"PORTSMOUTH POSSUM SCORING FOR SURGICAL ASSESSMENT IN PATIENTS UNDERGOING ABDOMINAL SURGERIES"

By

Dr. HARSHA R.

DISSERTATION SUBMITTED TO SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, KOLAR, KARNATAKA

In partial fulfillment of the requirements for the degree of

MASTER OF SURGERY

IN

GENERAL SURGERY

Under the Guidance of

Dr. MOHAN KUMAR K.

PROFESSOR & HOD

DEPARTMENT OF GENERAL SURGERY,
SRI DEVARAJ URS MEDICAL COLLEGE,
TAMAKA, KOLAR-563101

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under the guidance of
Dr.MOHAN KUMAR K.
PROFESSOR & HOD
Department of General Surgery,
Sri Devaraj Urs Medical College,
Tamaka, Kolar.

Date:
Place: Kolar

Signature of the candidate
Dr. HARSHA R.

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, TAMAKA, KOLAR, KARNATAKA

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This is to certify that the dissertation entitled

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Dr. HARSHA R

Under my guidance and supervision

in partial fulfillment of the requirement for the Degree of

M.S. in GENERAL SURGERY

Signature of the Guide

Dr. MOHAN KUMAR K.

PROFESSOR & HOD,

Department of General surgery,

Sri Devaraj Urs Medical College,

Tamaka, Kolar.

Date:

Place: Kolar

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, TAMAKA, KOLAR, KARNATAKA

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Dr. H A R S H A R.

under the guidance of

Dr. MOHAN KUMAR K.
Professor & HOD,
Department Of General Surgery.

Dr. MOHAN KUMAR K	**Dr. M.L.HARENDRA KUMAR**
Professor & HOD	Principal,
Department of General Surgery,	Sri Devaraj Urs Medical College
Sri Devaraj Urs Medical College,	Tamaka, Kolar
Tamaka, Kolar	
Date:	Date:
Place: Kolar	Place: Kolar

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH, TAMAKA, KOLAR, KARNATAKA

ETHICAL COMMITTEE CERTIFICATE

This is to certify that the Ethical committee of
Sri Devaraj Urs Medical College & Research, Tamaka, Kolar
has unanimously approved

Dr. HARSHA R
Post-Graduate student in the subject of
GENERAL SURGERY

at Sri Devaraj Urs Medical College, Kolar
to take up the Dissertation work entitled

"PORTSMOUTH POSSUM SCORING FOR SURGICAL ASSESSMENT IN PATIENTS UNDERGOING ABDOMINAL SURGERIES"

to be submitted to

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH TAMAKA, KOLAR, KARNATAKA.

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Sri Devaraj Urs Academy of Higher
Education & Research,
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Signature of the candidate

Dr. HARSHA R.

Post graduate student,

Department of General Surgery

Sri Devaraj Urs Medical College,

Kolar

Date:

Place: Kolar

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Signature of the candidate

Dr. HARSHA R.

LIST OF ABBREVIATIONS

AAA	Abdominal Aortic Aneurysm
APACHE	Acute Physiology and Chronic Health Evaluation Score
BHOM	Biochemistry and Hematology Outcome Models
BMI	Body Mass Index
BL	Blood loss
BP	Blood Pressure
BU	Blood Urea
CVA	Cerebro Vascular Accident
CVS	Cardiovascular Signs
d.f.	Degrees of Freedom
DVT	Deep Vein Thrombosis
e.g	Example
ECG	Electro Cardio Gram
EN	Enteral nutrition
GCS	Glasgow Coma Scale
GI	Gastro Intestinal

LIST OF ABBREVIATIONS

g/dl	Grams / Deciliter
Hb%	Hemoglobin Percentage
IBW	Ideal Body weight
IV	Intra Venous
J-POSSUM	Jabalpur POSSUM
MA	Malignancy
mEq	Milli Equivalent
mg/dl	Milli Grams / Decilitre
MI	Myocardial Infarction
mmhg	Millimetres of Mercury
mmol/l	Millimoles / Litre
MP	Multiple Procedures
NG	Nasogastric
NO	Nitric Oxide
O : E	Observed To Expected
OS	Operative Severity
POSSUM	Physiological and Operative Severity Score for enUmeration of Mortality and morbidity

LIST OF ABBREVIATIONS

P-POSSUM	Portsmouth- POSSUM
PN	Parenteral Nutrition
PR	Pulse Rate
PS	Peritoneal Soiling
PUO	Pyrexia of Unknown Origin
REE	Resting Energy Expenditure
RGCRI	Revised Goldmann Cardiac Risk Index
ROC	Receiver Operating Characteristic Score
RS	Respiratory Signs
$S.Na^+$	Serum Sodium
$S.K^+$	Serum Potassium
SRS	Surgical Risk Score
TPN	Total Parenteral Nutrition
USA	United States of America
UK	United Kingdom
UTI	Urinary Tract Infection
VO_2	Oxygen Consumption
WBC	White Blood Count
x^2	chi Square

ABSTRACT

Background:

The need for evaluation of surgical risk based on a patient's preoperative health and general physical condition is frequently encountered in surgical practice. To overcome this limitation as well as to provide evidence based assessment of possible risks to the patient, their kith and kin and provide reassurance as well as safeguard the interests of the practicing surgeon in high risk cases, The Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM) and its modification the Portsmouth POSSUM, have been proposed as methods of standardizing patient related data to achieve direct comparisons.

Application of the P-POSSUM scoring system in a rural setup of a developing nation, where the level of healthcare and resources differ is limited. In this particular study, P-POSSUM scoring system was applied to predict anticipated mortality rate and compare it with observed mortality rate in general surgical patients undergoing abdominal surgeries and also to assess applicability of the scoring system in identifying risk factors for adverse outcome.

OBJECTIVES OF THE STUDY:

1. To assess the applicability of Portsmouth POSSUM scoring system in predicting anticipated mortality rate and compare with the actual mortality rate in general surgical patients admitted for abdominal surgeries in our hospital.

2. To assess the applicability of Portsmouth POSSUM scoring system in identifying risk factors for adverse outcome.

METHODOLOGY:

A total of 120 abdominal surgeries as defined by the POSSUM scoring system criteria were studied. The risk of complication and death was calculated using P-POSSUM equations. The estimated rates were compared with observed rates using both linear and exponential methods of analysis.

INCLUSION CRITERIA:

Patients undergoing elective and emergency abdominal surgeries (laparotomy).

EXCLUSION CRITERIA:

1).Pediatric surgeries.

2).Day care surgeries.

3).Follow up period criteria not met.

RESULTS:

In all 18 deaths were observed during the period of study. P-POSSUM with linear method of analysis predicted 21.34 deaths with O: E ratio of 0.84, which was clinically significant with statistical insignificance. Exponential method of analysis using P-POSSUM under predicted deaths, a predicted value of 14 deaths with O: E ratio of 1.28 was noted, which was found to be both statistically and clinically insignificant. Morbidity analysis predicted a value of 59 while 41 patients in actual had developed complications, with O: E ratio 0.69, which had clinical significance but was statistically insignificant.

CONCLUSION:

Utilization of P-POSSUM scoring using the optimal statistical method of analysis accurately predicts the mortality and morbidity risk in patients undergoing abdominal surgeries. Furthermore, the system also aids in precise identification of risk factors responsible for poor outcome.

Keywords: Surgical scoring; Mortality; Morbidity, P-POSSUM

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INTRODUCTION

Mortality and morbidity are the key objective measures for surgical outcome. It is crucial for the surgeon and the patient to have a preoperative assessment of the probability of success of any surgical procedure[1]. The current day surgical practice is under strong scrutiny and performance is established through comparative audit of rates of morbidity and mortality[2].

Peri-operative care is the major factor that determines the success of any surgery, and post-operative mortality is one of the foremost issues of apprehension for patients and family members. Evaluation of surgical risk based on a patient's preoperative health status and general condition is a key challenge that clinicians have to face every day[3].

Survival without complications, death or long term morbidity are possible outcomes of surgical intervention, which are not entirely dependent on the abilities of surgeon alone. The nature of disease, physiological status of the patient, severity of the disease, nature of surgery, as well as pre and post-operative support services have major effect on the ultimate outcome. Raw mortality and morbidity rates cannot explain these differences and the use of such statistics is frequently misleading and inaccurate[1]. To provide proportional audit between diverse populations, measures of outcome must incorporate methods, which accommodate differences in case types[4].

Risk scoring systems should be able to quantify a patient's risk of death or morbidity, based on the severity of illness, derived from data available at the earliest stage of hospitalization. In the present era of surgical practice it is particularly imperative[5].

There is a need for an accurate risk adjusted scoring system, which should be specific to the patient being studied, incorporate the influence of the diagnosis for which he/she is being subjected to surgery, either elective or emergency. Furthermore, it should allow the assessment of variable presentation of each patient, and also be able to demonstrate the efficiency of the particular procedure performed[5].

These scoring systems should quantify a patient's risk of death or morbidity based on the severity of illness derived from data available. It is of substantial importance in surgical practice[6]. It should be easy to use, fast and comparable among different subtypes of patients. Moreover such a scoring system should allow initiation of preventive measures and predict post-operative complications, which in turn enable early recognition and institution of appropriate treatment, resulting in better outcomes after surgery[4,5].

The scoring system should allow assessment of efficacy of various procedures by comparing differences in observed to expected mortality rates which ultimately lead to a better and meaningful surgical audit. Concurrently, it also helps in faster adaptation of newer procedures by comparing the decrease in the observed to expected adverse outcome rates. It could be used in predicting an individual patient's prognosis, rationalize regimens and help influence treatment decisions[5].

Numerous scoring systems were developed that predict risk of mortality with varying degrees of precision. A model scoring system for the surgical audit purpose should be able to assess mortality and morbidity and permit audit retrieval of surgical success. It must be quick and easy to use and should be applicable to all general surgical procedures in both emergency and elective settings. It must also be of use in all types of hospitals and provide educational information[3].

With the perception of all these factors using a method of multivariate discriminate analysis a system was developed to allow assessment of surgical quality that was risk adjusted for the patient's acute and chronic physiological status and for the nature of surgery. The POSSUM audit system (The Physiological and Operative Severity Score for enUmeration of Mortality and morbidity) was designed to be easy and rapid to use and to have wide application across the general surgical spectrum both in the elective and emergency settings[1].

The POSSUM has been proposed as a risk adjusted scoring system to permit direct comparison between the observed and expected adverse outcome rates. It has also been referred to as a surgeon based scoring system[7].

The Portsmouth POSSUM (P-POSSUM) is a modification of the POSSUM scoring system, which incorporates the same variables and grading system, but a dissimilar equation, providing a better fit to the observed mortality rate, an important and objective measure of outcome[4,7].

P-POSSUM scoring system has been integrated into surgical practices of vascular[8,9,10,11], general[12], colorectal[13,14,15] , esophageal[16] and laparoscopic procedures[17]. However, most of these studies have found relevance in developed countries, where patient characteristics, presentation and resources differ from our setup[18].

There is a necessity to test the applicability of P-POSSUM scoring system in rural India, where limitation of resources are to be acknowledged , delay in presentation a frequent occurrence, malnourishment a common phenomenon, all of which can influence the patient's complication rates, even with ample quality of care[19,20,21].

Major surgeries as defined by the POSSUM scoring system (Figure 7) include both emergency and elective procedures, comprise the high risk group wherein, the comparison of observed to expected mortality rate is expected to yield significant results[1].

This study was undertaken to assess the applicability of P-POSSUM scoring system in patients undergoing major surgeries in our hospital, in an attempt to try and analyze the causes for low outcome in this high risk group and also to assess the applicability of P-POSSUM scoring system in a rural background with limited resources.

OBJECTIVES OF THE STUDY

The objectives of the study were:

1. To assess the applicability of Portsmouth POSSUM scoring system in predicting anticipated mortality rate and compare with the actual mortality rate in general surgical patients admitted for abdominal surgeries in our hospital.

2. To assess the applicability of Portsmouth POSSUM scoring system in identifying risk factors for adverse outcome.

REVIEW OF LITERATURE

ANATOMY OF THE ANTERIOR ABDOMINAL WALL[22]

The anterior abdominal wall can be considered to have two parts: anterolateral and middle (or midline). The anterolateral portion is composed of the external oblique (Figure 1), the internal oblique (Figure 2), and the transversus abdominis muscles. The middle portion is composed of the rectus abdominis (Figure 3) and pyramidal muscles. (Table 1).

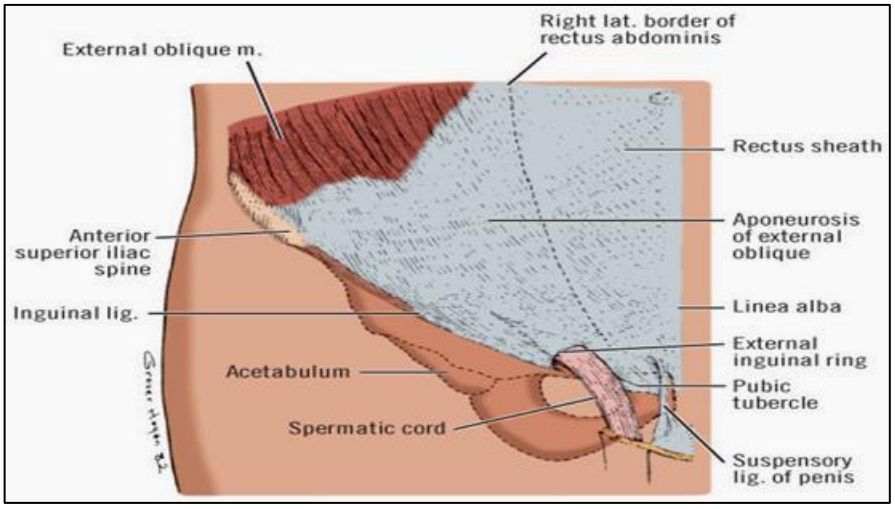

Figure 1. External oblique muscle and aponeurosis

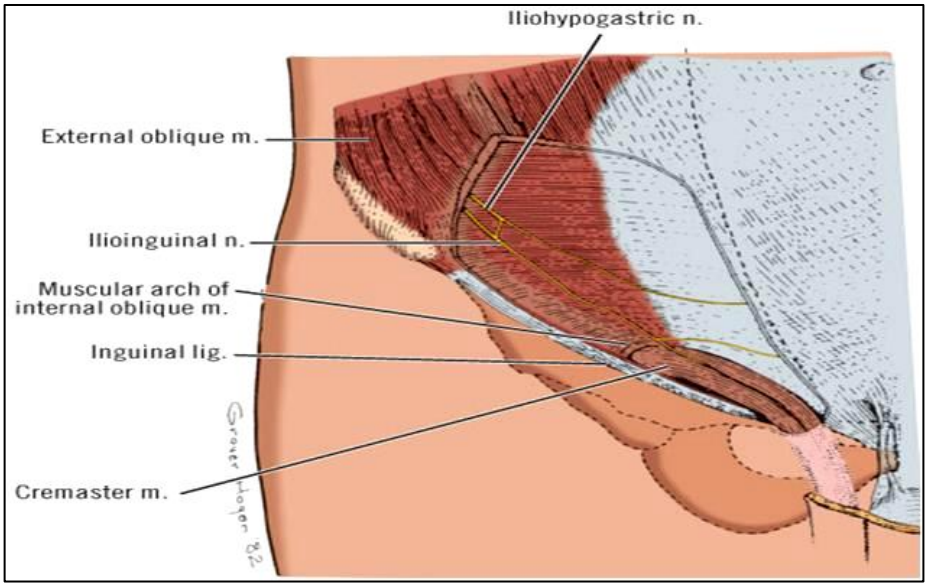

Figure 2. Internal oblique muscle.

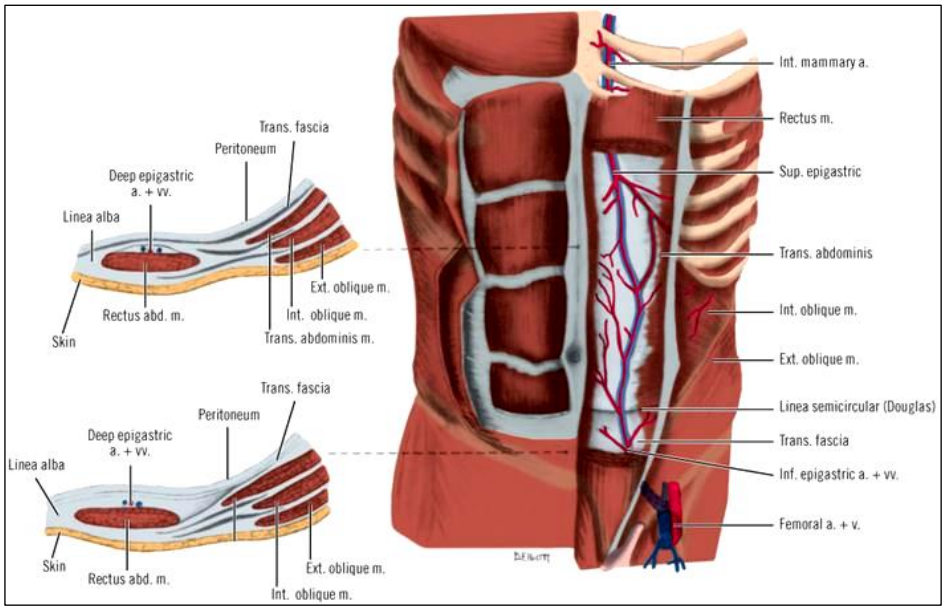

Figure 3. Rectus abdominis muscle and rectus sheath

Table 1. Muscles of the Anterior Abdominal Wall[22]

Name	Origin	Insertion	Action	Nerve	Observations
External oblique	Inferior border of lower 8 ribs	Aponeurosis to linea alba from xiphoid to symphysis, iliac crest, anterior superior iliac spine	Compresses abdomen Flexes and laterally rotates spine Depresses ribs	Lower 6 thoracic spinal nerves	
Internal oblique	Iliac fascia. Anterior iliac crest. Lumbar aponeurosis.	Lower border of ribs 9-12 with aponeurosis to linea alba and pecten pubis	Compresses abdomen Flexes and laterally rotates spine Depresses ribs	Lower 6 thoracic spinal nerves. 1st lumbar spinal nerve	Related to lateral ½ of inguinal ligament (approx.), but does not arise from ligament
Transversus abdominis	Iliac crest. Lumbodorsal fascia Cartilages of lower ribs	Through aponeurosis to linea alba. Pecten pubis.	Compresses abdomen. Depresses ribs	Same as above	Related to lateral ⅓ of inguinal ligament but does not arise from ligament
Rectus abdominis	Crest of pubis and pubic symphysis	Cartilages of ribs 5-7. Xiphoid process	Compresses abdomen. Lifts chest. Flexes spine.	Intercostals 6-12	
Pyramidal	Pubis and anterior pubic ligament	Linea alba	Tenses linea alba	T12	

SURGICAL PATIENTS AND METABOLISM[23]

A diverse range of chemical processes required for sustenance of life and to enable growth, development, reproduction, healing, adaptation, homeostasis and response to the environment encompass metabolism. In critically ill patients, nutritional and metabolic processes may be impaired as a consequence of pathologic, environmental, or traumatic factors, leading to a need for nutritional supplementation which enables healing and recovery.

