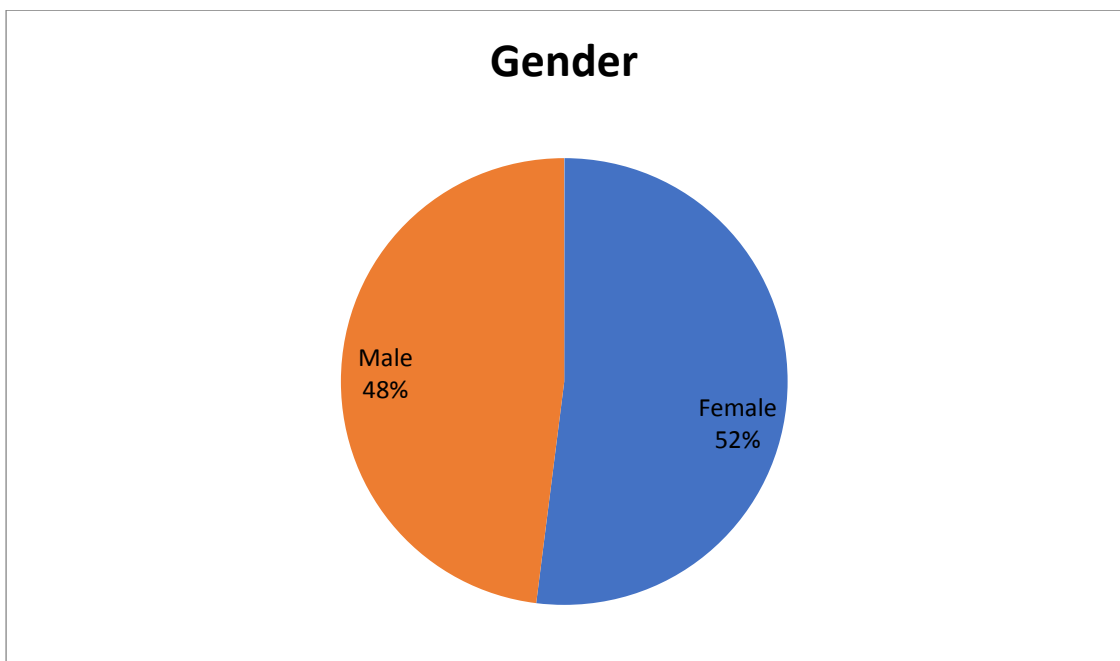


Figure 3: Gender distribution of the participants

Diagnosis

Out of 50 patients, around 20% (n=10) had cholelithiasis while 12% (n=6) had carcinoma of caecum. Choledocholithiasis was found in 14% (n=7) of the patients. The following tables and figures shows the diagnosis of the patients.

Diagnosis	Frequency	Percent
Acute cholecystitis	3	6.0
Carcinoma of ascending colon	3	6.0
Carcinoma Caecum	6	12.0
Carcinoma colon at hepatic flexure	2	4.0
Carcinoma colon at splenic flexure	2	4.0
Carcinoma descending colon	3	6.0
Carcinoma sigmoid colon	4	8.0
Carcinoma transverse colon	3	6.0
Choledocholithiasis	7	14.0
Cholelithiasis	10	20.0
Gist of ascending colon	1	2.0

Gist of caecum	1	2.0
Gist of descending colon	1	2.0
Gist of ileum	2	4.0
Rectosigmoid growth	2	4.0
Total	50	100.0

Table 4: Diagnosis

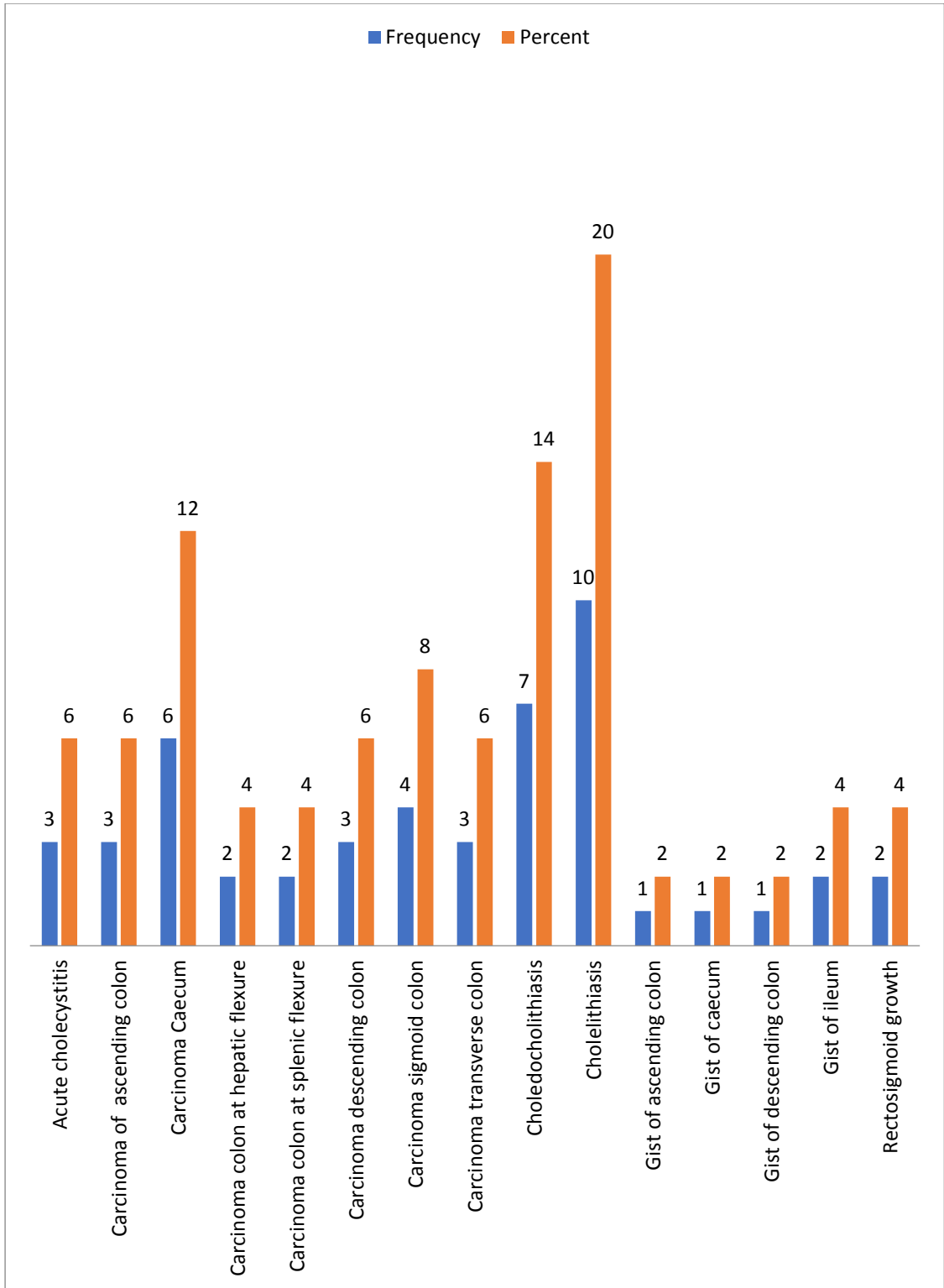


Figure 4: Diagnosis

Number of days in hospital

The mean number of days of hospital stay is 5.10 days with a standard deviation of 0.931 days ranging between 4 to 6 days and a median of 5 days. The most commonly admitted duration is six days. The following tables and charts shows the number of days in the hospital.