The development and implementation of nutritional support represents one of the foremost advances of the previous century that has led to enhanced patient care and surgical outcomes.

Skeletal muscle protein catabolism has been recognized as a major factor contributing to adverse outcomes following trauma and major surgery[23]. Catabolic response as the basis of metabolic exhaustion and emaciation in burn patients was described by Sneve in 1905. Cuthbertson studied the effects of long bone fractures in animal models, characterizing physiologic and metabolic responses into two phases: the early ebb phase and the flow phase (Figure 4).

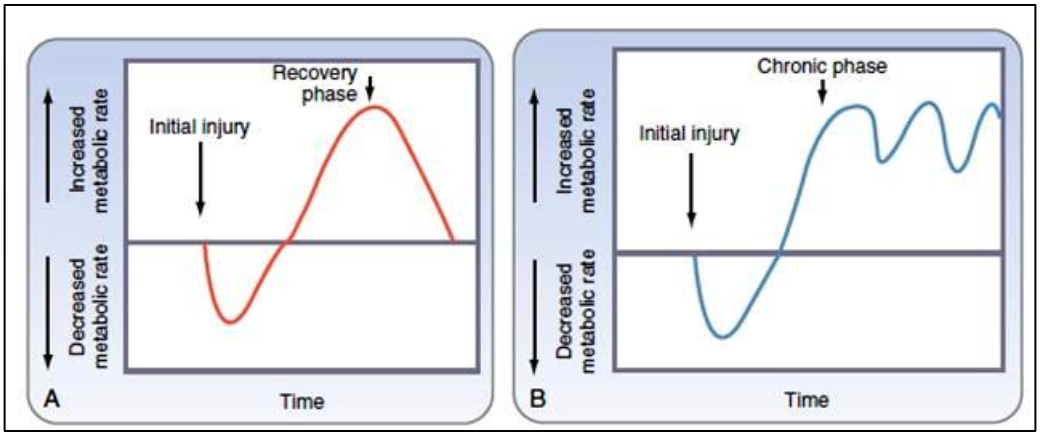

Figure 4. Classic ebb and flow phases of the acute stress response.

The ebb phase manifests during the first several hours following injury, on average lasting 2 to 3 days, and is distinguished by reduced oxygen consumption (VO_2), glucose tolerance, cardiac output, and basal metabolic rate. The latter usually starts many days after injury, lasting days to weeks, and features catabolic breakdown of skeletal muscle, hyperglycemia, negative nitrogen balance, increased cardiac output, VO_2 and respiratory rate.

The metabolic response to injury (Figure 5) aims to restore homeostasis. It is characterized by changes in the flow of substrates among organs, increasing glucose and amino acid supply to the wound or site of injury to facilitate repair and healing.

Inflammatory and neuroendocrine mediators of stress response provoke changes such as muscle proteolysis, which lead to the release of amino acids, primarily glutamine and alanine. These are essential for protein synthesis at the site of injury and are also transformed to glucose by hepatic gluconeogenesis. Glutamine serves as fuel supply to

the gut and is converted to alanine and ammonia, which are utilized by the liver or converted to urea.

Hypermetabolism results in critically ill patients when the metabolic response is prolonged and severe, together with a hyperdynamic circulation, increased nitrogen loss muscle catabolism and glucose intolerance.

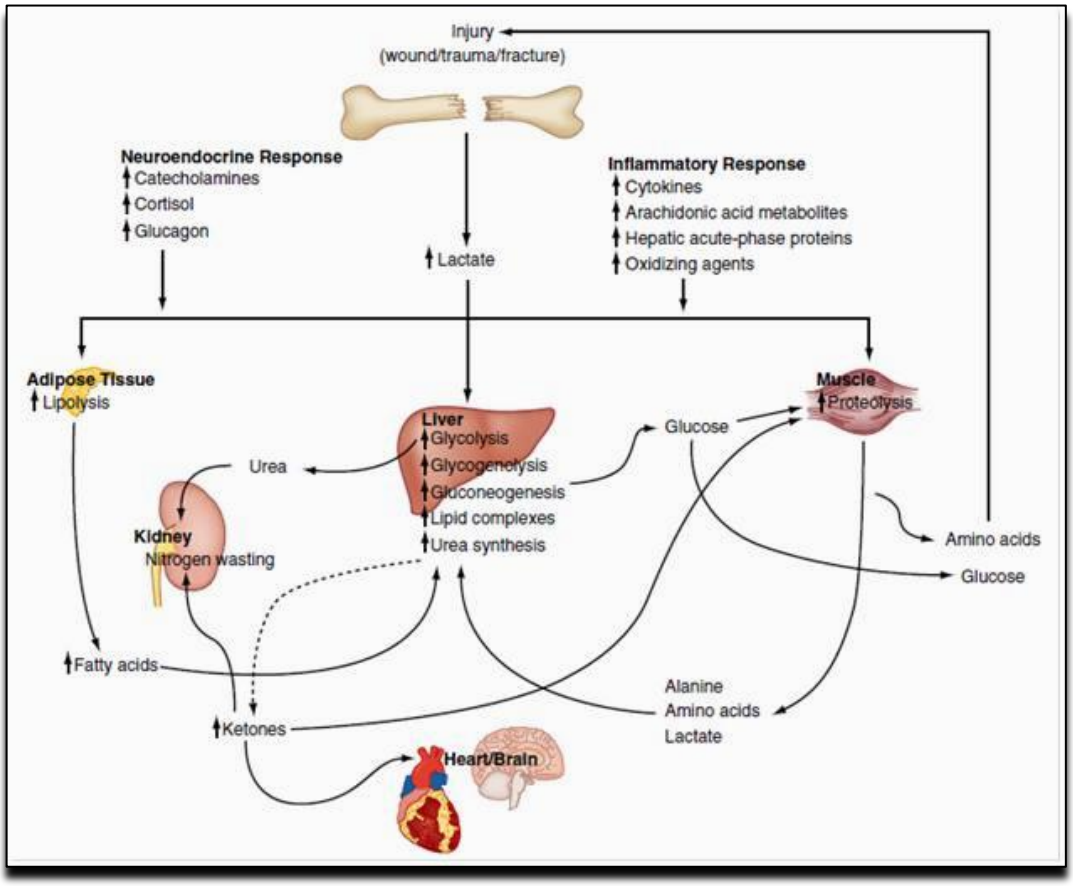

Figure 5. Metabolic response to injury

NUTRITIONAL ASSESSMENT IN SURGICAL PATIENTS[23]

Appraisal of preexisting medical conditions, malnutrition or obesity, and metabolic disorders, drug dependency, malabsorption and alcoholism form the spectrum of nutritional assessment in surgical patients.

Malnutrition may exist first and foremost because of insufficient intake or an underlying pathology, secondarily due to trauma, disease and inflammatory processes or as a consequence of surgical intervention and operative procedures.

Stress responses to critical illness and trauma lead to derangement of normal metabolic and physiologic processes, induction of inflammatory cascades, hepatic acute-phase protein responses, capillary leakage of plasma proteins and subsequent fluid compartment shifts, elevated basal energy expenditure, and catabolism of muscle protein, which result in organ dysfunction and associated morbidity. The aim should be to assess and precisely meet nutritional demands while avoiding overfeeding.

Overfeeding is detrimental, leading to hypercapnia and metabolic acidosis, hyperglycemia, hypertriglyceridemia, hepatic dysfunction, and azotemia.

Goal-oriented nutritional support is indispensable for improving outcomes following trauma and surgery and should be based on repeated assessment of response to feeding.

Nutritional support should be started as early as possible if circumstances indicate unlikely adequate oral intake for a patient within five days or if a preexisting nutritional deficit is present.

MALNUTRITION AND STARVATION[23]

Almost 50% of patients admitted to the hospital may be malnourished and an additional 25% to 30% become malnourished at some stage in hospital stay. It may occur as a result of protein-calorie deficiency, predominant protein deficiency or due to deficiency of specific micronutrients. It may also result from a hypermetabolic state following trauma, critical illness, sepsis, severe burns, or major surgery.

Malnutrition leads to impairment of multiple organ systems, including the immune system which in turn leads to augmented incidence of infection and delayed wound healing. Severe malnutrition and protracted starvation eventually lead to reduced GI barrier function, skeletal muscle wasting, respiratory insufficiency, decreased myocardial mass, renal atrophy, diastolic cardiac dysfunction, and decreased sensitivity to inotropes.

Glycogen serves the purpose of being the chief body fuel in the metabolic response to starvation during the first 12 to 24 hours. Once stores are exhausted, gluconeogenesis increases and amino acids begin to be degraded to fuel. Over time, ketone bodies from fat serve as the primary oxidative fuel source. In hypercatabolic states, increases occur in catabolic hormones—cortisol, glucagon, catecholamines, and a host of other inflammatory mediators.

Hyperglycemia, increased urinary nitrogen excretion and elevated lactate levels, are characteristic features. Fat and muscle are used as sources of energy. Muscle protein is used preferentially relative to visceral protein. Hence, the rate of loss of lean body mass exceeds the overall weight loss.

Malnutrition occurring as a result of starvation responds to restoration of nutrition, whereas that secondary to stress response and disease is less responsive to nutritional support. Enteral nutrition (EN) enhances immune response, and increasing protein content of the enteral diet has been shown to reduce immunosuppression.

METHODS OF NUTRITIONAL ASSESSMENT[23]

The various methods for assessing nutritional status are:

- Clinical history
- Body weight
- Anthropomorphic measurements: Ideal body weight, body mass index (BMI), skin fold thickness
- Indirect calorimetry
- Oxygen consumption, determination of respiratory quotient
- Body composition analysis: Dual-energy X-ray absorptiometry
- Biochemical measurements: albumin, transferrin, prealbumin
- Measurement of nitrogen balance
- Measurements of immunologic function

PHYSICAL BODY MEASUREMENTS[23]

BODY WEIGHT

Body weight reflects both fluid balance and nutritional status. Significant weight loss, particularly hasty or unplanned, is a powerful predictor of mortality. Patients should be weighed daily and accurate intake and output records should be maintained[23]:

Weight loss = [(usual weight - present weight)/ usual weight] x 100

ANTHROPOMETRIC MEASUREMENTS

Anthropometric measurements encompass a multitude of physical body measurements that are compared with standard values or used to assess individual changes in nutritional status over time. They also take account of estimation of ideal body weight (IBW) and body mass index (BMI).

EVALUATING CALORIC REQUIREMENTS

Assessing nutritional requirements of gravely ill patients is essential because provision of insufficient or excess calories adversely affects the outcome. Measurement of resting energy expenditure (REE) or basal metabolic rate is of the essence in nutritional management of surgical patients under various types of stress, who may experience significantly increased energy demands. Estimates of caloric requirements can be made using several different equations, calculated using blood gas measurements with the Fick's equation, or measured by indirect calorimetry using bedside metabolic charts to determine REE.

MONITORING NUTRITIONAL STATUS

Cautious monitoring is necessary to ensure optimal feeding and avoid underfeeding or overfeeding, regardless of the methods used to estimate nutritional needs. It involves regular clinical assessment of vital signs, respiratory status, functional improvement and wound healing, all of which present essential clues about the accurate nutritional status. In addition to clinical assessment, monitoring trends in a range of parameters serve to guide nutritional support and the need for enhancement of feeding regimens.

NITROGEN BALANCE

Calculation of Nitrogen balance can help monitor the adequacy of protein intake. A negative nitrogen balance occurs when the excretion of nitrogen exceeds the daily intake, which is a sign of muscle breakdown, whereas a positive nitrogen balance is associated with muscle gain.

Sequential monitoring of total nitrogen balance in patients permits evaluation of response to nutritional support and thereby identifies patients at risk of developing muscle protein loss. Persistent nitrogen losses and protein catabolism lead to decreased muscle strength,

altered body composition, increased infectious complications, and subsequent delay in rehabilitation.

SERUM PROTEINS

A host of serum proteins are used as indicators of nutritional status, albumin being the prime. Albumin levels are also valuable in detecting protein-energy malnutrition, which is frequently difficult to recognize in patients not presenting with low body weight and results from increased demands associated with the stress of illness, injury, or infection.

If these requirements are not met from dietary sources, body protein stores are exhausted, leading to complications (e.g., malabsorption, impaired immunologic response, reduced production of other constitutive proteins). Counter intuitively, IV administration of albumin is usually ineffective because it degrades quickly after infusion and does not treat the underlying cause of malnutrition.

The use of serum protein levels as indicators of nutritional status may be limited in acute phase following injury, inflammation, infection, and surgical stress.

Fluid shifts and amplified capillary permeability lead to protein leakage from the intravascular compartment, which results in hemodilution and false hypoproteinemia.

NUTRITIONAL SUPPORT

Surgical patients with suboptimal nutritional support have impaired wound healing, altered immune responses, accelerated catabolism, increased organ dysfunction, delayed recovery and increased morbidity and mortality. Post surgery, patients who are insufficiently fed become undernourished within 10 days and display a marked increase in mortality.

Commencement of early feeding addresses elevated nutritional demands. It also offsets any preexisting nutritional impairment. The ultimate goal of perioperative nutritional management is to increment caloric and nutrient specific requirements safely to promote wound healing, diminish risk of infection, and prevent loss of muscle protein.

INITIATING NUTRITIONAL SUPPORT

Nutritional support should be considered for all patients according to clinical assessment and guidelines over the perioperative period.

CRITERIA FOR INITIATION OF PERIOPERATIVE NUTRITIONAL SUPPORT[23]

Severe nutritional risk expected with at least one of the following:

• Past medical history: Severe under nutrition, chronic disease.

• Expected blood loss >500 ml during surgery.

• Involuntary loss >10%-15% of usual body weight within 6 months or >5% within a month

• Weight of 20% under IBW or BMI <18.5 kg/m2

• Failure to thrive on pediatric growth and development curves.

• Anticipation that patient will be unable to meet caloric requirements within 7-10 days post operatively.

• Serum albumin <3.0 g/dL or transferrin <200 mg/dL in the absence of an inflammatory state, hepatic dysfunction, or renal dysfunction

• Catabolic disease (e.g. significant burns or trauma, sepsis, and pancreatitis)

PRINCIPLES GUIDING ROUTES OF NUTRITION

Following a decision to initiate support, a route of administration should be carefully selected, with the following considerations:

1. Use the oral route if the GI tract is fully functional and there are no other contraindications to oral feeding.
2. Initiate nutrition via the enteral route if the patient is not expected to be on a full oral diet within 7 days post-surgery and there are no GI tract contraindications.
3. If the enteral route is contraindicated or not tolerated, use the parenteral route within 24 to 48 hours in patients who are not expected to be able to tolerate full EN within 7 days.
4. Administer at least 20% of the caloric and protein requirements enterally while reaching the required goal with additional parenteral nutrition (PN).
5. Maintain PN until the patient is able to tolerate 75% of calories through the enteral route and EN until the patient is able to tolerate 75% of calories via the oral route.

ENTERAL NUTRITION

Establishment of early (24 to 48 hours) EN following major surgery minimizes the risk of under nutrition and can halt hypermetabolic response seen after surgery. Administration of EN can be accomplished via various routes, including the use of

nasogastric (NG), nasoduodenal and nasojejunal tubes , which are preferentially used in patients who are expected to require support for short time periods (<4 weeks).

Other surgical options include open or percutaneous gastrostomy and jejunostomy, generally for those patients who are expected to require long-term EN (>4 weeks). In general, EN offers the beneficial effects of trophic feedings, which include structural maintenance and functional support of the intestinal mucosa, accomplished by providing nutrients such as glutamine, preserving blood supply and promoting peristalsis. Use of enteral nutrition to protect and maintain the integrity of the intestinal mucosa may therefore help reduce the risk of sepsis caused by bacterial translocation.

In critically ill patients, EN should be initiated within 48 hours of injury or admission; average intake delivered before the end of first week should be at least 60% to 70% of the total anticipated energy requirements, as determined by the assessment.

Provision of EN in this time frame and at this level may be associated with decreased length of hospital stay, days on mechanical ventilation and infectious complications.

CONTRAINDICATIONS TO ENTERAL NUTRITION[23]

The contraindications to enteral nutrition are as follows:

- Intractable vomiting, diarrhoea refractory to medical management.
- Diffuse peritonitis.
- Paralytic ileus.
- GI obstruction, ischemia.
- Distal high-output intestinal fistulas (too distal to bypass with feeding tube)
- Severe shock or hemodynamic instability.
- Severe short bowel syndrome (less than 100 cm of small bowel remaining)
- Severe GI haemorrhage.
- Severe GI malabsorption.
- Inability to gain access to GI tract.
- Need is expected for <7 days

PARENTERAL NUTRITION

PN was developed during the 1960's and soon became a major advancement in the nutrition of patients with a nonfunctioning GI tract. It involves intravenous infusion of nutrients in an elemental form, bypassing the usual processes of digestion.

When long term delivery of hyperosmolar regimens is required, total parenteral nutrition (TPN) is facilitated through a dedicated central line. A peripheral line can be used for lower osmolar solutions during shorter periods of time.