Statistics	Days in Hospital
Mean	5.10
Median	5.00
Mode	6
Std. Deviation	.931
Minimum	4
Maximum	6

Table 5: Number of Days in Hospital

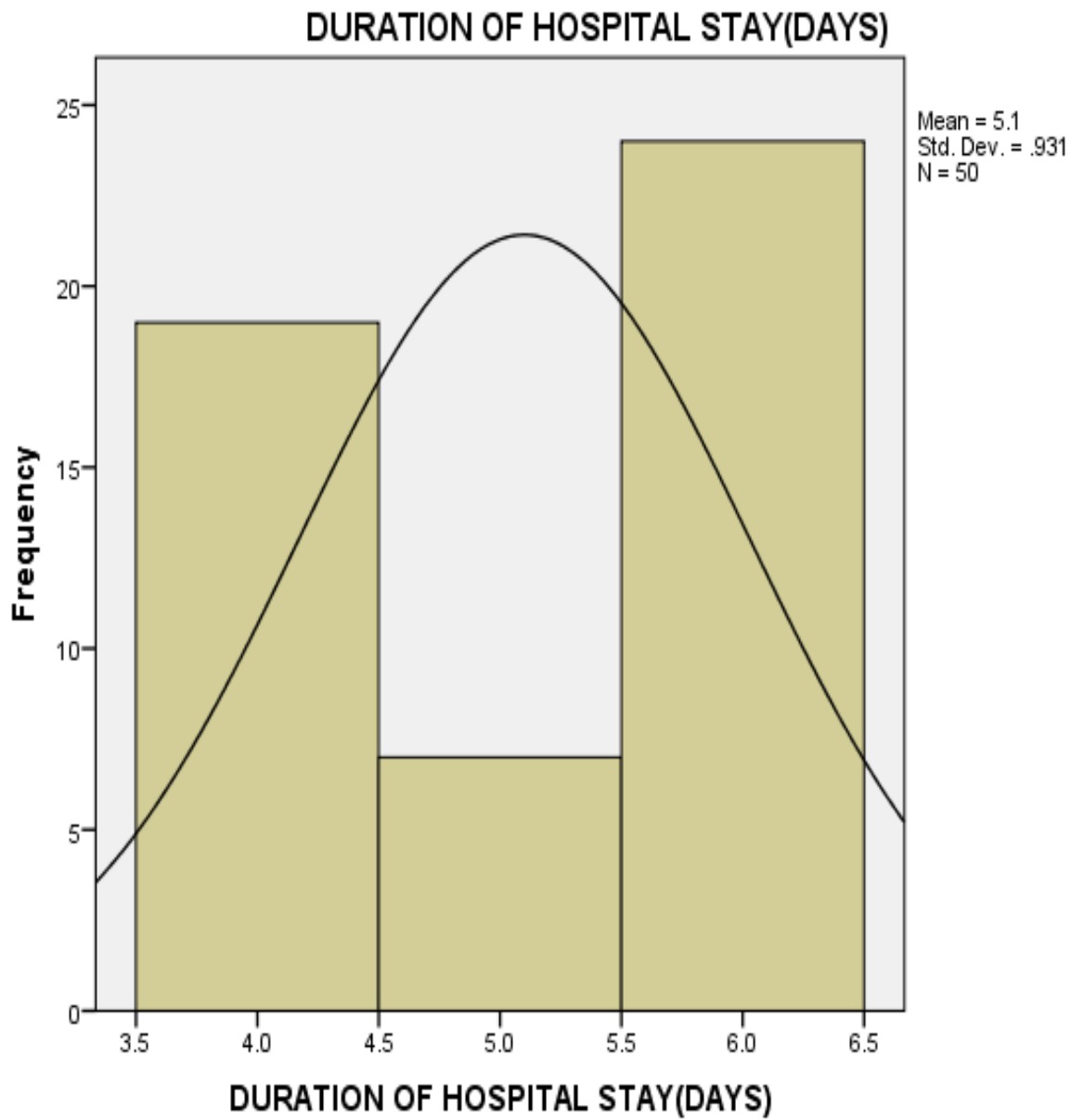


Figure 5: Duration of hospital stay (days)

**Categorisation of the samples gives only three groups namely 4 days,
5 days or 6 days**

Number of days in Hospital	Frequency	Percent
4.0	19	38.0
5.0	7	14.0
6.0	24	48.0

Table 6: Duration of hospital stay

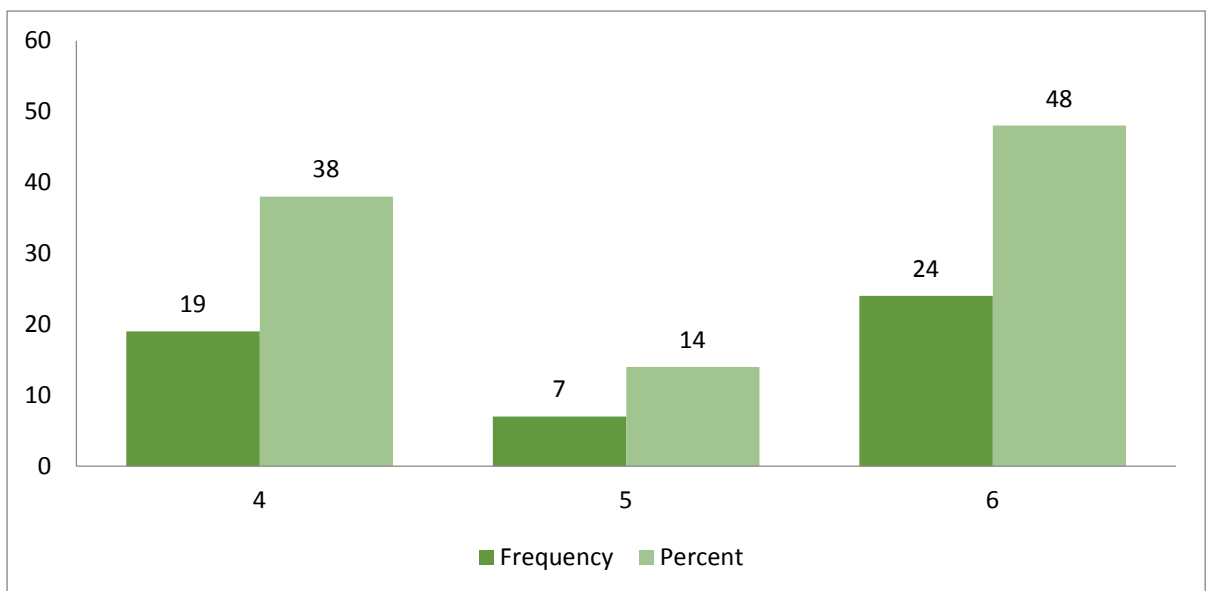


Figure 6: Duration of hospital stay

Procedure

The most commonly performed procedure was open cholecystectomy with CBD exploration (26%, n=13) followed by right hemicolectomy (24%, n=12). The following tables and figures show the procedures performed.

Procedure	Frequency	Percent
Cholecystectomy With CBDExploration	7	14.0
Elective Laparotomy & Colostomy	2	4.0
Extended Right Hemicolectomy	5	10.0
Hartmann's Procedure	4	8.0
Left Hemicolectomy	6	12.0
Open Cholecystectomy	13	26.0
Resection & Anastomosis	1	2.0
Right Hemicolectomy	12	24.0
Total	50	100.0

Table 7: Procedure done

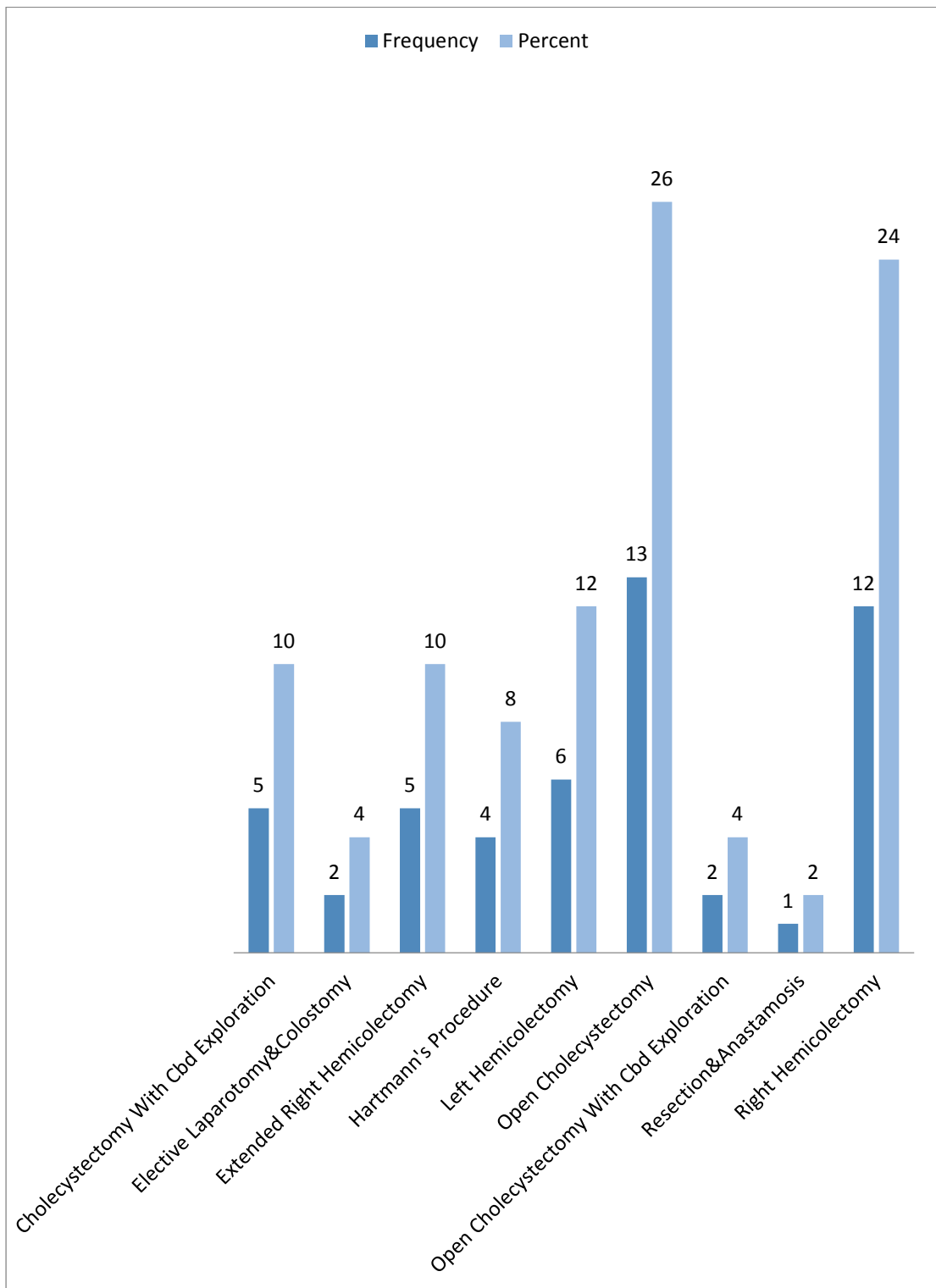


Figure 7: Procedure done

Ambulation

Majority of them were ambulated on the first post-operative day (n=27, 54%) while the rest were ambulated on the day of surgery (n=23, 46%).

The following tables and figures show the ambulation.

Ambulation	Frequency	Percent
First Post-Operative Day	27	54
Day of surgery	23	46

Table 8: Ambulation

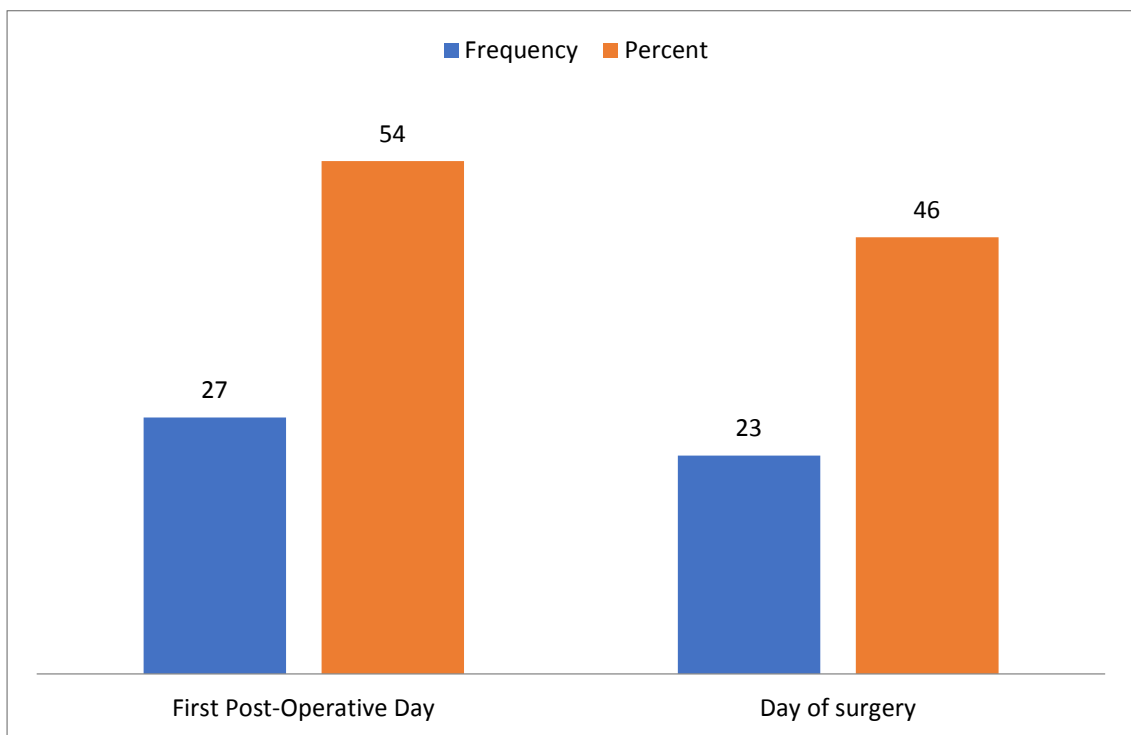


Figure 8: Ambulation

Day of starting oral diet

Out of 50 patients, 25 of them (50%) were started on oral diet on 2nd post-operative day and the rest were started on oral diet on the 4th post-operative day. The following tables and charts shows the day of starting the oral diet.