Since its early use, parenteral nutrition has benefitted patients who meet the criteria for nutritional support because of temporary or permanent limitation of GI tract function. Due to lower costs and improved outcomes of patients administered on enteral nutrition, the use of parenteral nutrition has declined from its popularity and is now reserved for patients in whom contraindications to enteral nutrition are present.

To promote gut integrity and motility in patients on parenteral nutrition alone, small volumes of enteral nutrition are encouraged, wherever possible.

Prior to initiating parenteral nutrition, patient's hemodynamic stability should be determined. Also the patient should be able to tolerate the fluid volume and nutrient content of parenteral formulations; it should be used with caution in patients with congestive heart failure, pulmonary disease, diabetes mellitus, and other metabolic disorders.

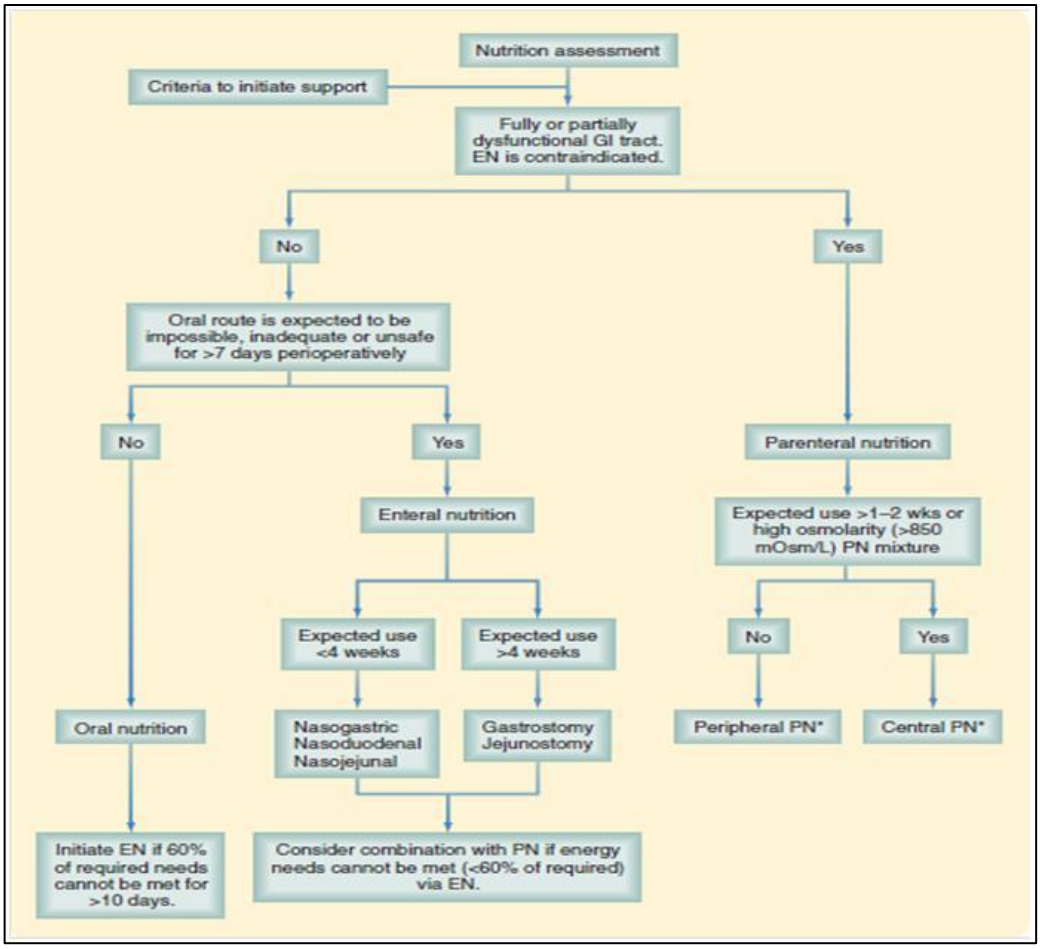

Figure 6. Routes of nutritional support in surgical patients- management protocol.

FLUID AND ELECTROLYTES[23]

Patients with GI disorders, particularly the ones who have undergone extensive bowel resection, experience demanding water and electrolyte imbalances. Such patients require extra vigil; monitoring is critical for the prevention, early diagnosis, and treatment of these imbalances. In adult patients receiving parenteral nutrition, at least 30 to 40 ml/kg of fluid, 1 to 2 mEq/kg of sodium and potassium, 10 to 15 mEq of calcium, 8 to 20 mEq of magnesium, and 20 to 40 mmol of phosphate need to be administered daily.

Patients who are rapidly anabolic, including those previously malnourished, may require additional potassium, magnesium and phosphorus, whereas those with renal impairment may require restriction.

IMMUNONUTRITION

Major injury, whether traumatic or induced by surgery, leads to significant suppression of immune function which influences a patient's recovery. Specific nutrients, including glutamine, arginine, omega-3 polyunsaturated fatty acids and nucleotides, have been shown to modulate the host response in animal and clinical experiments, with potential improvements in immune function but with inconsistent clinical evidence.

Working hypothesis is that the clinical use of a solution containing increased amounts of arginine stimulates T lymphocytes and provides a substrate for the generation of nitric oxide (NO), whereas the inclusion of omega-3 fatty acids promotes the synthesis of more favorable prostaglandins, and inclusion of nucleotides nonspecifically enhances immune-competence.

Long-chain omega-3 fatty acids reduce the production of inflammatory eicosanoids, cytokines and adhesion molecules. This occurs directly by replacing arachidonic acid as an eicosanoid substrate, inhibiting arachidonic acid metabolism, and giving rise to anti-inflammatory resolvins.

The indirect effect occurs through modulation of transcription factors that regulate expression of inflammatory genes. Omega-3 polyunsaturated fatty acids are potentially useful anti-inflammatory agents and are beneficial to patients at risk of acute and chronic inflammatory conditions.

Several clinical trials have evaluated the effectiveness of immune-enhancing enteral formulae and have shown superior outcomes compared with standard formulations in certain patient populations. Their use has been recommended 7 days prior to 7 days after surgery in the following circumstances:

- Major neck surgery for cancer (e.g., laryngectomy, pharyngectomy)
- Severely malnourished patients (serum albumin level <2.8 g/dL) or patients undergoing major GI surgery (e.g., esophagus, stomach, pancreas, duodenum, hepatobiliary tree)
- Patients with severe trauma to two or more body systems.

POSSUM AND P-POSSUM SCORING SYSTEMS[1]

The genesis and first description of POSSUM Score (Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity) was by Copeland et al in 1991 as a method for standardizing patient data so that direct comparisons of patient outcome could be made despite differing patterns of referral and population groups. He suggested usage of POSSUM scoring system for identification of high risk patients who could be benefited from preoperative and per operative optimisation to provide better surgical care[1].

The POSSUM score[1] by Copeland was derived by an analysis of 62 individual parameters (48 physiological and 14 operative factors) over a 6 month period to reduce the number of variables in an effort to create a simple, surgeon based risk adjusted scoring system. Of these, 35 factors were further studied over further 6 months to produce the final set of 12 physiological and 6 operative factors as shown in Table 2.

POSSUM score is a two part scoring system which includes physiological severity score and a measure of operative severity. The physiological score includes 12 variables, each divided into 4 grades with an exponentially increasing score (1, 2, 4 and 8). The physiological variables are those apparent at the time of surgery and include clinical symptoms and signs, results of basic biochemical and hematological investigations, and electrocardiographic changes[24].

If a particular variable is not available, a score of 1 is allocated. Some variables may be evaluated by means of clinical symptoms or signs or by means of changes on chest radiographic findings. The minimum score, therefore, is 12, while the maximum score is 88[1].

Table 2. POSSUM Scoring Parameters – Physiologic and Operative

Physiological parameters	**Operative parameters**
Age	Operative severity
Cardiac history	
Respiratory history	Multiple procedures
Electrocardiography	
Blood pressure	Total blood loss
Pulse rate	
Glasgow coma score	Peritoneal soiling
Hemoglobin level	
White cell count	Presence of malignancy
Urea concentration	
Na+ level	Mode of surgery
K+ level	

The POSSUM physiology score based on preoperative factors predicted outcome for individual operations, but not for groups of surgical patients as a whole. For example, a patient having an abdominal aortic aneurysm repair was likely to have a higher probability of death than the same patient having an ischio-rectal abscess drained. To address this, a six-factor operative severity score was added using similar methodology[25]. POSSUM score derived from the physiological variables is a measure of pre-operative severity of illness.

POSSUM has the advantage of including operative severity variables, which make it better in predicting morbidity and mortality rates. The operative severity score includes 6 variables, each divided into 4 grades with exponentially increasing scores (1, 2, 4 and 8). The number of operations indicates the chronology of the procedure(s) within 30 days[1].

The physiological and operative scores are obtained by applying preoperative physiological values and operative severity variables to physiological and operative severity assessment table for the POSSUM system as developed by Copeland et al[24] shown in Table 3 and Table 4.

Table 3. Physiological Parameters and Scoring Criteria for POSSUM

Score	**1**	**2**	**4**	**8**
Age	<60	61-70	>71	
Cardiac signs (Chest radiograph)	No failure	Diuretic, digoxin, anti anginal or antihypertensive therapy	Peripheral oedema, Warfarin therapy, Borderline cardiomegaly	Raised jugular venous pressure Cardiomegaly
Respiratory signs (Chest radiograph)	No dyspnoea	Dyspnoea on exertion	Limiting dyspnoea (one flight of stairs) Mild COAD	Dyspnoea at rest (rate > 30/min) Fibrosis or consolidation
Blood pressure (mm hg)	110-130	131-170 or 100-109	> 171 or 90-99	<89
Pulse (beats/min)	50-80	81-100 or 40-49	101-120	>121 or <39
Glass coma scale	15	12 to 14	9 to 11	<8
Haemoglobin (g/dl)	13-16	11.5-12.9 or 16.1-17	10-11.4 or 17.1-18	< 9.9 or > 18.1
White cell count ($x10^3$/l)	4 to 10	10.1-20 or 3.1-4	>20.1 or <3.1	
Urea (mmol/l)	<7.5	7.6-10	10.1-15	>15.1
Sodium (mEq/l)	>136	131-135	126-130	<125
Potassium (mEq/l)	3.5-5	3.2-3.4 or 5.2-5.3	2.9-3.1 to 5.4-5.9	< 2.8 or >6
ECG			Atrial fibrillation (rate 60-90)	Any other abnormal rhythm or >5 ectopics/ min, Q waves or ST/T wave changes
COAD = Chronic obstructive airway disease; ECG = Electrocardiogram				

Severity of surgery was classified as minor, intermediate, major and major+ based on the POSSUM classification as shown in Figure 7.

Table 4. Operative Severity Parameters and Scoring Criteria for POSSUM

Score	**1**	**2**	**4**	**8**
Operative severity	Minor	Moderate	Major	Major+
Multiple procedures	1		2	>2
Total blood loss (ml**)**	<100	100-500	501-999	>1000
Presence of malignancy	None	Primary only	Nodal metastasis	Distant metastases
Peritoneal soiling	None	Minor (serous fluid)	Local pus	Free Bowel content, pus or blood
Mode of Surgery	Elective		Emergency resuscitation of >2h possible<24 hr after admission	Emergency surgery <2h needed

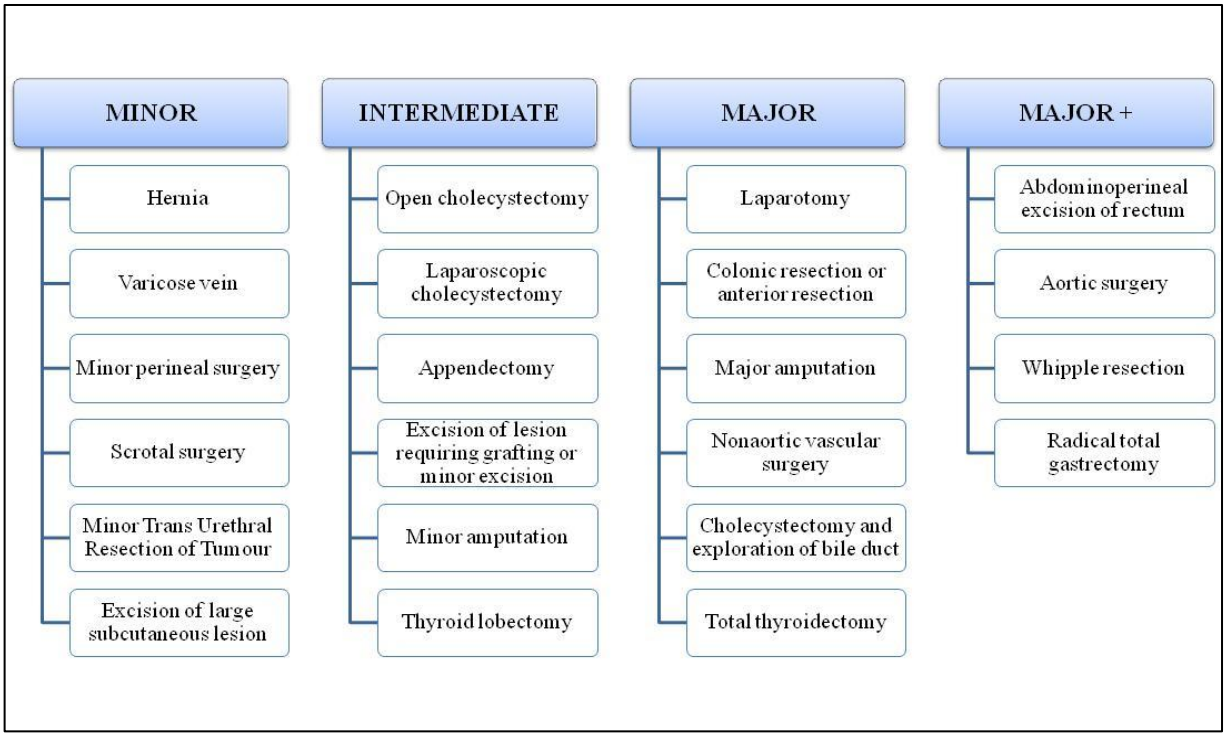

Figure 7. Examples of surgical magnitude for general surgery.

Once the physiological score and the operative severity scores are obtained following summation of all respective variables, the POSSUM score can be calculated using the following equations[1]:

Morbidity is calculated as follows:

$$Log_e[R/1-R] = (-5.91) + (0.16 \times \text{physiological score}) + (0.19 \times \text{operative score})$$

Where R = risk of morbidity.

Mortality is calculated as follows:

$$Log_e [R/1-R] = (- 7.04) + (0.13 \times \text{physiological score}) + (0.16 \times \text{operative score})$$

Where R= Risk of mortality.

Copeland assessed predictive value of these equations and validated it by the determination of receiver operating characteristic curves[1].

The patients were then followed up for a period of 30 days following the surgical procedure and complications if any, were noted depending upon the following criteria as defined for POSSUM scoring system[24]:

1. Wound haemorrhage: local haematoma requiring evacuation.
2. Deep haematoma: postoperative bleeding requiring re-exploration.
3. Chest infection: production of purulent sputum with positive bacteriological cultures, with or without chest radiography changes or pyrexia, or consolidation seen on chest radiograph.
4. Wound infection: wound cellulitis or the discharge of purulent exudate.
5. Urinary infection: the presence of $> 10^5$ bacteria/ml with the presence of white cells in the urine, in previously clear urine.
6. Deep infection: the presence of an intra-abdominal collection confirmed clinically or radiologically.
7. Septicaemia: positive blood culture.
8. Pyrexia of unknown origin: any temperature above 37^0 Celsius for more than 24 hours after the original pyrexia following surgery (if present) had settled, for which no obvious cause could be found.
9. Wound dehiscence: superficial or deep wound breakdown.

10. Deep venous thrombosis and pulmonary embolus: when suspected, confirmed radiologically by venography or ventilation/perfusion scanning, or diagnosed at post mortem.
11. Cardiac failure: symptoms or signs of left ventricular or congestive cardiac failure which required alteration from preoperative therapeutic measures.
12. Impaired renal function: arbitrarily defined as increase in blood urea > 5mmol/l from preoperative levels.
13. Hypotension: a fall in systolic blood pressure below 90 mmHg for more than 2 hours as determined by sphygmomanometry or arterial pressure transducer measurement.
14. Respiratory failure: respiratory difficulty requiring emergency ventilation.
15. Anastomotic leak: discharge of bowel content via the drain, wound or abnormal orifice.
16. Any other complications.

Whilst the POSSUM mortality equation was used to assess mortality and morbidity it was noted to over predict deaths. Whiteley et al demonstrated that the original POSSUM regression equation was unsuccessful in patients in Portsmouth. The authors found that POSSUM over predicted death in a Cohort study comprising of 1485 patients, principally patients at low risk. However the POSSUM data set could still be used albeit with a dissimilar regression equation. They modified the approach using standard methods to arrive at a logistic regression model that fitted well with the observed mortality[7].

To differentiate the modified score from POSSUM as described by Copeland et al[24], the altered method of applying POSSUM is termed P-POSSUM. It uses the physiological and operative scoring methods described by Copeland et al, with the modification that uses accepted methods to obtain, the logistic regression equation for mortality and for applying it to the population being studied[7].

P POSSUM risk of mortality is calculated as follows[7]:

$Log_e[R/1-R]$ = - 9.065 + (0.1692 x physiological score.) + (0.1550 x operative score)

R indicates risk of mortality.

To compare the efficiency of POSSUM and APACHE II scoring systems Jones R D conducted a study in a general surgery unit, in which the two scoring system were used to calculate the adverse outcome in 117 patients undergoing major surgeries (elective and emergency). Data was collected pre and intra operatively and patients were monitored to note any complications for the first 30 postoperative days. 13 patients (11%) died and the incidence of post-operative complications was 50%. ROC curve analysis was performed to calculate predictive value of POSSUM and APACHE II scoring systems. They found POSSUM scoring system was a good predictor of mortality (area under curve 0.753) and morbidity (area under curve 0.82). They also noted that APACHE II scoring system showed a poor predictive value (area under curve 0.54) with a statistically significant difference ($p < 0.002$).Therefore, POSSUM scoring system was suggested as an accurate predictor of post-operative adverse outcome[26].

POSSUM for comparative audit in 344 patients undergoing reconstructive vascular surgery to assess its efficiency in comparative audit between two units was applied by Copeland G P. He was able to exhibit that POSSUM was a better predictor of adverse outcome following surgery. Patients were classified into 2 units. Anticipated mortality rates of 10.2% for unit A (observed 9.4%) and 20.2% for unit B (observed 20.2%) were obtained and using ROC curves, no statistically significant difference between the two units were noted. They concluded that POSSUM scoring system was a superior guide for comparing effectiveness of quality of care, rather than crude mortality rates[27].

An analysis by Neary et al compared a number of risk scoring systems prospectively in a cohort of patients who underwent non elective surgery. A total of 2349 patients undergoing emergency surgery were prospectively analyzed using the Portsmouth Physiological Operative Severity Score for enUmeration of Mortality (P-POSSUM), surgical risk score (SRS), revised Goldman cardiac risk index (RGCRI), and biochemistry and hematology outcome models (BHOM). Observed 30 day and 1 year mortality was compared with expected mortality. The authors observed 141 deaths within 30 days of surgery and 254 after 1 year; the area under the receiver operator characteristic (ROC) curve for 30 days was 0.90 for P-POSSUM 0.85 for SRS, 0.84 for BHOM and 0.73 for RGCRI. They concluded that P-POSSUM, SRS and BHOM were able to distinguish precisely the expected and observed mortality rates, but SRS had the advantage of ease of calculation[28].

Another review to evaluate and compare various scoring systems for risk scoring in surgical patients with relevance to general surgeons was done by Jones and Cossart. Articles relating to severity of illness, morbidity, mortality, and post-operative complications were identified along with papers about 'specific identified scoring systems' like ASA, Goldman cardiac index, prognostic nutritional index, hospital prognostic index, APACHE II, POSSUM and P-POSSUM scoring systems. They concluded POSSUM and P-POSSUM scoring systems are the most suitable of all presently available scoring systems for general surgical practice[5].

A prospective study by Prytherch et al compared POSSUM and P-POSSUM in 10,000 general surgical patients between August 1993 and November 1995. The POSSUM scoring system was applied to all 10,000 patients, while the first 1,500 patients were used to derive a modified P-POSSUM equation, which was applied prospectively to the residual cases. POSSUM scoring system over predicted the mortality rate by a factor of 2, the observed mortality rate being 287 deaths and predicted 697 deaths. The P-POSSUM scoring system when applied prospectively on the next 7,500 cases showed an observed to expected ratio of 0.90 ($x2$ =1.63; 5 d.f.,) and 0.85 ($x2$ =1.35; 4 d.f). A conclusion suggesting application of P-POSSUM scoring system for predicting mortality was arrived at and also emphasis was laid on the need for appraisal of geographical dissimilarity in predicting the adverse outcome rate[4].

The physiological scoring system of POSSUM was used by Treharne et al to compare outcome in patients undergoing abdominal aortic aneurysm (AAA) repair by endovascular and conventional procedures. There were 104 patients in conventional surgery group and 49 endovascular surgery patients in the study. P-POSSUM scoring system was used to match the two diverse groups of patients to achieve comparability. Even though the indications for the type of surgery depended upon the patient's physiological status, using P-POSSUM they were able to match the two groups. 6% deaths were noted in the endovascular AAA repair group and 16% in the conventional aneurysm repair group. P-POSSUM formulae predicted mortality rates of 8 and 19 per cent respectively. The mean physiological scores were identical for both groups; the operative severity scores were considerably greater in the conventional group. It was concluded that open AAA repair had a higher operative severity than endovascular repair which was demonstrated in the increased mortality rate predicted by P-POSSUM[10].

In a retrospective analysis conducted, in a teaching hospital of Korea to evaluate the usefulness of POSSUM and P-POSSUM in predicting 30-day mortality after intraoperative cardiac arrest in adult patients undergoing non-cardiac surgery, the overall predicted 30-day mortality rates using POSSUM and P-POSSUM were 65.5% and 57.5%, respectively. The observed-to-predicted (O: E) ratio for the POSSUM 30-day mortality was 1.07 whereas that with P-POSSUM was 1.10, with no significant difference between the observed and predicted values. Area under the curve values at 95% confidence interval were 0.771 and 0.785 for POSSUM and P-POSSUM, respectively.

They concluded that both POSSUM and P-POSSUM performed well in predicting overall 30-day mortality following intraoperative cardiac arrest in adults undergoing non-cardiac surgery[29].

In a retrospective study conducted by Neary et al to predict the adverse outcome rate following intra-arterial thrombolysis of acute leg ischemia, the physiological aspect of POSSUM score was used. It was found that the physiological component of POSSUM accurately predicted the adverse outcome rate. They suggested application of POSSUM in non-operative cases as well[11].

POSSUM scoring system was used by Sagar PM to compare adverse outcome following colorectal resection in 438 patients performed exclusively by five surgeons. Crude mortality rates were in the range from 5.6% to 6.9% and morbidity rates between 13.6% and 30.6%, risk adjusted analysis using POSSUM showed no statistically significant difference and the overall observed to expected ratio for mortality was found to be 0.87 and for morbidity, it was 0.97. He concluded that a noteworthy comparison of individual surgeon's efficiency was possible using POSSUM as it is a good predictor of adverse outcome[13].

Application of a modified POSSUM scoring system for the assessment of risk of morbidity and mortality in patients undergoing lumbar surgeries in a particular study comprising of 158 patients validated the efficacy of the scoring system. In the study, the expected mortality stood at 51, whereas the observed mortality was 42 cases (26.6 %).

The overall observed-to-expected ratio was 0.82, with no statistically significant difference between the expected and observed morbidities ($\chi 2$=1.23, P=0.27), they suggested that the modified POSSUM scoring system is a practical tool for prediction of morbidity and mortality in patients undergoing lumbar surgery[30].

A comparison between crude and risk adjusted mortality rates among four surgeons in patients undergoing gastrointestinal surgery was performed by Tekkis et al using P-POSSUM and POSSUM scoring systems. The study included 505 consecutive patients undergoing major gastrointestinal surgeries (emergency 33.9%, elective 66.1%). Using P-POSSUM, the expected rate was 11.3% (*x2* test =3.34, 4 d.f.=4, *P* = 0.51) the observed mortality rate using POSSUM was 11.1%, while the expected mortality rate was 21.5%, which was found to be a significant over prediction by a factor of 2 (*x2* test = 44.82, d.f.=4, *P*<0.001) the observed predicted ratio for P-POSSUM equation was close to unity (.905-1.067), but it was 0.45-0.56 for POSSUM equation. Evaluation suggested that P-POSSUM was a more precise predictor of mortality[14].

Prospective analysis of two cohorts in the United States of America (USA) (n = 1,056) and United Kingdom (UK) (n = 1,539) was done by Bennent-Guerrero et al using P-POSSUM scoring system to compare mortality rates. P-POSSUM scoring system expected mortality rates showed significant fit to the observed mortality rates in the USA (82 and 22) and in the UK (156 and 152). A better outcome among patients undergoing surgeries in the USA when compared to those in the UK was noted (Odds ratio = 4.5, *P* < 0.001). It was opined that increase in predicted risk, based on P-POSSUM was associated

with a higher mortality rate in both countries. However, risk adjusted mortality rates following major surgery were four times higher in the cohort. They concluded that such differences necessitate validation of the P- POSSUM scoring system in different countries[12].

In the Indian scenario, Mohil et al compared POSSUM and P-POSSUM for predicting the morbidity and mortality rate in patients undergoing emergency laparotomy. The prospective analysis comprised of 120 patients who underwent emergency laparotomy at Safdarjung hospital, Delhi. Physiological scoring was done at the time of admission and intra operative scoring was done to obtain the operative scoring variables, to calculate expected 30 day morbidity and mortality rates. POSSUM over predicted morbidity with an O: E ratio of 0.68 and 0.91 using linear and exponential method respectively for POSSUM (*x2* test = 10.79, 9 d.f., *P* = 0.148). POSSUM it also significantly over predicted mortality even with exponential method (O: E ratio 0.62). On applying linear and exponential analysis for P-POSSUM the O: E ratio for mortality were 0.66 and 0.88 (*x2* test = 5.33, 9 d.f., *P* = 0.619). They concluded by validating POSSUM and P-POSSUM scoring systems for accurate prediction of post-operative mortality rates in the Indian scenario, where patients usually belonged to the low socioeconomic strata with limited resources[19].

Evaluation of POSSUM and P-POSSUM scoring systems in risk adjusted surgical audit among patients undergoing general surgery in a tertiary referral hospital in Malaysia was done by Yii MK and Ng KJ, to assess its applicability in the circumstances

of a developing country. The observed rates among four different risk subsets were 6.1%. The POSSUM system predicted an expected mortality rate of 10.5% showing a significant difference compared to the observed rate ($P < 0.01$) the predicted mortality using P-POSSUM was 4.8% which showed a good fit to the observed rate. P-POSSUM was validated by them as an effective tool for predicting the adverse outcome rate in the Malaysian scenario[31].

A comparison between surgical risk score (SRS), POSSUM and P-POSSUM in higher risk surgical patients was undertaken by Brooks et al. The observed 30-day mortality rates of 949 consecutive patients undergoing inpatient surgical procedures were compared with mean mortality rates predicted by P-POSSUM, SRS and POSSUM. The observed mortality rate was 8.4% and predicted mortality rates for SRS, POSSUM and P-POSSUM were 5.9%, 12.6% and 7.3% respectively. No differences in the area under the receiver operator characteristic curves for the three methods were observed by the authors. They concluded that SRS, POSSUM and P-POSSUM predicted the mortality rates evenly in higher risk surgical patients[32].

The POSSUM methodology was evaluated in 221 patients undergoing elective and emergency arterial surgery under a single consultant, the observed morbidity and mortality rates were compared with the rates predicted by POSSUM and P-POSSUM using a linear method of analysis by Midwinter MS, Tytherleigh M and Ashley S. They noted that POSSUM predicted risk of morbidity was not significantly different from the observed complication rates. However, in their study POSSUM equation for mortality

over predicted mortality. The mortality rate estimated by P-POSSUM was not significantly different from the observed death rates. The authors concluded that the POSSUM methodology combined with P-POSSUM modification for mortality allows for satisfactory prediction of mortality and morbidity rates in patients undergoing vascular surgery[9].

The use of the POSSUM, P-POSSUM and O-POSSUM was evaluated by Lai et al in 545 patients undergoing elective thoracic esophagectomy, in hospital mortality rates were observed and compared with rates predicted by POSSUM, P-POSSUM and O-POSSUM, assessment was done using receiver-operation characteristic (ROC) curve analysis. The observed mortality rate was 5.5% whereas rate predicted by POSSUM, O-POSSUM and P-POSSUM were 15.0%, 10.9%, and 4.7 % respectively. POSSUM and O-POSSUM showed lack of fit against observed mortality, whereas P-POSSUM showed no lack of fit. They concluded that the P-POSSUM provided the most accurate prediction of in-hospital mortality rate[33].

An audit of low risk general surgical patients using the POSSUM and P-POSSUM scoring systems in 788 patients was performed by Parihar V. Good prediction of mortality and morbidity with exponential analysis using POSSUM (O: E ratio = 0.94 and 0.87) and with linear analysis using P-POSSUM (O: E ratio = 1.525) was observed. However they noted that the scoring system over predicted the outcome in the low risk group i.e. predicted mortality <10% and morbidity <40%. To reduce the over prediction in low risk general surgical patients, a multivariate regression analysis was performed to obtain a

new equation called Jabalpur POSSUM (J-POSSUM), which provided a better fit to the observed mortality and morbidity rates (O:E ratio = 1.04) in low risk general surgical patients. Their study validated POSSUM, P-POSSUM and J-POSSUM in predicting the adverse outcome rates in general surgical patients in the Indian scenario among low risk patients as well[34].

In another study, the POSSUM methodology was applied for quality assessment in high acuity surgeries among 296 patients undergoing pancreatic resections, the authors Vollmer et al calculated expected morbidity using POSSUM methodology and compared it with observed morbidity. They noted that the observed and expected morbidity rates were equal (54.1% vs. 55.1%) for an O: E ratio of 0.98. POSSUM scoring system was validated as a satisfactory method for predicting surgical complications across various levels of surgical procedures and complexity[35].

POSSUM scoring system was applied in patients undergoing elective craniotomy for various causes by Ramesh et al among 285 patients of the study population, the observed mortality (3.16%) was compared with predicted mortality by POSSUM (11%) and P-POSSUM (3.16%). The authors concluded that POSSUM scoring system over predicted mortality whereas P-POSSUM calculated mortality similar to observed rates. Their study validated the use of both scoring systems in neurosurgical patients[36].

A multitude of studies conducted by several authors in different institutes, with varied population groups and geographic conditions validated and approved POSSUM

and P-POSSUM scoring systems. In addition several studies further compared a variety of scoring systems with POSSUM and P-POSSUM scoring systems to compound firmly and validate with statistical evidence the accuracy of POSSUM and P-POSSUM systems. Furthermore, P-POSSUM was attributed to be the better among both scoring systems in predicting near observed mortality rate prediction[8, 9, 14].

However, certain other studies conducted on a smaller magnitude projected flaws of the systems and have warranted the need for further application of the scoring systems under different conditions[37, 38].

In a retrospective study, comprising 221 patients who underwent surgeries for various conditions Organ N et al evaluated P-POSSUM to test its effectiveness in the Australian scenario. Linear analysis and ROC curves were used for assessment. Significant difference between the observed mortality rates (28) and the predicted rates (49.9) was noted. A Conclusion was made that the discordance was too high to justify the applicability of P-POSSUM for routine assessment of expected mortality rates and suggested further studies for local calibration to arrive at a more effectual risk adjusted scoring system under Australian conditions[37].

A study using POSSUM and Portsmouth modification of POSSUM (P-POSSUM) for predicting mortality following vascular surgery in 312 consecutive patients was done by Wijesinghe et al. The 30 day postoperative period data was collected, which revealed 41 deaths. They used Linear and exponential methods of analysis for POSSUM and P-POSSUM respectively. Using the POSSUM scoring system they obtained an observed to expected ratio of 0.59 using linear analysis and 1.14 using exponential analysis. P-POSSUM revealed an observed to expected ratio of 0.89 using linear analysis, which was simpler and could predict the individual patient's mortality rate. They concluded that the O:E ratios for POSSUM and P-POSSUM were close to unity when an appropriate analysis was performed and over predicted death, if the method of analysis used was incorrect[8].

A study evaluating the reliability of POSSUM and P-POSSUM in predicting mortality of nonagenarians undergoing abdominal surgeries was undertaken in the University of Western Ontario. The study population comprised of 145 patients undergoing both elective and emergency surgeries. The common diagnoses were colorectal cancer (19.3 percent) and hernias (12.3 percent) and the most commonly performed procedures were bowel resection with anastomosis (25.5%) and hernia repair (18.6%). Overall in-hospital mortality rate was 15.2 percent (20.8% in the emergency group and 9.6% in the elective group). Both POSSUM and P-POSSUM scoring systems significantly over predicted mortality rate, particularly in high risk groups. They

concluded that the POSSUM and p-POSSUM scoring systems were not reliable predictors of in-hospital mortality[38].

In 251 patients undergoing laparoscopic colectomy , the authors Senagore AJ et al evaluated POSSUM scoring system to compare the observed mortality and morbidity rates with the expected morbidity and mortality rates calculated by POSSUM and P-POSSUM equations[39].

The study showed 6.8 percent morbidity rates which was significantly lower than the predicted rate by POSSUM (12.4 percent). The POSSUM and P-POSSUM scoring systems also over predicted mortality rate (9.6 percent and 3.5 percent respectively) as compared to observed rates (0.8 percent). However they noted that P-POSSUM calculated the mortality rate appropriately when a correction to the operative severity score of 1 was given. POSSUM and P-POSSUM were found to over predict mortality and morbidity rates in this study[39].

A prospective observational study for evaluation of POSSUM and P-POSSUM scoring in predicting post-operative mortality in a level 1critical care setting was undertaken at the Royal Derby Hospital, University of Nottingham. The Observed to expected (O:E) mortality ratio for POSSUM and P-POSSUM showed significantly fewer than expected deaths in all risk groups. They suggested the use of POSSUM models to predict mortality in patients admitted to level 1 care ward is inappropriate or that a recalibration of POSSUM is required to make it useful in a level 1 care ward setting[40].

Retrospective analysis conducted by Zafirellis et al evaluated the applicability of POSSUM scoring system for assessing mortality and morbidity rates in patients of esophageal cancer, undergoing esophagectomy. POSSUM scoring system was applied in 204 patients who underwent oesophagectomy. The observed and predicted mortality rates were 12.7 and 19.1 percent respectively. Morbidity rates were 53.4 and 62.3 percent. ROC curve analysis revealed that POSSUM had poor predictive accuracy both for mortality and morbidity. The study concluded that POSSUM scoring system does not accurately predict mortality and morbidity in patients undergoing oesophagectomy and needed modification[16].

METHODOLOGY

SOURCE OF DATA:

Patients admitted to department of General Surgery undergoing abdominal surgeries at R L Jalappa Hospital and Research Centre, Tamaka, Kolar, attached to Sri Devaraj Urs Medical College.

Study period: December 2014 to June 2016.

Inclusion criteria:

Patients undergoing elective and emergency abdominal surgeries (laparotomy).

Exclusion criteria:

1) Pediatric surgeries.

2) Day care surgeries.

3) Follow up period criteria not met.

METHOD OF COLLECTION OF DATA

The study comprised of a prospective assessment of 120 patients who underwent abdominal surgeries admitted in all general surgical units of RLJH and RC. All patients were subjected to clinical examination with relevant investigations after obtaining an informed consent.

Data was collected prospectively on a prepared proforma for the study. All patients would have their physiological score recorded at the time admission and an operative severity score was tabulated based on findings recorded by the operating surgeon on the proforma. Patients were followed up for a period of 30 days post surgery and complications if any were recorded. The collected data was then analyzed using statistical analysis.