Day	Frequency	Percent
2nd Post operative day	25	50.0
4th Post operative day	25	50.0

Table 9: Day of starting oral diet

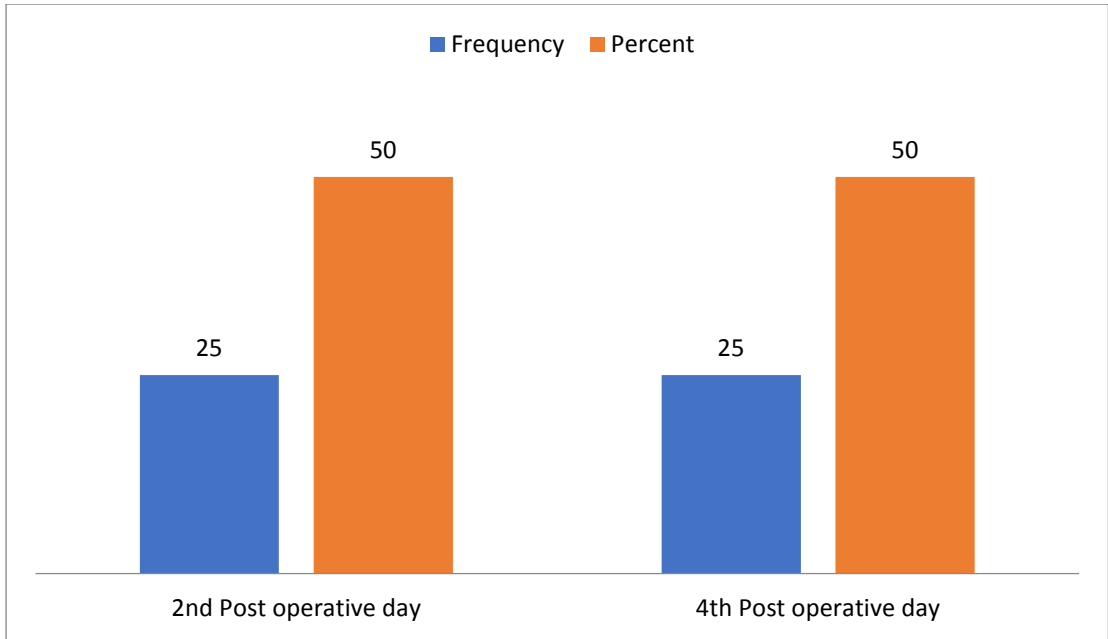


Figure 9: Day of starting oral diet

Removal of drain

Out of 50 patients, majority of them (n=29, 58) removed the drain on 4th postoperative day. Around 26% (n=13) removed the drain on 2nd postoperative day.

Drain Removed on	Frequency	Percent
2ND POD	13	26.0
3RD POD	7	14.0

4TH POD	29	58.0
5TH POD	1	2.0

Table 10: Removal of drain

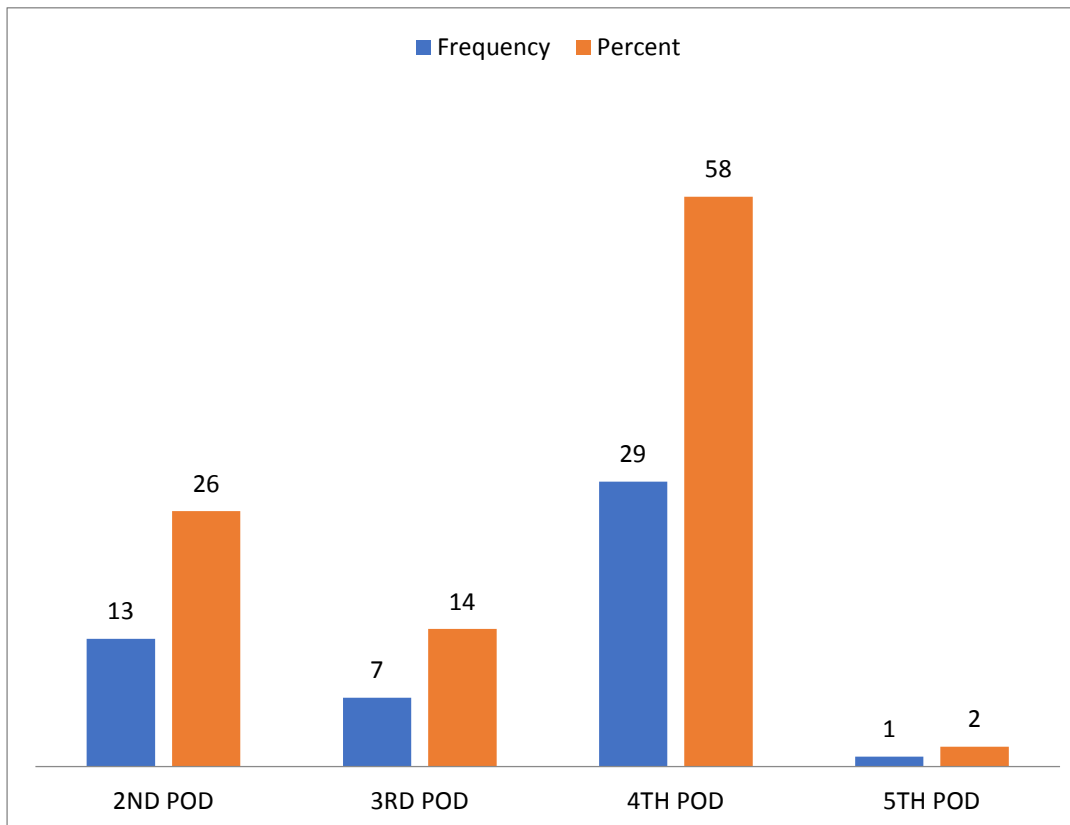


Figure 10: Removal of drain

Complications and Readmission within six weeks

None of the patients had complications or readmission within the next six weeks.

Discussion

A prospective study among 50 patients admitted for elective laparotomy with the objectives to show the usefulness of ERAS in evaluating; Length of hospital stay, Decrease in major morbidity, Post operative recovery, Reduction of surgical stress response and Cost effectiveness revealed the following results. The cases admitted to GMKMC hospital, Salem for elective laparotomy were closely monitored from the day of admission to the day of discharge. The study included; All patients undergoing elective laparotomy, Cases undergoing following procedures were included: gastrectomy , cholecystectomy, bowel resection & anastomosis, ileostomy/colostomy , hernia repair , Hartmann's procedure, Hemodynamically stable patients and Patients with ASA I & II. The following tables and figures show the age distribution of the participants of the study. The mean age of the patients is 47 years with a standard deviation of 13.08 years ranging between 28-75 years. Majority of them (n=15, 30%) were in the age group of 36-45 years. The mean age of the patients is 47 years with a standard deviation of 13.08 years ranging between 28-75 years. Majority of them (n=15, 30%) were in the age group of 36-45 years. Females were large in number (n=26, 52%) while the rest were males (n=24, 48%). Out of 50 patients, around 20% (n=10) had cholelithiasis while 12% (n=6) had carcinoma of caecum. Cholelithiasis was found in 14% (n=7) of the patients. The mean number

of days of hospital stay is 5.10 days with a standard deviation of 0.931 days ranging between 4 to 6 days and a median of 5 days. The most commonly admitted duration is six days. The most commonly performed procedure was open cholecystectomy with CBD exploration (26%, n=13) followed by right hemicolectomy (24%, n=12). Majority of them were ambulated on the first post-operative day (n=27, 54%) while the rest were ambulated on the day of surgery (n=23, 46%). Out of 50 patients, 25 of them (50%) were started on oral diet on 2nd post-operative day and the rest were started on oral diet on the 4th post-operative day. Out of 50 patients, majority of them (n=29, 58) removed the drain on 4th postoperative day. Around 26% (n=13) removed the drain on 2nd postoperative day. None of the patients had complications or readmission within the next six weeks.

The findings are in accordance with the published studies that are discussed below.

Post-operative period is very crucial for the management of the patients for faster recovery and earlier return to function. This aim of reducing stress and promote faster return to function has led to the formulation of an evidence-based multimodal perioperative protocol called Enhanced Recovery After Surgery (ERAS)¹¹. An important feature of ERAS is that it shortened the duration of stay in the hospital with lower incidence of

post-operative complications in addition to the cost-effectiveness of the entire procedure. Also, it helps in keeping the entire post-operative period economical saving millions of rupees in the long term for both the patient and the healthcare industry^{12,13}. This has led to the shifting landscape of the peri-operative care from the surgical wards to the evidence in literature¹⁴.

Operation can induce various types of injury and stress to the patient through pain, stress-induced catabolism, decreased pulmonary function, elevated cardiac demands, risk of thromboembolism, ileus, nausea and vomiting. These post-operative events may further lead to complications, require hospitalisation, increase fatigue and delay convalescence. The recent advent of short-acting anesthetics, that are safe are known to cause better pain relief though the mechanisms of early intervention coupled with multimodal analgesia (stress reduction using regional anaesthetic techniques, blockade and glucocorticoids). These are instrumental for providing enhanced recovery.

When surgical injury is succeeded by these multimodal management principles, there is an enhanced recovery with decrease in post operative pain and duration of stay in the hospital. Even major operations can be handled effectively through these. The enhanced recovery should be

attempted by a multidisciplinary team comprising of surgeons, anaesthetists, nurses and physiotherapists.

The origin of ERAS can be attributed to the Danish Surgery Professor Dr. Henrik Kehlet. He developed the ERAS protocol to question the traditional method of perioperative care giving to patients in the surgical wards including¹⁴; prolonged fasting, mobility limitations, mechanical bowel preparation and routine use of drains. He was the first to hypothesize that the unnecessary stress to the patient with longer duration of stay can be avoided by¹⁵; reducing the stress faced by the body metabolically, Fluid overload and Insulin resistance.

Subsequently, Olle Ljungqvist and Kenneth Fearon improvised the ERAS protocol by including postulates. This led to the founding of ERAS study group in the year 2001 and subsequent creation of the ERAS society in 2010. The main stakeholders of the study group were surgeons and anesthesiologists who did a systematic review and meta-analysis to gather evidence in support of this ERAS protocol¹⁴.

The entire protocol is designed to seamlessly facilitate and manage right from preadmission, admission. pre-operative and operative till discharge and rehabilitation¹⁶. The utilisation and dissemination of the protocol demanded the creation of the ERAS society. This included the creation of a global network with national and regional expert centers for the smooth

facilitation of the ERAS protocol¹⁵. Right from its inception, the beneficial effects of ERAS has been seen in several disciplines¹⁷⁻²⁰;

The salient features of ERAS recommended by various committees were validated in this study; The goal of maintaining the physiological equilibrium in the post-operative period and optimise the outcomes in the patient led to the development of ERAS. This should be cost-effectively with minimum post-op complications or recurrence. In order to maintain this equilibrium and help reduce the effects of surgery, a combination of multiple elements are packed into this ERAS protocol. The basic aspect of ERAS is to give attention to the following elements; preoperative counseling, nutritional strategies, avoidance of prolonged perioperative fasting, focus on regional anesthetic and nonopioid analgesic approaches, focus on nonopioid analgesic approaches, fluid balance, maintenance of normothermia, focus on postoperative recovery strategies, early mobilization, and appropriate thromboprophylaxis.

Following established benefits are seen in ERAS;

- shorter length of hospital stay
- low postoperative pain
- low need for analgesia,
- increase return of bowel function
- decreased complications

- low readmission rates
- increased patient satisfaction

When the body is undergoing a surgery, it responds by promoting catabolism through stress hormones. These are mediated by the central nervous system and its constituent mediators²¹. The important aspect of this catabolism is the development of resistance to insulin. This resistance is causative in the prolonged recovery periods and the increased morbidity post surgically. This resistance is positively correlated to the duration of recovery with higher resistance increasing the duration of stay in the hospital and lower resistance leading to lesser duration of stay in the surgical wards. The resultant hyperglycemia paradoxically reduces the uptake of glucose by fat and muscles. The reduction in lean body mass combined with the low glucose uptake leads to severe loss of function of the muscles. The loss of muscle power in turn orchestrates the reduction in the mobilisation of the patient thereby delaying rehabilitation. This cycle continues with prolonged immobilisation, increased loss of working days and reduce the quality of life apart from the economic and social costs. In addition to all these, the non-insulin sensitive cells also increase their glucose uptake acting as an instrument in the development of a number of post-operative complications mainly infections and cardiovascular problems²².

The ERAS starts with the pre-operative counseling about the surgical procedure. This helps in reducing the anxiety and unnecessary worry about the illness among the patients which is known to promote recovery and pain control postoperatively. It also helps to show better fidelity to the treatment protocol and enable early recovery and faster discharge with early return to work²³.

The traditional mechanical bowel preparation (MBP) focusses on removing the feces of the body and lower the microbial flora in the intestinal tract. But this practice does not necessarily do that instead increase the liquidity of the feces and increase the risk of spilling the flora surgically. Also, it is known to unaffected the microbial flora of the intestine. Apart from this, it is known to cause the water and electrolyte imbalances through these preparation methods²⁴.

Another aspect of traditional method of preparation includes preoperative fasting which is done to reduce the risk of pulmonary aspiration. No published studies support this claim though. On the other hand, pre-operative fasting is capable of augmenting the metabolic stress found after the surgery²⁵.

This can be counteracted by causing a metabolically fed state through the ingestion of a beverage that is rich in carbohydrate before the midnight and just before two to three hours before surgery. The metabolically fed

state is known to reduce thirst, anxiety and hunger preoperatively. Also, studies show that this fed state might reduce the insulin resistance seen in the patients after surgery²⁶. A state of anabolism is reached through this loading of carbohydrates with reduction in the loss of proteins and nitrogen. This ensures a better muscle strength, mass and power leading to faster recovery and return to work requiring lesser rehabilitation time and physiotherapy²⁷.

Systematic reviews and meta-analysis of published literature shows that LMWH (low molecular weight heparin) can be used in the place of low-dose subcutaneous unfractionated heparin. Low-dose subcutaneous unfractionated heparin was given to reduce the incidence of pulmonary embolism, deep vein thrombosis and have an impact in the overall mortality of the patient. The reason for choosing low molecular weight heparin is due to the ease of giving a single dose per day. Also, it is known to lower the risk of heparin-induced thrombocytopenia²⁸.

Previously published literature is known to have advocated the use of prophylactic antibiotics to control aerobic and anaerobic infections²⁹. The preservation of the body temperature is also implicated in the reduction of the wound infections, transfusion requirements, bleeding and cardiac complications. Therefore, in ERAS, the maintenance of temperature is done by heating the upper body using forced air and administering warm

fluids intravenously 2-hours before and after surgery. This helps in reducing the post operative chills and rigor³⁰. This is against the previous protocol of overdosing the fluid requirements based on the expected loss during surgery. The over dosage of fluids are known to cause delayed wound healing, reduction in the rate of healing of anastomoses with slower return to the functioning of the gut by affecting the tissue oxygenation. These protocols increased the duration of stay in the hospital.