STATISTICAL ANALYSIS

Data was analyzed using the statistical program for social sciences (SPSS) software version 12 and chi-square test was used to obtain p-value. The risk of morbidity and death was calculated using P-possum equations.

P- POSSUM equation for calculation of mortality:

Log R/1-R = - 9.065 + (0.1692 x physiological score) + (0.1550 x operative severity score)

where R = risk of mortality

Postoperative morbidity and death in the hospital was recorded in accordance with definitions described.

Risk of morbidity was calculated using the POSSUM equations.

POSSUM equations for morbidity:

1) Log R / 1-R = -5.91 + (0.16 x physiological score) + (0.19 x operative severity score)

where R = risk of morbidity

RESULTS

The study population comprised of a total of one hundred and twenty subjects admitted to RL Jalappa hospital, Kolar. These included patients subjected to abdominal surgeries due to various causes for the period encompassing one and a half years from December 2014 to June 2016 (Table 5).

Table 5: Distribution of cases according to diagnosis

DIAGNOSIS	**MODE OF SURGERY**		**Total**
	ELECTIVE	**EMERGENCY**	
Bowel obstruction	3	9	12
Duodenal perforation	0	11	11
Gastric perforation	0	24	24
Blunt injury abdomen	0	5	5
Gall bladder pathology	16	0	16
Ileal perforation	1	6	7
Large bowel pathology	3	7	10
Jejunal perforation	0	2	2
Gastric malignancy	3	3	6
Appendicular pathology	13	7	20
Others	4	3	7
Total	**43**	**77**	**120**

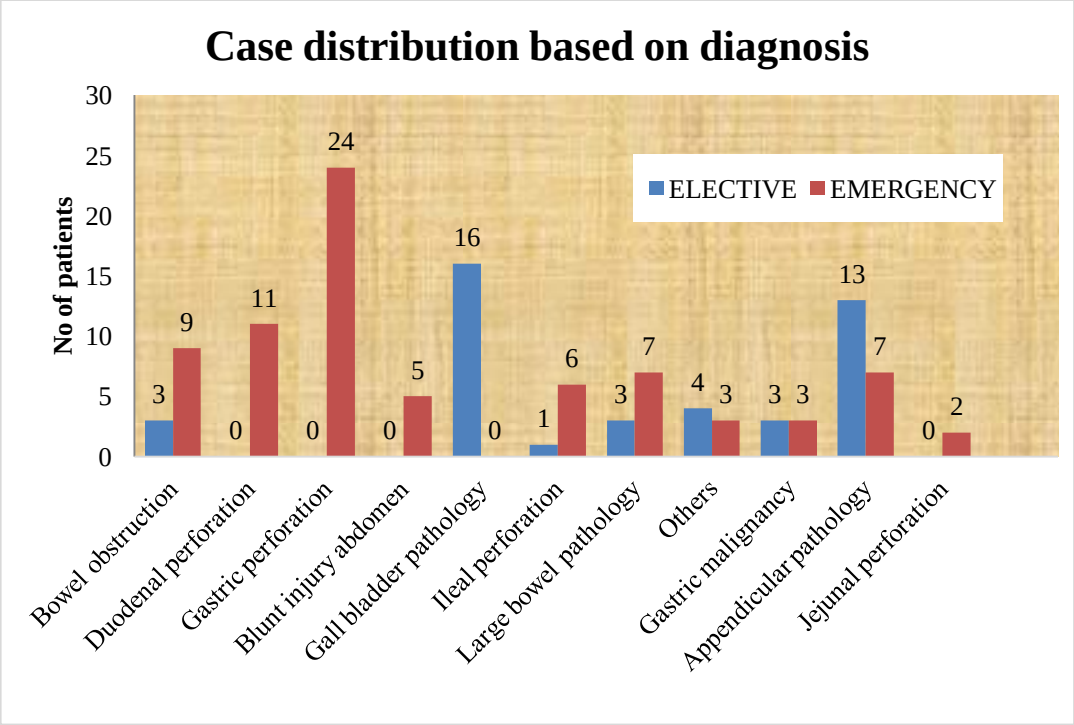

Figure 8: Graphical representation of cases according to diagnosis

A total of 120 patients comprised the study population of which 43 patients were subjected to elective surgery for causes primarily including appendicular pathology such as acute or recurrent attacks of appendicitis or mostly for gall bladder pathology in the form of cholelithiasis. Emergency surgeries comprised the vast majority of the study population (77 cases) of which pre pyloric perforation (24 cases) was the most common cause for which patients were subjected to laparotomy as shown in Figure 8.

Common causes for which patients were subjected to emergency laparotomy included duodenal perforation (11 cases), intestinal obstruction (9 cases), ileal perforation (6 cases) and jejunal perforation (2 cases). Other causes for which patients were subjected to laparotomy included cases such as stab injury to abdomen, meckel's diverticulum causing intestinal obstruction and cases of incisional hernia.

Table 6 : Distribution of patients according to gender

Gender	Mode Of Surgery		Total
	Elective	Emergency	
Female	18	18	36
Male	25	59	84
Total	43	77	120

In all 36 females and 84 males were part of the study population (Table 6) among them 18 females (50%) underwent elective surgery and the rest were subjected to emergency surgeries. Among the male population of the study, 25 patients underwent elective surgery and 59 patients underwent emergency surgeries for different pathologies as shown in Figure 9.

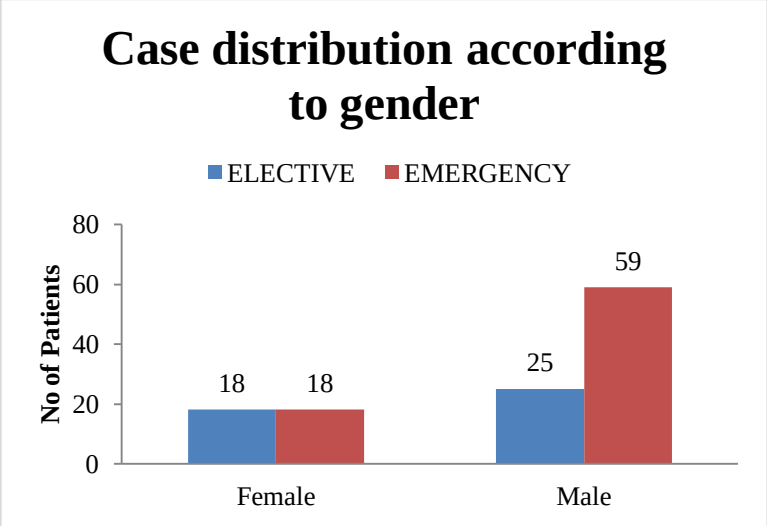

Figure 9 : Graph showing distribution of cases according to gender

ANALYSIS OF RISK FACTORS:

PHYSIOLOGICAL SCORING PARAMETERS

1. Age

Of the 120 cases 29 patients in the study group were 60 years of age or above who underwent laparotomy for different causes. These cases accounted for 8 deaths. However, it was found to be statically insignificant (Table 7).

Table 7 : Distribution of cases according to age among two groups

Age group*	Mode of surgery		Total	*P* value
	Elective	Emergency		
1	31	60	91	0.726
2	7	11	18	
4	5	6	11	
Total	43	77	120	

*Age (years): 1 = < 60, 2 = 61-70, 4 = > 71 ;*P* = 0.726; not significant

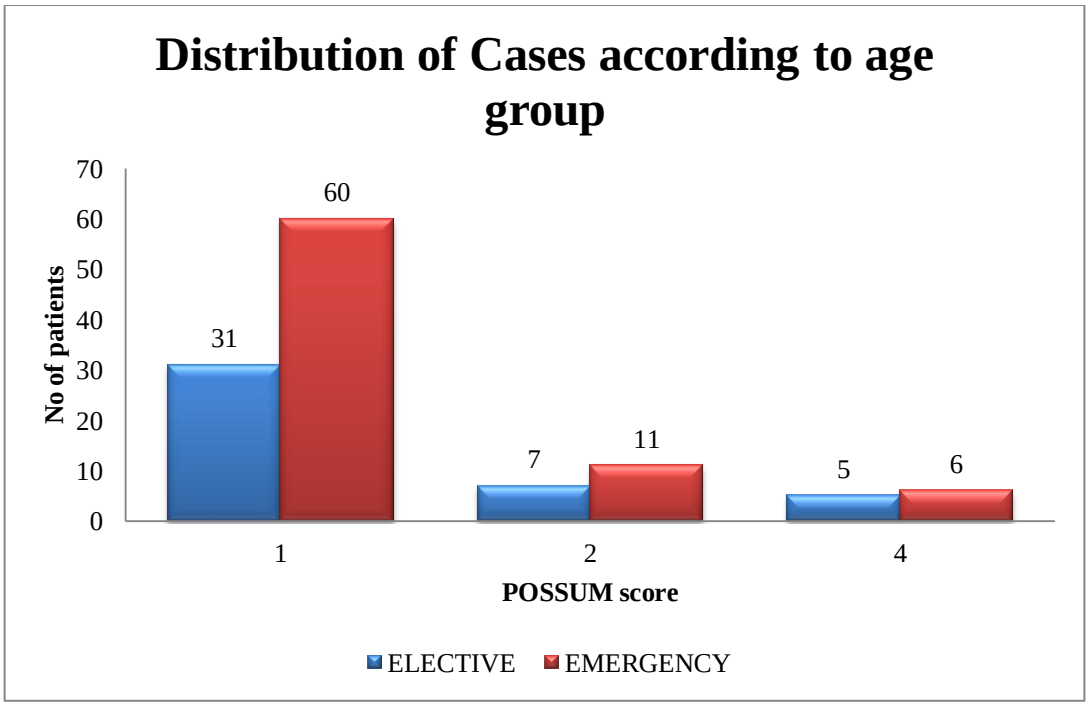

Figure 10: Graph showing distribution of cases according to age among two groups

Out of 120 patients, 91 patients were below 60 years of age in the population and were assigned a score of 1 according to POSSUM scoring, 18 patients were between 61-70 years of age and 11 patients were above 70 years of age as shown in Figure 10.

2. Cardiovascular system

Higher POSSUM score was noted in 39 patients for cardiac abnormalities among patients who were subjected to surgeries in our study population of which 12 deaths were recorded. The risk factor however was found to be statistically insignificant with *P* = 0.755 (Table 8).

Table 8 : Distribution of cases according to CVS among two groups

CVS	Mode Of Surgery		Total	*P* value
	Elective	Emergency		
1	29	52	81	0.755
2	12	18	30	
4	2	6	8	
8	0	1	1	
Total	43	77	120	

CVS – Cardiovascular signs : 1 = Normal, 2 = Cardiac drugs or steroids, 4 = Edema; Warfarin, Borderline cardiomegaly, 8 = Raised JVP, Cardiomegaly *P* = 0.755; not significant

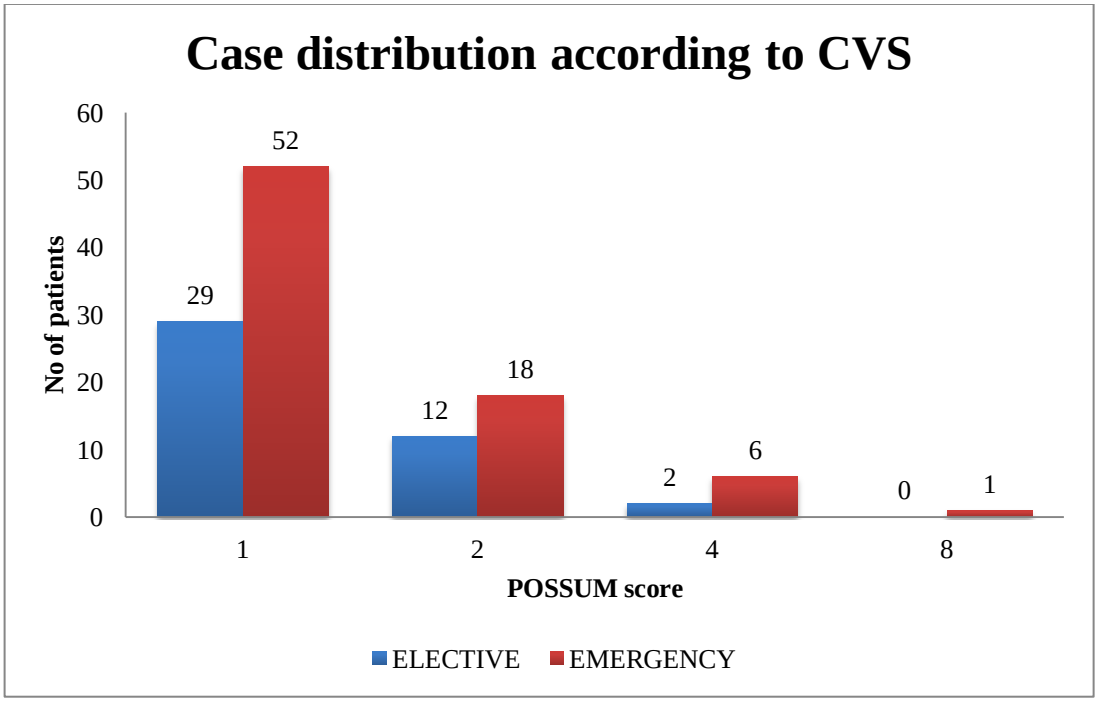

Figure 11: Graph showing distribution of cases according to CVS among two groups

A total of 81 patients were assigned a score of 1 of which 29 patients underwent elective surgery and 52 patients were subjected to emergency laparotomy. There were 30 patients with score of 2, 12 of whom underwent elective surgery and 18 emergency surgeries for various causes. 8 patients were assigned a score of 4 of which 2 patients underwent elective surgeries and 6 were subjected to emergency surgeries. One patient was assigned a score of 8 in the study population as shown in Figure 11.

3. Respiratory system

In all 43 surgeries were performed on patients with higher POSSUM scores and these procedures resulted in 13 deaths. It was not found to be statistically significant in predicting mortality (*P* = 0.711) (Table 9).

Table 9: Distribution of Cases According to RS among Two Groups

RS	**Mode Of Surgery**		**Total**	***P* value**
	Elective	**Emergency**		
1	30	47	77	0.711
2	8	19	27	
4	5	10	15	
8	0	1	1	
Total	43	77	120	
RS – Respiratory signs : 1 = Normal, 2 = SOB exertion, Mild COAD, 4 = SOB stairs, Moderate COAD, 8 = SOB rest, any other changes. *P* = 0.711; not significant				

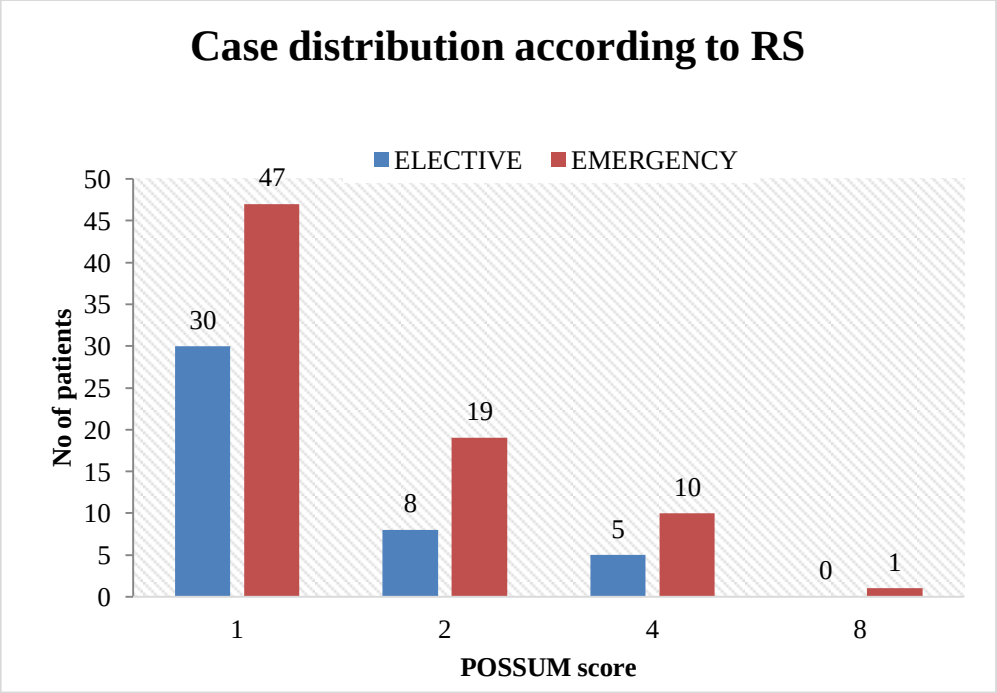

Figure 12: Graph showing distribution of cases according to RS among two groups

In the present study, 77 patients had no respiratory abnormalities, 47 in the emergency population and 30 patients among the elective population. 27 patients presented with complaints of shortness of breath on exertion, 15 patients with shortness of breath on climbing a flight of stairs and one patient had shortness of breath at rest as shown in Figure 12.

4. Blood pressure

Overall 57 procedures were done on patients with higher POSSUM score for blood pressure and these cases accounted for 17 deaths .The risk factor was found to be statistically significant (Table 10).

Table 10 : Distribution of cases according to BP among two groups

BP	**Mode Of Surgery**		**Total**	***P* value**
	Elective	**Emergency**		
1	32	31	63	<0.001
2	8	22	30	
4	3	9	12	
8	0	15	15	
Total	43	77	120	

BP – Systolic Blood pressure (mm/Hg): 1 = 110-130, 2 = 131-170 or 100-109, 4 = > 171 or 90-99, 8 = < 89; *P*<0.001 (significant).