The present literature suggests that post-operative sodium-rich fluid administration should be limited. The IV infusions must be stopped and oral fluids should be started early, as early as the first post operative day. The post operative complications such as ileus is known to reduce because of this thereby reducing the duration of hospital stay³¹.

In-depth analysis of lived experiences of the patients show that pain is less morbid than nausea and vomiting. These post-operative symptoms have certain predisposing factors namely;

- female gender
- non-smokers
- history of motion sickness
- postoperative use of opioids

When individuals are having these issues, they must be administered with

a) In the beginning by dexamethasone sodium phosphate

b) or in the end by serotonin receptor antagonists³²

After uncomplicated procedures, drainage should not be used. These drains are not known for reducing the risk nor severity of the leaks in the anastomoses³³. The use of ERAS is shown to hasten recovery, reduce pain and lower the incidence of complications. The compression through nasogastric tube should be avoided in the light of atelectasis, fever and pneumonia³⁴.

The recommended procedures are either to completely avoid the nasogastric tube or remove them before the anesthesia gets reversed. This helps to reduce the risk of pneumonia and also aid in the rapid progression of consumption of solid foods³⁵.

The recovery of the patient can be prolonged through the use of long acting sedatives, hypnotics and opioids that might hamper the process of mobilisation and reversion to the normal diet. The early return to the normal diet early helps in early mobilisation, decreased recovery, rehabilitation and regular activities. Also, it reduces the insulin resistance due to starvation and prevent loss of protein. The earlier the urinary catheters are removed, the earlier the patients are mobilised³⁶.

For reducing the incidence of ileus, following strategies are used;

- a) use of epidural analgesia in open surgical procedures
- b) Avoid opioids
- c) Avoid fluid overload
- d) use of oral laxatives early after surgery

The patient should be discharged when³⁷;

- a) Oral diet is initiated
- b) Bowel movements returns
- c) Pain is orally controlled
- d) Presence of enough mobility that the patient can take care of himself or herself
- e) there are no complications requiring hospitalisation

The ultimate aim of ERAS is not early discharge rather to prepare the patient for an early discharge and make him or her self-sustainable once they reach home.

What is probably the most important in ERAS—its aim is not to discharge a patient from hospital as soon as possible. It rather aims to prepare him for early discharge by making him fully capable of going home.

The ERAS has been used and studied mostly in the field of colorectal surgeries. This section deals with the major findings and methodologically adopt studies for review. The paramount Dutch study where a multicentric randomised control trial was done had the following finding³⁸; The group that underwent laparoscopic with ERAS showed better recovery post-operatively than the other groups.

Other studies showed that³⁹⁻⁴¹;

a) ERAS in colorectal surgery reduced the post operative morbidity by 40% to 50%

b) The LOS was reduced by two to three days

In these studies, it was concluded that new trials are not necessary rather a procedure to standardise the protocol to implement worldwide should be adopted³⁹. New policies are therefore required for adoption of the ERAS protocol.

One important findings in colorectal surgeries is that ERAS protocol along with laparoscopy can reduce post-operative morbidity and eliminate the risk factors and the complications from surgery^{42,43}. Even in patients with advanced colon and rectal cancer, ERAS can be used with similar effectiveness when the protocols are strictly followed^{44,45}. At present, ERAS is well established in the field of colorectal surgery.

Compared to colorectal surgeries, gastric surgeries have implemented ERAS less and its use and applicability is still under exploration⁴⁶⁻⁴⁸. Yu

et al in 2014 did a meta-analytic study of around 400 patients who were on perioperative ERAS care and reported the following⁴⁹;

4. duration of stay in the hospital was reduced
5. the time to first flatus was early
6. economically it was less burdensome on the patient

The ERAS committee for gastrectomies came up with a 25-item long protocol that was evidence-based for patients undergoing gastrectomies⁵⁰. Another meta analysis study in 2015 among 524 patients and seven randomised control trials stated that ERAS gave the following benefits⁵¹; lesser postoperative hospitalization, reduction in hospitalization expenditure, less pain, and improved quality of life.

Another meta analysis study in 2018 showed the following findings for ERAS⁵²; lesser time for passing first flatus, lesser duration of postoperative hospital stay and highly economical.

The use of drains though is not seen with any change in morbidity and mortality among patients, even when they are not in line with the ERAS protocol⁵³.

Finally, the postoperative feeding when initiated early using ERAS is known to be beneficial over the traditional late feeding patterns with a

lower duration of hospital stay. Also, the complications are also less incident⁵⁴.

In liver surgeries, ERAS is known to be beneficial and has been implemented in various centers⁵⁵. Wong-Lun-Hing et al in 2014 showed that hepatic surgery protocols already have many of the components of ERAS already implemented⁵⁶. The studies though are less standardised and optimised for broader decision making. This led to the formulation of the recommendations of ERAS society⁵⁷.

Studies show that there are a number of studies that have been published for ERAS but with methodological limitations like the studies mentioned below, yet they have shown the efficacy and clinical safety of ERAS in major resections to be significant; 62 patients in Kapritsou et al. study⁵⁸ and 160 in Qi et al. RCT⁵⁹.

The pancreatic surgeries have used ERAS and have reported findings that are favorable⁶⁰. Multi-centric randomised control trials have been stated as a requirement for getting better insight while keeping in mind the safety of the patients^{61,62}. But the use of laparoscopic surgeries in pancreatic carcinomas is still not well established^{63,64}. There are also studies that show that in pancreatic patients, ERAS can reduce the post operative complications and prevent recurrence⁶⁵. It is essential to

understand that pancreatic surgeries have their own complications like fistula which may affect the early initiation of oral feeding and LOS.

Following established benefits are seen in ERAS; shorter length of hospital stay, low postoperative pain, low need for analgesia, increase return of bowel function, decreased complications, low readmission rates and increased patient satisfaction.

Any institute that wants to adopt the ERAS program must evaluate their own infrastructure and consider the possibilities of using the ERAS protocol. In order to make the program self-sustainable, the protocol should be adopted into the standard method of care in the regular system. Published literature shows success of ERAS when all the key components are addressed. This explains why ERAS pathways are necessary for better institutional management of the patients.

There are not many studies from India that explores the effectiveness of ERAS protocol. This study shows the usefulness of ERAS in evaluating; Length of hospital stay; Decrease in major morbidity; Post operative recovery; Reduction of surgical stress response and Cost effectiveness.

Summary and Conclusions

A prospective study among 50 patients admitted for elective laparotomy with the objectives to show the usefulness of ERAS in evaluating; Length of hospital stay, Decrease in major morbidity, Post operative recovery, Reduction of surgical stress response and Cost effectiveness revealed the following results.

1. The cases admitted to GMKMC hospital, Salem for elective laparotomy were closely monitored from the day of admission to the day of discharge. The study included; All patients undergoing elective laparotomy, Cases undergoing following procedures included are gastrectomy , cholecystectomy, bowel resection & anastomosis , ileostomy/colostomy , hernia repair , Hartmann's procedure, Hemodynamically stable patients and Patients with ASA I & II.
2. The mean age of the patients is 47 years with a standard deviation of 13.08 years ranging between 28-75 years. Majority of them (n=15, 30%) were in the age group of 36-45 years. Majority of them (n=15, 30%) were in the age group of 36-45 years. Females were large in number (n=26, 52%) while the rest were males (n=24, 48%).