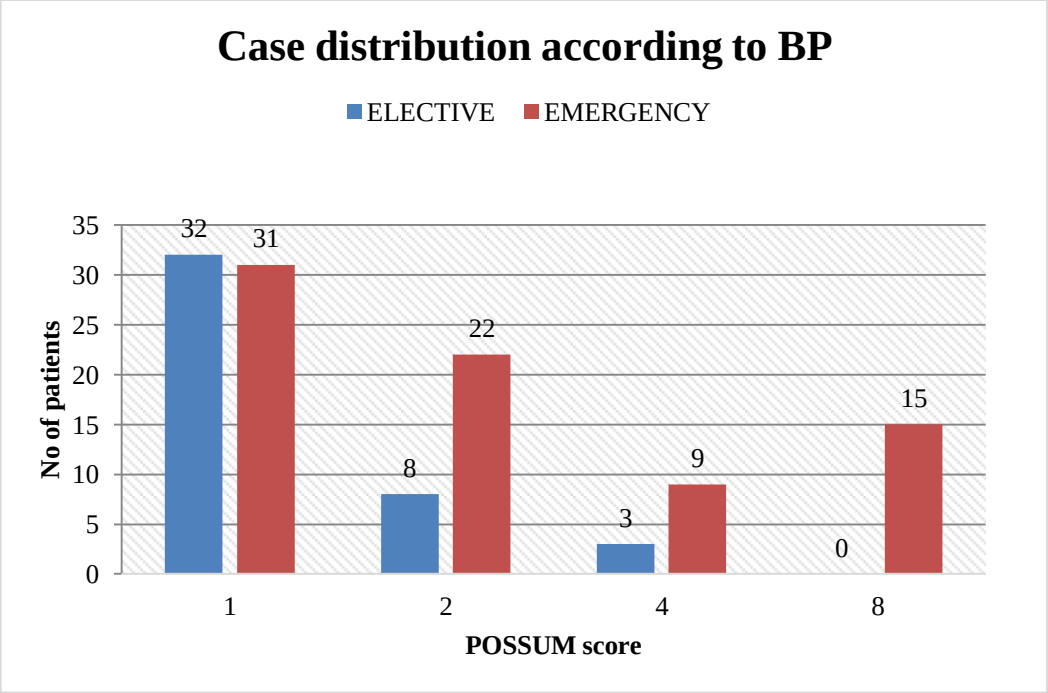

Figure 13 : Graph showing distribution of cases according to BP among two groups

The vast majority of patients (63cases: 32 elective and 31 emergency) in both groups had blood pressure in the normal range. In the elective group, score 2 was assigned to 8 patients, score 4 to 3 patients. Among emergency group 22 patients had score of 2, 9 patients had score of 4 and 15 patients a score of 8 as shown in Figure 13.

5. Pulse rate

A total of 65 surgeries were done on patients with higher POSSUM scores for pulse rate which accounted for 14 deaths. It was found to be statistically significant (Table 11).

Table 11 : Distribution of Cases According to PR among Two Groups

PR	**Mode of surgery**		**Total**	***P* value**
	Elective	**Emergency**		
1	30	25	55	<0.001
2	9	24	33	
4	3	12	15	
8	1	16	17	
Total	43	77	120	

PR – Pulse rate (beats / min) : 1 = 50-80, 2 = 81-100 or 40-49, 4 = 101-120, 8 = > 121 or < 39.
**P*<0.001= significant

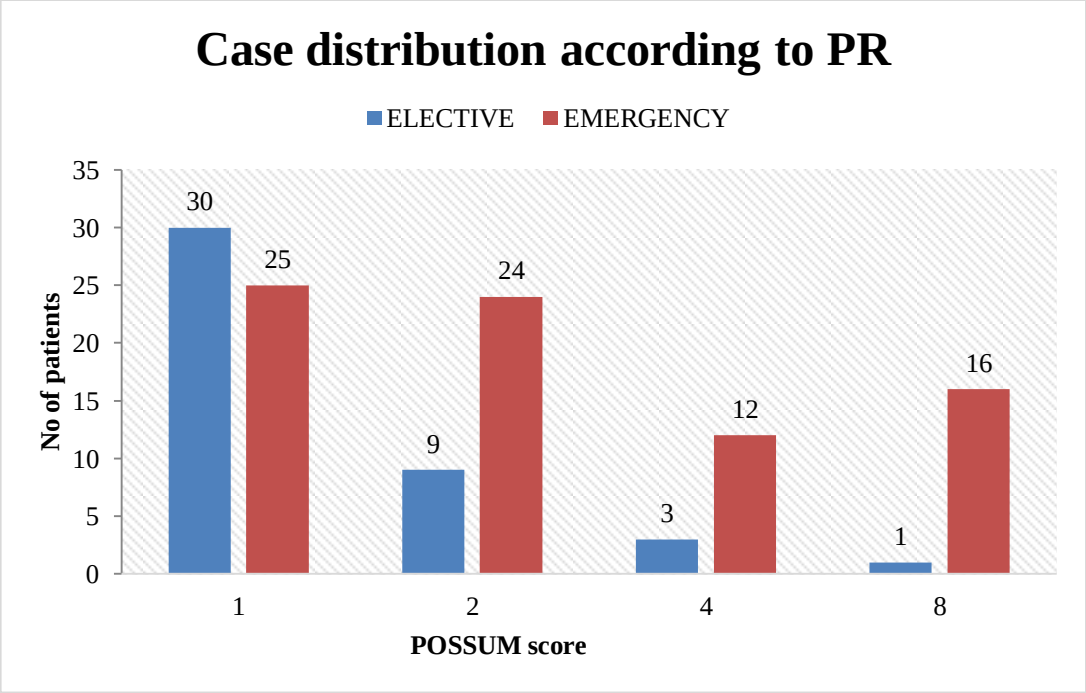

Figure 14 : Graph showing distribution of cases according to PR among two groups

In the elective group among the 4 scores of pulse rate, 30 patients were assigned score 1, 9 patients score 2, 3 patients score of 4 and 1 assigned a score of 8.

In the emergency group, 25 patients were assigned score 1, 24 patients score of 2, 12 patients score 4 and 16 patients assigned a score of 8 as shown in Figure 14

6. Glasgow coma scale

From the total of 120 cases, 11 cases with higher POSSUM scores for GCS were included in our study population which accounted for 5 deaths. It was found to be statistically significant with *P* = 0.034. (Table 12)

Table 12 : Distribution of cases according to GCS among two groups

GCS	Mode of surgery		Total	*P* value
	Elective	Emergency		
1	43	66	109	0.034
2	0	9	9	
4	0	2	2	
Total	43	77	120	

GCS – Glasgow Coma scale: 1 = 15, 2 = 12-14, 4 = 9-11, 8 = < 8.
**P*<0.05= significant

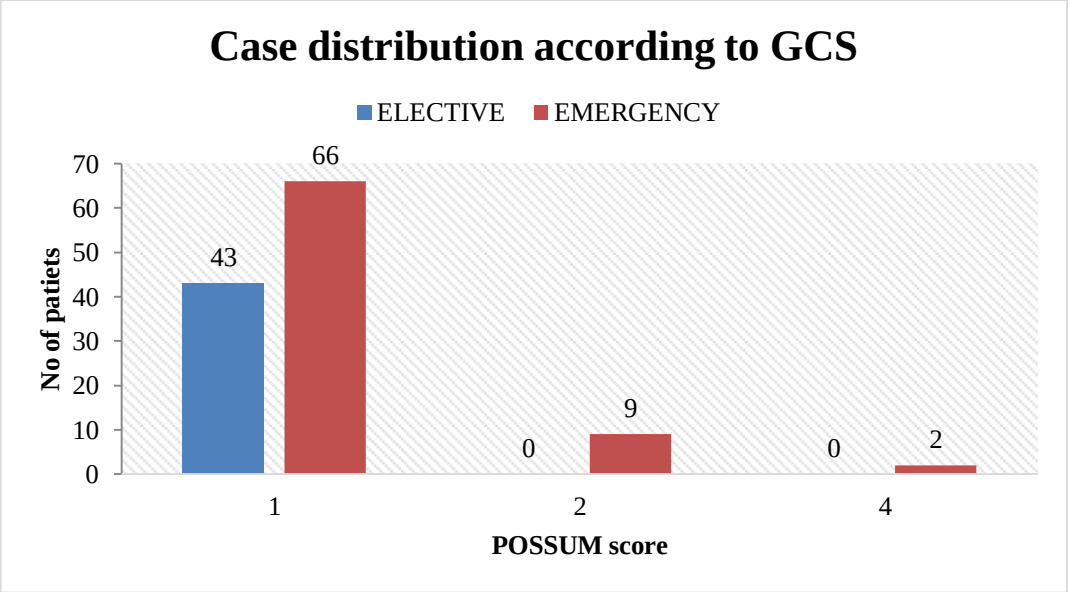

Figure 15 : graph showing distribution of cases according to GCS among two groups

Of the study population comprising 120 cases, 109 patients had Glasgow Coma Scale scores of 15. 9 patients had GCS scores between 12 to 14 and 2 patients had GCS scores between 9 to 11 as shown in Figure 15.

7. Hemoglobin

In all 120 patients were subjected to either elective or emergency laparotomy for various causes of which 25 patients had POSSUM score of 8 which accounted for 6 deaths. It was not found to be statistically significant. (Table 13)

Table 13 : Distribution of cases according to Hb% among two groups

Hb%	**Mode of surgery**		**Total**	***P* value**
	Elective	**Emergency**		
1	15	26	41	0.810
2	12	20	32	
4	9	13	22	
8	7	18	25	
Total	43	77	120	

Hb %– Hemoglobin in gm/dL : 1 = 13-16, 2 = 11.5-12.9 or 16.1-17, 4 = 10-11.4 or 17.1-18, 8 = < 9.9 or > 18.1. *P* = 0.810; not significant

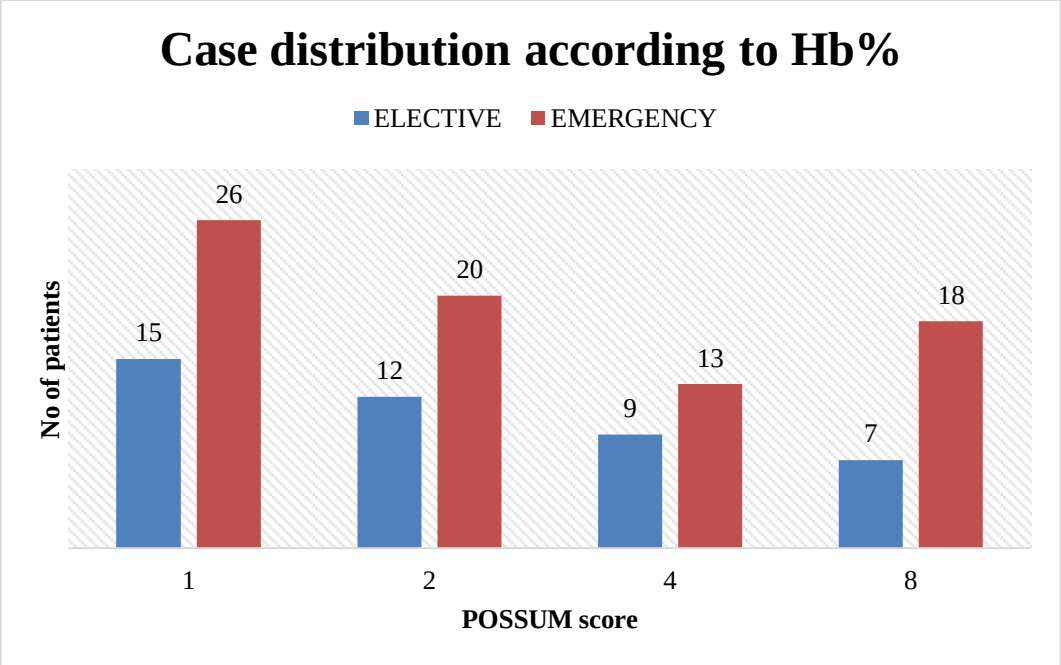

Figure 16 : Graph showing distribution of cases according to Hb% among two groups

Distribution of hemoglobin among 4 scores of POSSUM in patients undergoing elective and emergency surgery were: elective group: score 1- 15 patients, score 2-12 patients, score 4 - 9 patients and score 8 – 7 patients; Emergency group: score 1-26 patients, score 2- 20 patients, score 4- 13 patients and score 8- 18 patients as shown in Figure 16.

8. White cell count

Of the 120 patients who underwent laparotomy 74 patients had leucocytosis (or leucopenia) which accounted for 17 deaths. It was found to be statistically insignificant. (Table 14)

Table 14 : Distribution of cases according to WBC among two groups

WBC	Mode of surgery		Total	*P* value
	Elective	Emergency		
1	20	26	46	0.348
2	14	34	48	
4	9	17	26	
Total	43	77	120	

WBC – White blood count (x 1012/L) : 1 = 4-10, 2 = 10.1-20 or 3.1-3.9, 4 = > 20.1 or < 3.
P = 0.348; not significant

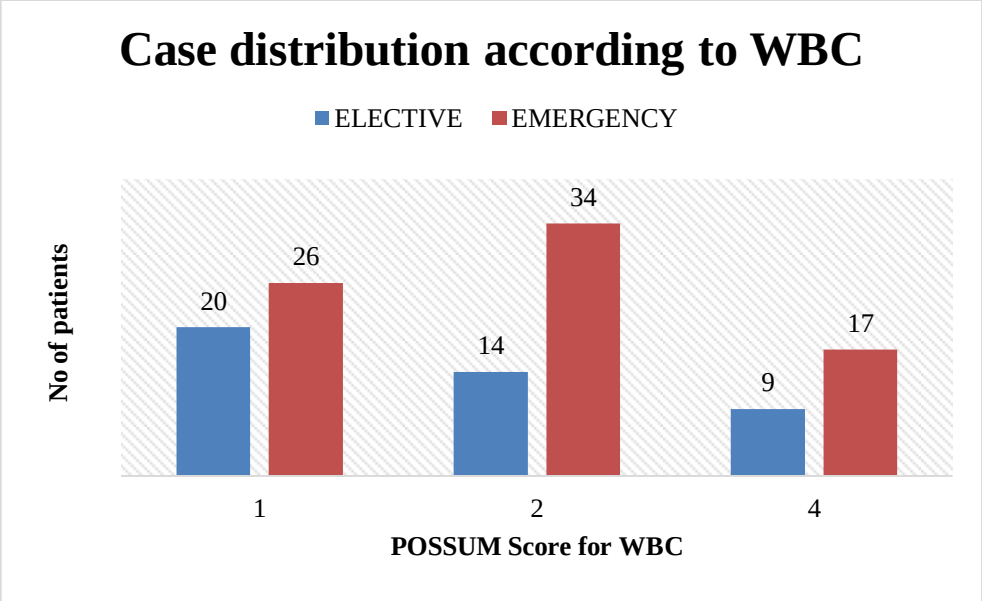

Figure 17 : Graph showing distribution of cases according to WBC among two groups

White blood cell count distribution was primarily among the scores 1 and 2 both in elective and emergency surgeries. In elective surgery, score 1 was assigned to 20 patients, score 2 was assigned to 14 patients and score 4 was assigned to 9 patients. Among emergency group, score 1 was seen in 26 patients, score 2 in 34 patients and score 4 assigned to 17 patients as shown in Figure 17 .

9. Blood urea

A total of 68 procedures were performed on patients with elevated blood urea levels and these cases accounted for 18 deaths. It was found to be statistically significant with *P*<0.001 (Table 15)

Table 15: Distribution of cases according to BU among two groups

BU	Mode of surgery		Total	*P* value
	Elective	Emergency		
1	28	24	52	<0.001
2	12	20	32	
4	2	14	16	
8	1	19	20	
Total	43	77	120	

BU – blood urea nitrogen (mg/dl) : 1 = < 7.5, 2 = 7.6 -10, 4 = 10.1-15, 8 = > 15.1.
P<0.00; Significant

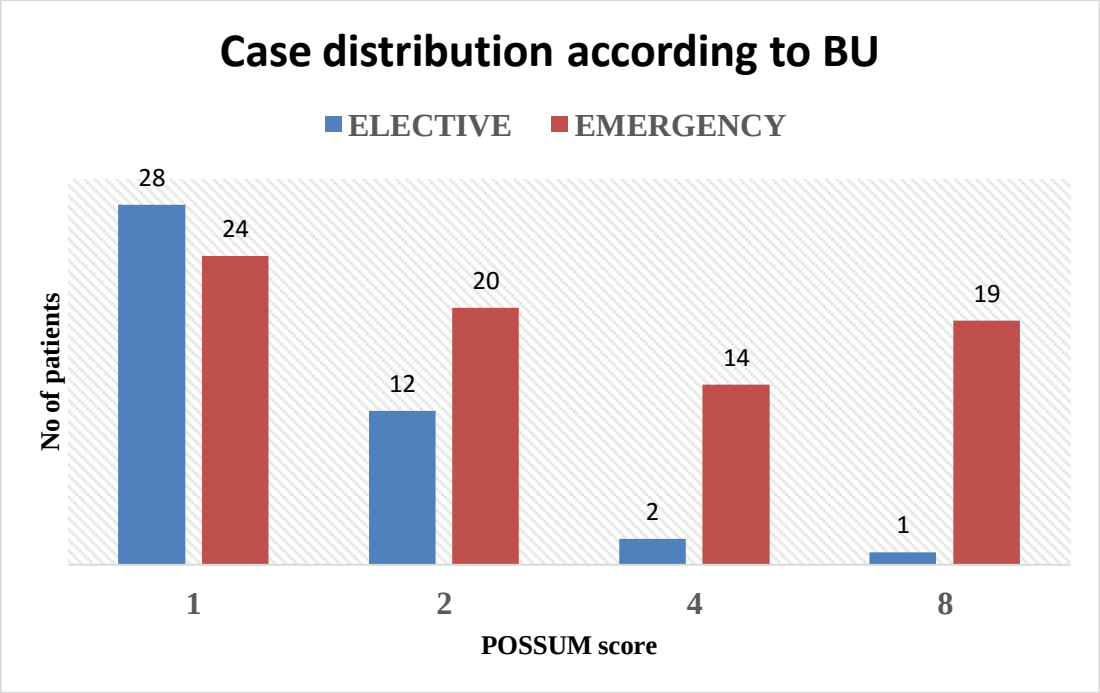

Figure 18 : Graph showing distribution of cases according to BU among two groups

Scores of 1, 2, 4 and 8 were assigned according to the pre operative blood urea levels. In the emergency group, 24 patients had score 1, 20 patients had score of 2, 14 patients had score of 4, and 19 patients were assigned a score of 8. Among patients who underwent elective surgery, score 1 was assigned to 28 patients, score 2- 12 patients, score 4 - 2 patients and score 8 was assigned to 1 patient as shown in Figure 18.