3. Out of 50 patients, around 20% (n=10) had cholelithiasis while 12% (n=6) had carcinoma of caecum. Cholelithiasis was found in 14% (n=7) of the patients.
4. The mean number of days of hospital stay is 5.10 days with a standard deviation of 0.931 days ranging between 4 to 6 days and a median of 5 days. The most commonly admitted duration is six days.
5. The most commonly performed procedure was open cholecystectomy with CBD exploration (26%, n=13) followed by right hemicolectomy (24%, n=12).
6. Majority of them were ambulated on the first post-operative day (n=27, 54%) while the rest were ambulated on the day of surgery (n=23, 46%).
7. Out of 50 patients, 25 of them (50%) were started on oral diet on 2nd post-operative day and the rest were started on oral diet on the 4th post-operative day.
8. Out of 50 patients, majority of them (n=29, 58) removed the drain on 4th postoperative day.
9. Around 26% (n=13) removed the drain on 2nd postoperative day.

10. None of the patients had complications or readmission within the next six weeks.

Following established benefits are seen in ERAS;

- shorter length of hospital stay
- low postoperative pain
- low need for analgesia,
- increase return of bowel function
- decreased complications
- low readmission rates
- increased patient satisfaction

Limitations

Following limitations were found in the study;

1. The study was single centric
2. The sample size was small
3. It was a prospective study that did not account for other co-morbid factors

Future Recommendations

- 1) Future studies are required to completely understand the effectiveness of ERAS in elective laparotomy
- 2) Studies should be multi-centric
- 3) Sample size should be large
- 4) Randomised control trials are the preferred study designs for future studies
- 5) Studies should focus more on the implementation of the ERAS protocol and the challenges in doing the same

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“ENHANCED RECOVERY AFTER SURGERY(ERAS) IN ELECTIVE LAPARATOMY”- A PROSPECTIVE STUDY

Proforma

Name:

Address:

Age/Sex:

Religion:

O.P No:

I.P No:

D.O.A:

Time & Date Of Operation:

D.O.D:

B. Chief Complaints:

C.Past History:

DM : Yes/ No

TB :Yes/ No

Epilepsy :Yes/ No

Malaria :Yes/ No

Previous Surgery :Yes/ No

Jaundice :Yes/ No

Cirrhosis :Yes/ No

D. Personal History:

Smoker

Alcoholic

Drug Addiction

E.Initial Assessment Of Patient

1.Vitals:

Pulse :

BP :

RR :

Temperature :

2.General Signs:

Pallor :

Tongue :

Skin :

Icterus :

Cyanosis :

F.Systemic Examination:

CVS:

RS:

CNS:

Abdomen:

Inguino scrotal region:

Per Rectal Examination:

External Genitalia:

Clinical Diagnosis :

INVESTIGATIONS

- The study requires the following investigations to be conducted on patients a. HB%, TC, DC, ESR.
- b. Blood urea, Serum creatinine, Blood sugar.
- c. Blood grouping and Rh typing.
- d. BT, CT. e. Urine routine examination.
- f. Screening for HIV, Hbs Ag and VDRL after informed consent
- g. Chest X-ray PA view.
- h. x ray abdomen erect
- i. CECT abdomen and pelvis

MASTER CHART

1	NAME	AGE	DIAGNOSIS	PROCEDURE	D.O.A	D.O.S	D.O.D	AMBULAT	ORAL DIET	DRAIN REM	DURA	ANY C	READM
2	1 RAJA	38/M	CA COLON AT SPLENIC FLEXURE	LT HEMICOLECTOMY	04.11.2017	04.11.2017	10.11.2017	1ST POD	4TH POD	4TH POD	6 NO	NO	
3	2 LAKSHMI	50/F	CHOLELTHIASIS	OPEN CHOLECYSTECTOMY	16.11.2017	16.11.2017	20.11.2017	DOS	2ND POD	2ND POD	4 NO	NO	
4	3 ARUMUGAM	59/M	CA CAECUM	RT HEMICOLECTOMY	12.12.2017	12.12.2017	18.12.2017	1ST POD	4TH POD	4TH POD	6 NO	NO	
5	4 FATHIMA	52/F	GIST OF ILEUM	RESECTION&ANASTAMOSIS	25.12.2017	25.12.2017	31.12.2017	1ST POD	4TH POD	4TH POD	6 NO	NO	
6	5 JAYANTHI	53/F	RECTOSIGMOID GROWTH	ELECTIVE LAPAROTOMY&COLOSTOMY	03.01.2018	03.01.2018	08.01.2018	DOS	2ND POD	4TH POD	5 NO	NO	
7	6 DHANBAKIYAM	38/F	CHOLELITHIASIS	OPEN CHOLECYSTECTOMY	24.01.2018	24.01.2018	28.01.2018	DOS	2ND POD	2ND POD	4 NO	NO	
8	7 RAJARAJAN	42/M	CA ASCENDING COLON	RT HEMICOLECTOMY	29.01.2018	29.01.2018	02.02.2018	DOS	2ND POD	4TH POD	4 NO	NO	
9	8 KRISHNAVENI	41/F	CHOLEDOCHOLITHIASIS	CHOLECYSTECTOMY WITH CBD EXPLORATION	05.02.2018	05.02.2018	11.02.2018	1ST POD	4TH POD	3RD POD	6 NO	NO	
10	9 AKBAR	40/M	CA DESCENDING COLON	LT HEMICOLECTOMY	20.02.2018	20.02.2018	26.02.2018	1ST POD	4TH POD	4TH POD	6 NO	NO	
11	10 RAMYA	35/F	CHOLELTHIASIS	OPEN CHOLECYSTECTOMY	24.02.2018	24.02.2018	28.02.2018	DOS	2ND POD	2ND POD	4 NO	NO	
12	11 VIGNESH	29/M	CA CAECUM	RT HEMICOLECTOMY	02.03.2018	02.03.2018	08.03.2018	1ST POD	4TH POD	4TH POD	6 NO	NO	
13	12 PAVITHRA	44/F	CHOLEDOCHOLITHIASIS	CHOLECYSTECTOMY WITH CBD EXPLORATION	20.03.2018	20.03.2018	26.03.2018	1ST POD	4TH POD	3RD POD	6 NO	NO	
14	13 RAJAJOTHI	52/F	CA ASCENDING COLON	RT HEMICOLECTOMY	27.03.2018	27.03.2018	02.04.2018	1ST POD	4TH POD	4TH POD	6 NO	NO	
15	14 MOORTHI	64/M	GIST OF ILEUM	RT HEMICOLECTOMY	04.04.2018	04.04.2018	10.04.2018	1ST POD	4TH POD	4TH POD	6 NO	NO	
16	15 VELLAYAPPAN	68/M	CA SIGMOID COLON	HARTMANN'S PROCEDURE	24.04.2018	24.04.2018	30.04.2018	1ST POD	4TH POD	5TH POD	6 NO	NO	
17	16 THERASA	44/F	CHOLELITHIASIS	OPEN CHOLECYSTECTOMY	03.05.2018	03.05.2018	08.05.2018	DOS	2ND POD	2ND POD	5 NO	NO	
18	17 VIJAY	40/M	CA COLON AR HEPATIC FLEXURE	EXTENDED RT HEMICOLECTOMY	23.05.2018	23.05.2018	29.05.2018	1ST POD	4TH POD	4TH POD	6 NO	NO	
19	18 DEEPIKA	35/F	CHOLEDOCHOLITHIASIS	CHOLECYSTECTOMY WITH CBD EXPLORATION	05.06.2018	05.06.2018	09.06.2018	DOS	2ND POD	3RD POD	4 NO	NO	
20	19 SIVAKUMAR	53/M	CA TRANSVERSE COLON	EXTENDED RIGHT HEMICOLECTOMY	20.06.2018	20.06.2018	26.06.2018	1ST POD	4TH POD	4TH POD	6 NO	NO	
21	20 VASANTHI	48/F	CA CAECUM	RT HEMICOLECTOMY	06.07.2018	06.07.2018	10.07.2018	1ST POD	2ND POD	4TH POD	4 NO	NO	
22	21 BALA	37/M	CHOLELITHIASIS	OPEN CHOLECYSTECTOMY	19.07.2018	19.07.2018	23.07.2018	DOS	2ND POD	2ND POD	4 NO	NO	
23	22 SURYA	34/M	CA DESCENDING COLON	LT HEMICOLECTOMY	28.07.2018	28.07.2018	03.07.2018	1ST POD	4TH POD	4TH POD	6 NO	NO	
24	23 CHANDRAN	61/M	CHOLEDOCHOLITHIASIS	CHOLECYSTECTOMY WITH CBD EXPLORATION	02.08.2018	02.08.2018	06.08.2018	DOS	4TH POD	3RD POD	4 NO	NO	
25	24 MANIMEGALAI	73/F	CA SIGMOID COLON	HARTMANN'S PROCEDURE	05.09.2018	05.09.2018	09.09.2018	1ST POD	2ND POD	4TH POD	4 NO	NO	
26	25 AJITH	32/M	GIST OF ASCENDING COLON	RT HEMICOLECTOMY	12.09.2018	12.09.2018	18.09.2018	1ST POD	4TH POD	4TH POD	6 NO	NO	