10. Serum sodium

Of all the patients subjected to laparotomy, serum sodium abnormalities accounted for 64 cases with mortality occurring in 10 cases. It was found to be statistically significant with *P* <0.001. (Table 16)

Table 16 : Distribution of cases according to S. Na^+ among two groups

S.Na^+	**Mode of surgery**		**Total**	***P* value**
	Elective	**Emergency**		
1	31	25	56	<0.001
2	11	36	47	
4	1	10	11	
8	0	6	6	
Total	43	77	120	

S.Na^+ - Sodium (mEq/L) : 1 = > 136, 2 = 131-135, 4 = 126-130, 8 = < 125
P<0.001 = Significant

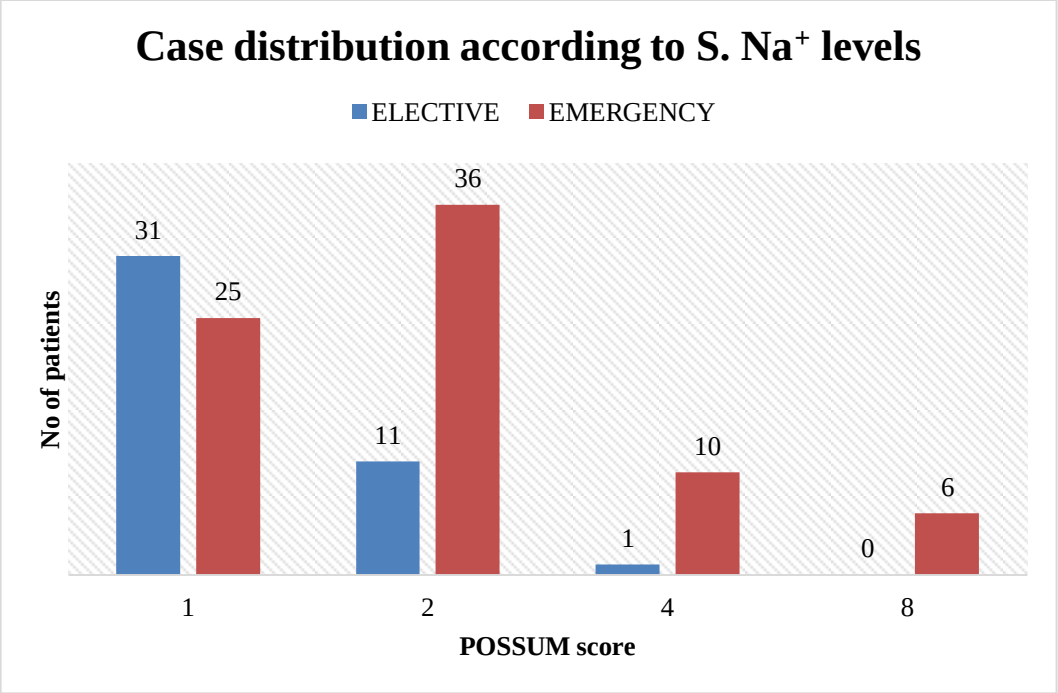

Figure 19 : Graph showing distribution of cases according to S.Na^+ among two groups

Serum sodium value was nearly uniformly distributed among the four scores in emergency group with 25 patients having score 1, 36 patients with score 2, 10 patients with score 4, and 6 patients with score 8. Among elective group, score 1 was assigned to 31 patients, score 2 to 11 patients, score 4 to 1 patient, no patients were assigned score 8 as seen in Figure 19.

11. Serum potassium

The study population comprised of 35 surgeries performed on patients with some degree of imbalance in serum potassium concentration which accounted for 10 deaths. On analysis it was found to be statistically insignificant. (Table 17)

Table 17 : Distribution of cases according to S. K^+ among two groups

S.K^+	**Mode of surgery**		**Total**	***P* value**
	Elective	**Emergency**		
1	34	51	85	0.068
2	4	20	24	
4	5	4	9	
8	0	2	2	
Total	43	77	120	

S.K^+ - Potassium (mEq/L): 1 = 3.5-5, 2 = 3.2-3.4 or 5.1-5.3, 4 = 2.9-3.1 or 5.4-5.9, 8 = < 2.8 or > 6
P = 0.068; Not significant.

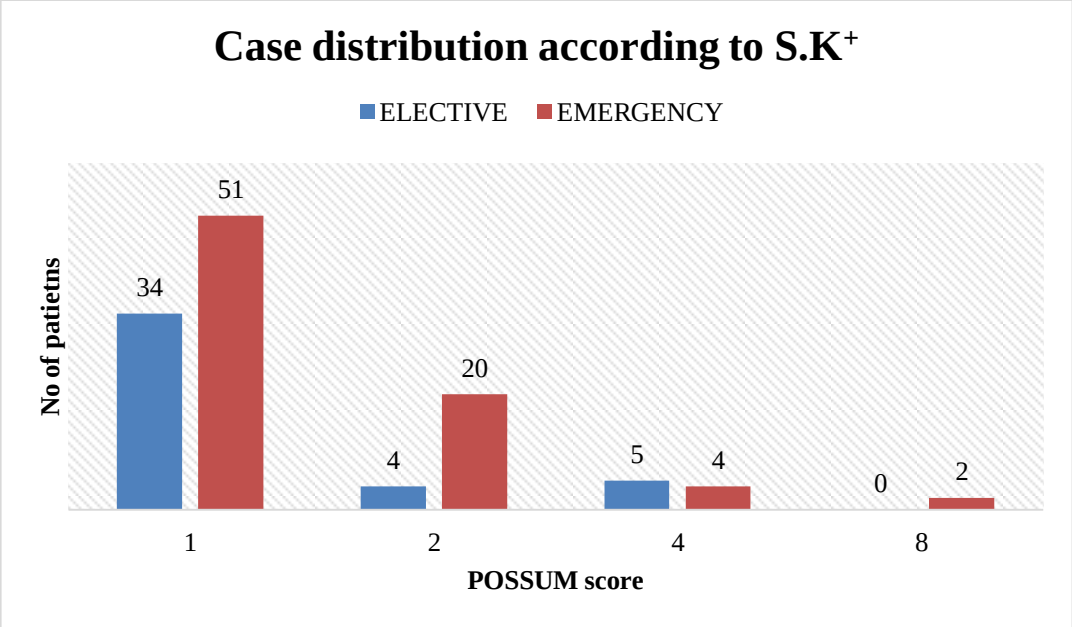

Figure 20 : Graph showing distribution of cases according to $S.K^{+}$ among two groups

Out of 43 elective cases, 34 patients had normal potassium scoring and 4 patients had score of 2 and 5 patients had score of 4. Of the 77 patients who underwent emergency laparotomy, 51 patients had normal potassium values and were assigned a score of 1, 20 patients had score of 2, 4 patients had score of 4 and 2 patients had a score of 8 as depicted in Figure 20.

12. Electrocardiogram findings:

Among the 120 cases included in our study, ECG abnormalities were noted in 12 patients, who accounted for an overall 8 deaths, however, no statistical significance was established with regard to ECG abnormalities in our study (Table 18).

Table 18 : Distribution of cases according to ECG among two groups

ECG	**Mode of surgery**		**Total**	***P* value**
	Elective	**Emergency**		
1	41	67	108	0.271
4	1	8	9	
8	1	2	3	
Total	43	77	120	

ECG – Electrocardiogram: 1 = Normal, 4 = atrial fibrillation (60-90), 8 = any other change
P = 0.271; not significant.

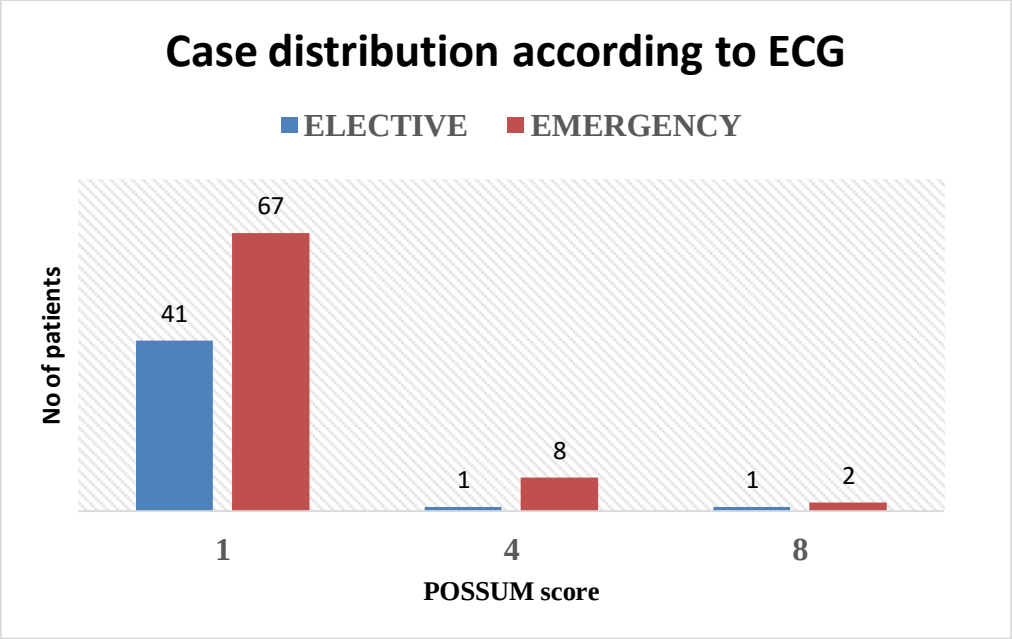

Figure 21: Graph showing distribution of cases according to ECG among two groups

From a total of 120 patients, 2 patients in the elective population and 10 patients in the emergency population had ECG abnormalities of whom 9 patients had a POSSUM score of 4 and the remaining a score of 8 as shown in Figure 21.

OPERATIVE SCORING PARAMETERS

1. Operative severity

Of 120 patients who underwent abdominal surgeries, mortality was higher among patients undergoing major surgeries. 88 patients had higher operative severity scores as described by the POSSUM criteria which accounted for a total of 17 deaths, it was found to be both clinically and statistically significant with $P = <0.001$.(Table 19)

Table 19 : Distribution of cases according to OS among two groups

OS	**Mode of surgery**		**Total**	***P* value**
	Elective	**Emergency**		
2	29	3	32	<0.001
4	11	72	83	
8	3	2	5	
Total	43	77	120	

OS – Operative severity: 1 = minor, 2 = intermediate, 4 = major, 8 = major +
P<0.001= significant

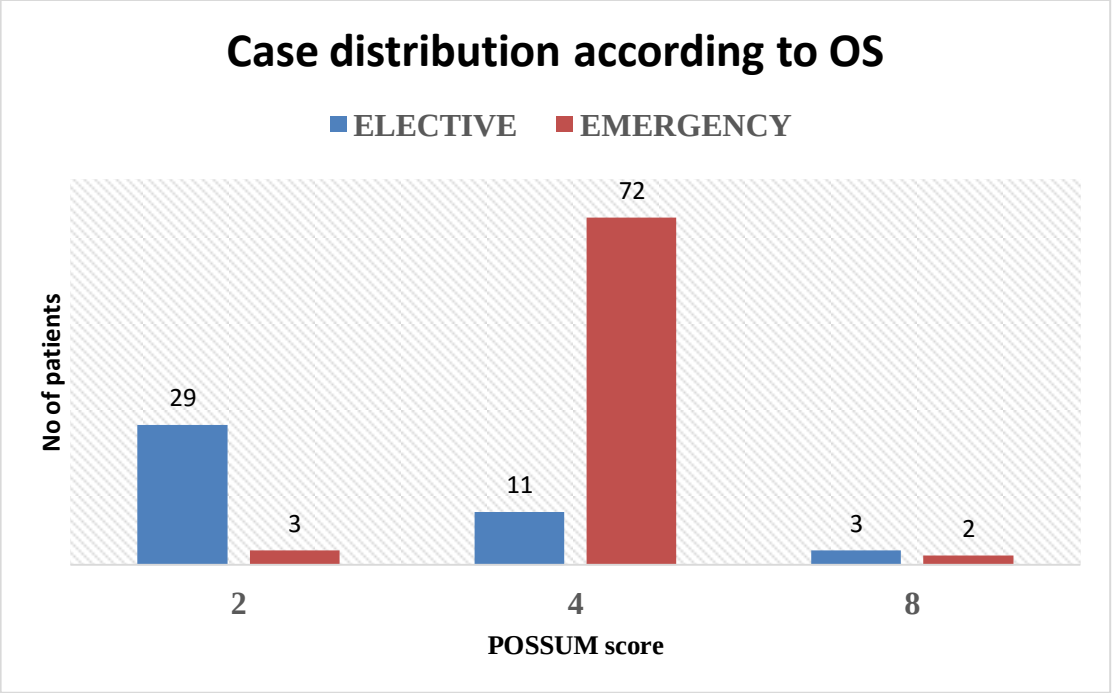

Figure 22: Graph showing distribution of cases according to OS among two groups

Among 43 elective abdominal surgeries performed, 29 were of intermediate category, 11 major and 3 major + category. In the emergency abdominal surgeries group, major surgery category constituted 72 patients, intermediate risk category comprised 3 cases and major + category comprised 2 cases as shown in Figure 22.

2. Multiple Procedures

Out of the sample size of 120, 12 patients underwent multiple procedures which accounted for 3 deaths. However there was no statistical significance. (Table 20)

Table 20 : Distribution of cases according to MP among two groups

MP	Mode of surgery		Total	P value
	Elective	Emergency		
1	38	70	108	0.6
4	5	6	11	
8	0	1	1	
Total	43	77	120	

MP – Multiple procedures: 1 = 1, 4 = 2, 8 = > 2

P = 0.06; not significant

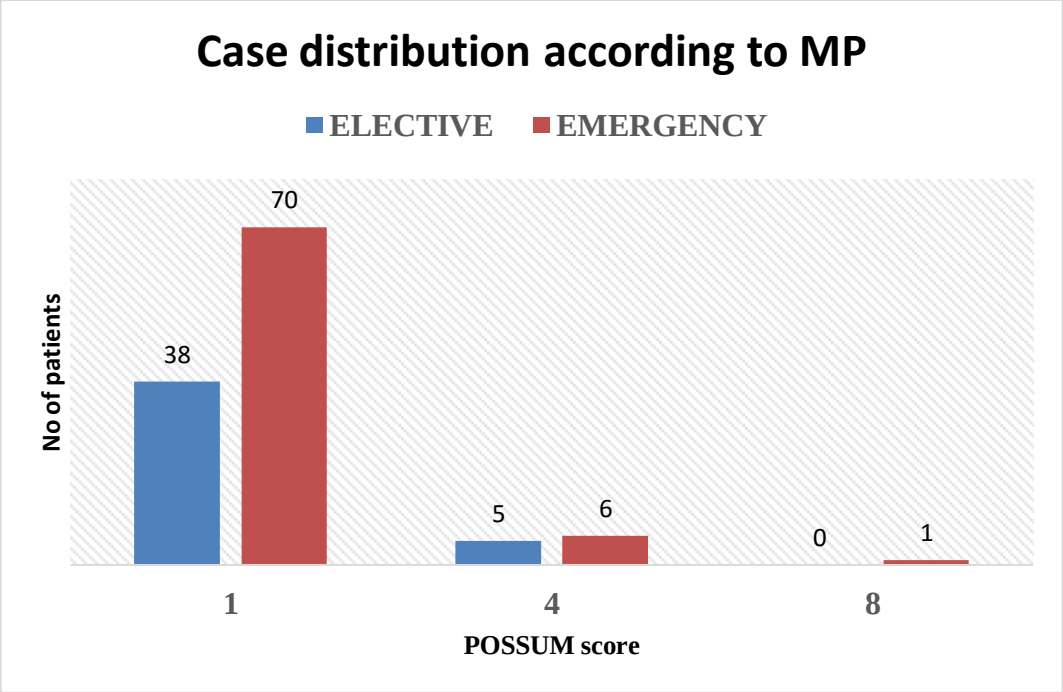

Figure 23: Graph showing distribution of cases according to MP among two groups

A total of 120 patients were included in the study population, of which 108 underwent single procedure only and were assigned a score of 1 according the POSSUM scoring parameters. 11 patients were assigned a score of 4 and one patient was assigned a score of 8. 5 patients in the elective group were assigned a score of 4 and 6 patients in the emergency group were assigned score of 4. One patient in the emergency group had a score of 8 as shown in Figure 23.