1	NAME	AGE	DIAGNOSIS	PROCEDURE	D.O.A	D.O.S	D.O.D	AMBULAT	ORAL DIET	DRAIN REMO	DURA	ANY C	READM
27	26 RASATHI	69/F	RECTOSIGMOID GROWTH	ELECTIVE LAPAROTOMY&COLOSTOMY	27.09.2018	27.09.2018	01.10.2018	DOS	2ND POD	4TH POD	4	NO	NO
28	27 ARCHANA	40/F	CA ASCENDING COLON	RT HEMICOLECTOMY	04.10.2018	04.10.2018	10.10.2018	1ST POD	4TH POD	4TH POD	6	NO	NO
29	28 BAVANKUMAR	38/M	CHOLELITHIASIS	OPEN CHOLECYSTECTOMY	27.10.2018	27.10.2018	01.11.2018	DOS	2ND POD	2ND POD	5	NO	NO
30	29 PARIJADHAM	67/F	CA TRANSVERSE COLON	EXTENDED RT HEMICOLECTOMY	01.11.2018	01.11.2018	06.11.2018	1ST POD	4TH POD	4TH POD	5	NO	NO
31	30 SADHA	38/M	CA CAECUM	RT HEMICOLECTOMY	20.11.2018	20.11.2018	26.11.2018	1ST POD	4TH POD	4TH POD	6	NO	NO
32	31 MAHESHWARI	35/F	CHOLEDOCHOLITHIASIS	CHOLECYSTECTOMY WITH CBD EXPLORATION	30.11.2018	30.11.2018	05.12.2018	DOS	2ND POD	3RD POD	5	NO	NO
33	32 SWATHI	30/F	CHOLELITHIASIS	OPEN CHOLECYSTECTOMY	07.12.2018	07.12.2018	11.12.2018	DOS	2ND POD	2ND POD	4	NO	NO
34	33 VELAN	50/M	CA COLON AT SPLENIC FLEXURE	LT HEMICOLECTOMY	25.12.2018	25.12.2018	01.01.2019	1ST POD	4TH POD	4TH POD	6	NO	NO
35	34 CHANDRAN	38/M	CA DESCENDING COLON	LT HEMICOLECTOMY	03.01.2019	03.01.2019	09.01.2019	1ST POD	4TH POD	4TH POD	6	NO	NO
36	35 LATHA	41/F	CA SIGMOID COLON	HARTMANN'S PROCEDURE	17.01.2019	17.01.2019	21.01.2019	1ST POD	4TH POD	4TH POD	4	NO	NO
37	36 ARUNACHALAM	60/M	ACUTE CHOLECYSTITIS	OPEN CHOLECYSTECTOMY	25.01.2019	25.01.2019	29.01.2019	DOS	2ND POD	2ND POD	4	NO	NO
38	37 RAMASAMY	75/M	CA CAECUM	RT HEMICOLECTOMY	06.02.2019	06.02.2019	12.02.2019	1ST POD	4TH POD	4TH POD	6	NO	NO
39	38 KALPANA	30/F	GIST OF DECSENDING COLON	LT HEMICOLECTOMY	19.02.2019	19.02.2019	23.02.2019	DOS	2ND POD	4TH POD	4	NO	NO
40	39 SOWMIYA	28/F	CHOLELITHIASIS	OPEN CHOLECYSTECTOMY	05.03.2019	05.03.2019	11.03.2019	DOS	2ND POD	2ND POD	6	NO	NO
41	40 SUNDHAR	47/M	ACUTE CHOLECYSTITIS	OPEN CHOLECYSTECTOMY	27.03.2019	27.03.2019	01.04.2019	DOS	2ND POD	2ND POD	5	NO	NO
42	41 KARTHIGA	35/F	CHOLEDOCHOLITHIASIS	OPEN CHOLECYSTECTOMY WITH CBD EXPLORA	11.04.2019	11.04.2019	15.04.2019	DOS	2ND POD	3RD POD	4	NO	NO
43	42 VINAYKUMAR	30/F	GIST OF CAECUM	RT HEMICOLECTOMY	24.04.2019	24.04.2019	30.04.2019	1ST POD	4TH POD	4TH POD	6	NO	NO
44	43 KARUPUSAMY	65/M	CA TRANSVERSE COLON	EXTENDED RT HEMICOLECTOMY	25.04.2019	25.04.2019	01.05.2019	1ST POD	4TH POD	4TH POD	6	NO	NO
45	44 KANMANI	41/F	ACUTE CHOLECYSTITIS	OPEN CHOLECYSTECTOMY	08.05.2019	08.05.2019	12.05.2019	DOS	2ND POD	2ND POD	4	NO	NO
46	45 KUPPAYI	75/F	CA SIGMOID COLON	HARTMANN'S PROCEDURE	21.05.2019	21.05.2019	25.05.2019	1ST POD	2ND POD	4TH POD	4	NO	NO
47	46 PARAMESHWARI	56/F	CHOLEDOCHOLITHIASIS	OPEN CHOLECYSTECTOMY WITH CBD EXPLORA	07.06.2019	07.06.2019	11.06.2019	DOS	2ND POD	3RD POD	4	NO	NO
48	47 KUMAR	46/M	CA CAECUM	RT HEMICOLECTOMY	26.06.2019	26.06.2019	02.07.2019	1ST POD	4TH POD	4TH POD	6	NO	NO
49	48 RASATHI	59/M	CHOLELITHIASIS	OPEN CHOLECYSTECTOMY	12.07.2019	12.07.2019	16.07.2019	DOS	2ND POD	2ND POD	4	NO	NO
50	49 SHANMUGAM	47/M	CA COLON AT HEPATIC FLEXURE	EXTENDED RT HEMICOLECTOMY	24.07.2019	24.07.2019	29.07.2019	DOS	2ND POD	4TH POD	5	NO	NO
51	50 MANI	48/F	CHOLELITHIASIS	OPEN CHOLECYSTECTOMY	01.08.2019	01.08.2019	07.08.2019	DOS	2ND POD	2ND POD	6	NO	NO