3. Blood loss

Of 120 patients included in our study population, 18 patients had blood loss of more than 500 ml which accounted for 8 deaths. The vast majority of cases resulted in blood loss of less than 500ml .It was noted that higher POSSUM score for blood loss was found to be statistically and clinically significant with *P* <0.001.(Table 21)

Table 21 : Distribution of cases according BL among two groups

BL	**Mode of surgery**		**Total**	***P* value**
	Elective	**Emergency**		
1	34	21	55	<0.001
2	8	39	47	
4	1	13	14	
8	0	4	4	
Total	43	77	120	

BL – Blood loss (ml) : 1 = < 100, 2 = 101-500, 4 = 501-999, 8 = >1000
*p<0.05= significant

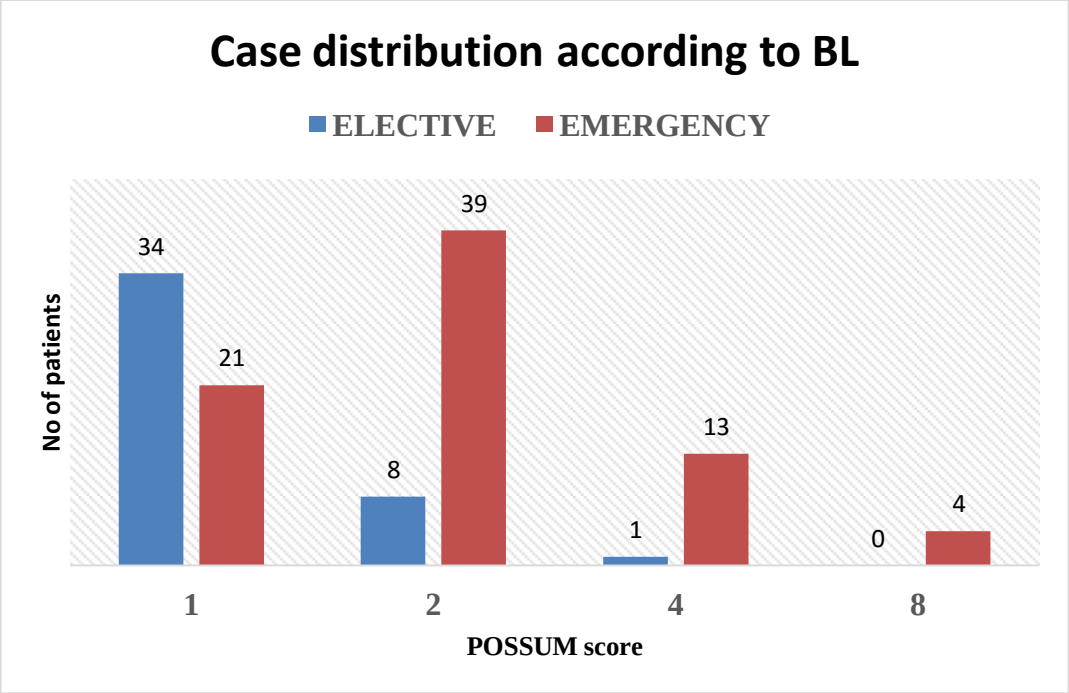

Figure 24: Graph showing distribution of cases according to BL among two groups

In patients undergoing emergency surgeries, majority of patients had blood loss between100-500ml (constituting 39 patients), 21 patients had blood loss of less than 100 ml, 13 patients had blood loss between 500-999 ml and 4 patients had blood loss of more than 1000 ml. In patients who underwent elective surgeries, 34 patients had blood loss less than 100 ml, 8 patients had blood loss between 100 to 500 ml and 1 patient had blood loss of more than 1000 ml as illustrated in Figure 24.

4. Malignancy

A total of 11 cases with malignancies were part of the study group, 5 cases were taken up for emergency surgery and 6 electively. 4 cases of mortality were encountered during the follow up period. On analysis there was no increase in mortality in patients with malignancy in the immediate postoperative period statistical insignificance was noted with respect to malignancy risk as part of POSSUM scoring parameter (Table 22).

Table 22 : Distribution of cases according to MA among two groups

MA	Mode of surgery		Total	*P* value
	Elective	Emergency		
1	37	72	109	0.133
2	0	0	0	
4	2	0	2	
8	4	5	9	
Total	43	77	120	

MA – Malignancy : 1 = No, 2 = primary cancer only, 4 = node metastases, 8 = Distant metastases
P = 0.133; not significant

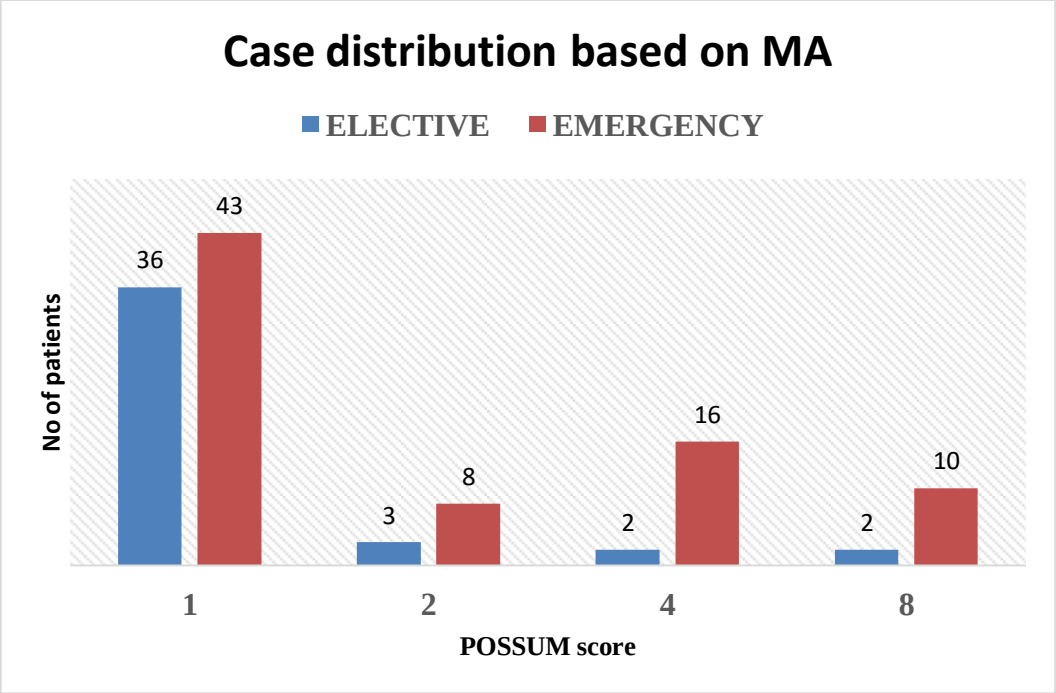

Figure 25 : Graph showing distribution of cases according to MA among two groups

There were 5 cases of malignancy in emergency group, where as in elective group 6 patients were part of the study population, 2 patients had nodal metastasis while 9 patients presented with distant metastasis as shown in Figure 25.

5. Peritoneal soiling

Peritoneal contamination of varying extent was found in 74 of the 120 cases. A higher rate of deaths per increase in scores was noted, suggesting association of degree of peritoneal contamination with adverse outcome. It was also found to be statistically significant with *P*<0.001. (Table 23)

Table 23 : Distribution of cases according to PS among two groups

PS	Mode of surgery		Total	*P* value
	Elective	Emergency		
1	38	8	46	<0.001
2	4	18	22	
4	1	33	34	
8	0	18	18	
Total	43	77	120	

PS – Peritoneal soiling: 1 = No, 2 = Serious, 4 = Local pus, 8 = Free bowel content, pus or blood
P<0.001; Significant

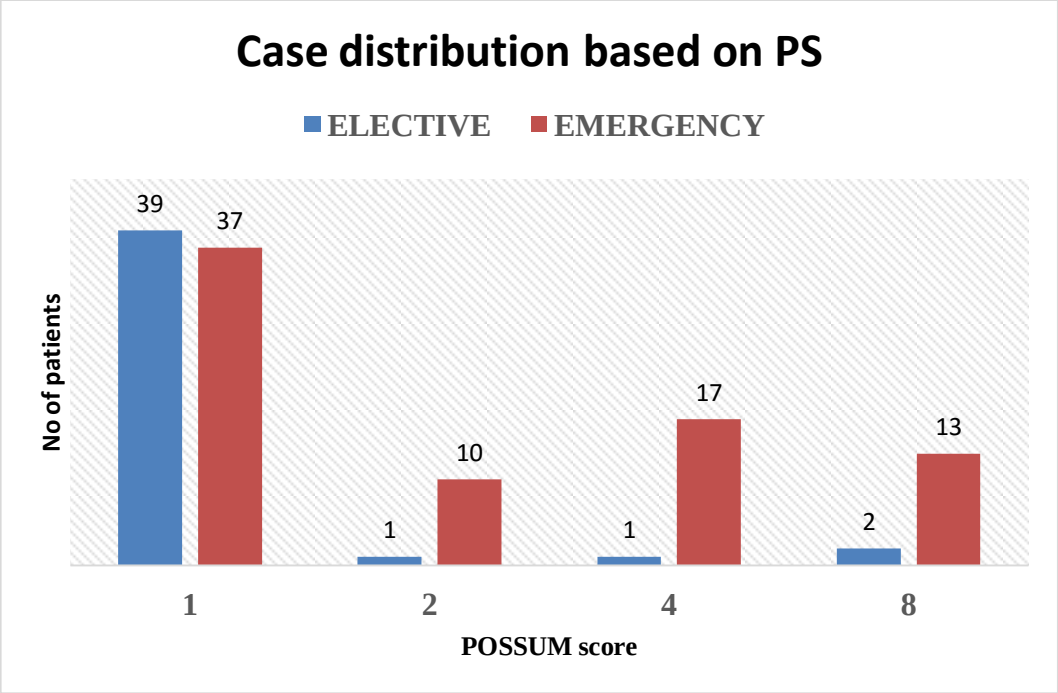

Figure 26 : Graph showing distribution of cases according to PS among two groups

In patients undergoing emergency laparotomy, score 1 was assigned to 8 patients, score 2- 18 patients, score of 4 and 8 to 33 and 18 patients respectively. In patients undergoing elective surgery, score of 1was assigned to 38 patients, score 2 to 4 patients and 1 patient had a score of 4 as represented in Figure 26.

6. Mode of surgery

There were 3 deaths among 43 (6.9%) elective cases and 15 deaths from 77 emergency surgeries (19.4%) in the study population.(Table 24) A positive rate of increment of deaths per score was noted.

Table 24 : Distribution of cases according to Mode of surgery

Mode of surgery	Frequency	Percent
1	43	35.8
4	52	43.3
8	25	20.8
Total	120	100.0
1=elective;4= Emergency resuscitation of >2h possible<24 hr after admission;8= Emergency surgery <2h needed		

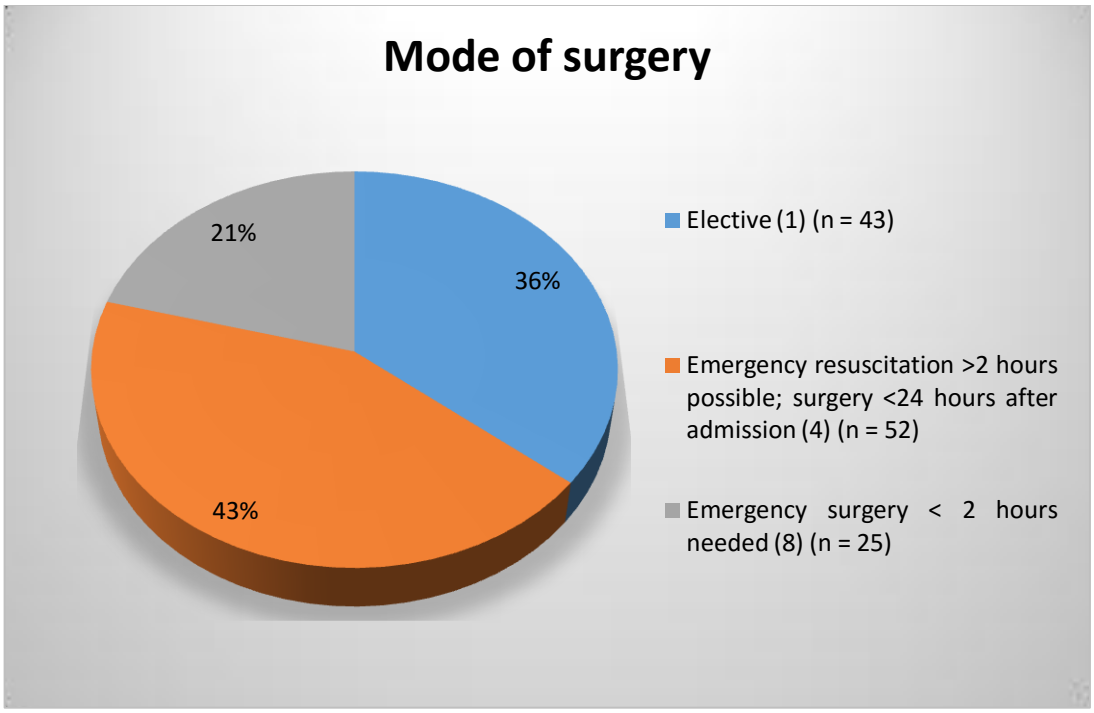

Figure 27 : Pie chart showing distribution of cases according to mode of surgery.

Of the sample size consisting 120 cases, 43 cases were taken up on an elective basis for surgery, 52 patients required surgery on the same day of presentation, while 25 cases required surgery within 2 hours of presentation.

A total of 18 deaths were encountered in the immediate as well as during the 30 day follow up period of the study duration. The crude mortality rate was found to be 15%.

STATISTICAL ANALYSIS

LINEAR ANALYSIS

Predicted risk of death and morbidity was calculated from P-POSSUM scoring equation. Patients were subdivided into groups based on their predicted risk of death and morbidity of less than 10,11-20,21-30,31-40,41-50,51-60,61-70,71-80,81-90,91-100. The number of patients in each group was multiplied by the average risk of death and morbidity to give predicted number of deaths and morbidity in that group.

EXPONENTIAL ANALYSIS

In the exponential method, cut off risk of death was considered in each stage of the calculation. All patients whose predicted risk falls above the cut off were grouped together. If the cut off level being analyzed is 70 percent risk of death, the number of predicted deaths in this group is the result of the number of patients with 70 percent or greater predicted risk of death, multiplied by 0.7 and so on for other percentages of risk.

For lowest cut of 0 percent multiplication by zero is avoided by using the median predicted risk of the below 10 percent mortality band.

MORTALITY ANALYSIS

The results of exponential analysis applied to P-POSSUM are shown in Table 25. P-POSSUM estimated the death rate of 14, compared to observed rate of 18 with O: E of 1.28.

The difference between the observed and expected rates were analyzed by chi-square test which was x^2- 4.51, d.f -3, *P* - 0.21.

By linear analysis, predicted death rate was 21.34, with O: E of 0.84, with chi-square value x^2- 3.15, d.f -5, *P* - 0.677 as shown in Table 26

Table 25: Comparison of observed and predicted mortality rate by P-POSSUM using exponential analysis

Mortality group (%)	Number of patients	Observed deaths	Expected deaths	O:E
0-10	80	5	1.2	4.16
11-20	11	0	1	0
21-60	14	2	2.8	0.71
61-100	15	11	9	1.22
0-100	80+11+14+15=120	5+0+2+11=18	1.2+1+2.8+9=14	1.28
Chi square value x^2- 4.51, d.f -3, p-0.21[*P* value <0.05=significant]				

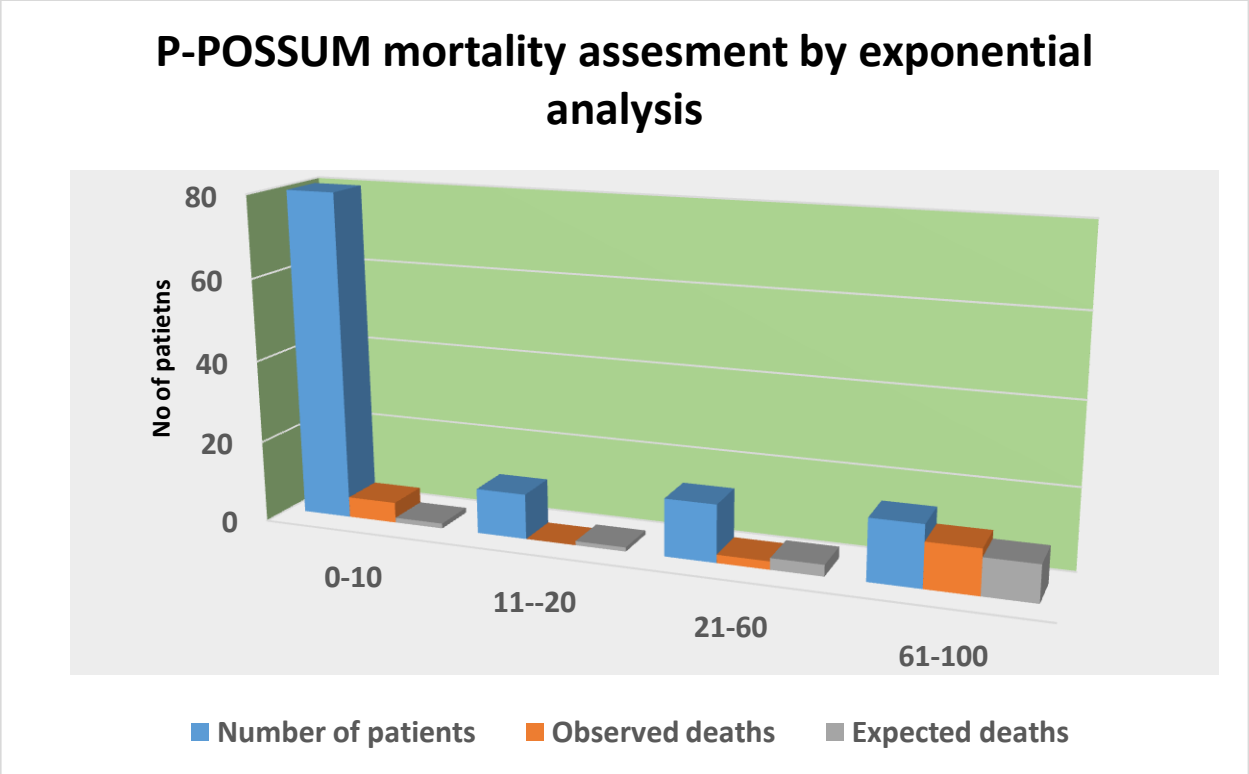

Figure 28: Graphical representation of exponential analysis for P-POSSUM (mortality group)

The mortality group is categorized into four bands i.e.: 0-10%, comprising a total of 80 patients with 5 observed deaths and expected death of 1.2 patients.11-20%, comprises a total of 11 patients with no observed death and expected death of 1 patient. 21-60% comprises a total of 14 patients with two observed deaths and expected death of 2.8 patients and 61-100% comprises of totally 15 patients with 11 observed deaths and 9 expected deaths as shown in Figure 28.

Table 26 : Comparison of observed and predicted mortality rate by P-POSSUM using linear analysis

Mortality group (%)	Number of patients	Observed deaths	Expected deaths	O:E
<10	80	5	2.24	2.2
11-20	11	0	1.5	0
21-30	5	0	1.3	0
31-40	5	2	1.8	1.1
41-50	3	0	1.3	0
51-60	1	0	0.5	0
61-70	3	2	2	1
71-80	3	1	2.3	0.43
81-90	3	3	2.6	1.15
91-100	6	5	5.8	0.86
0-100	120	18	21.34	0.84
Chi square x^2- 3.15, d.f -5, p-0.677 [*P*<0.05 = significant]				

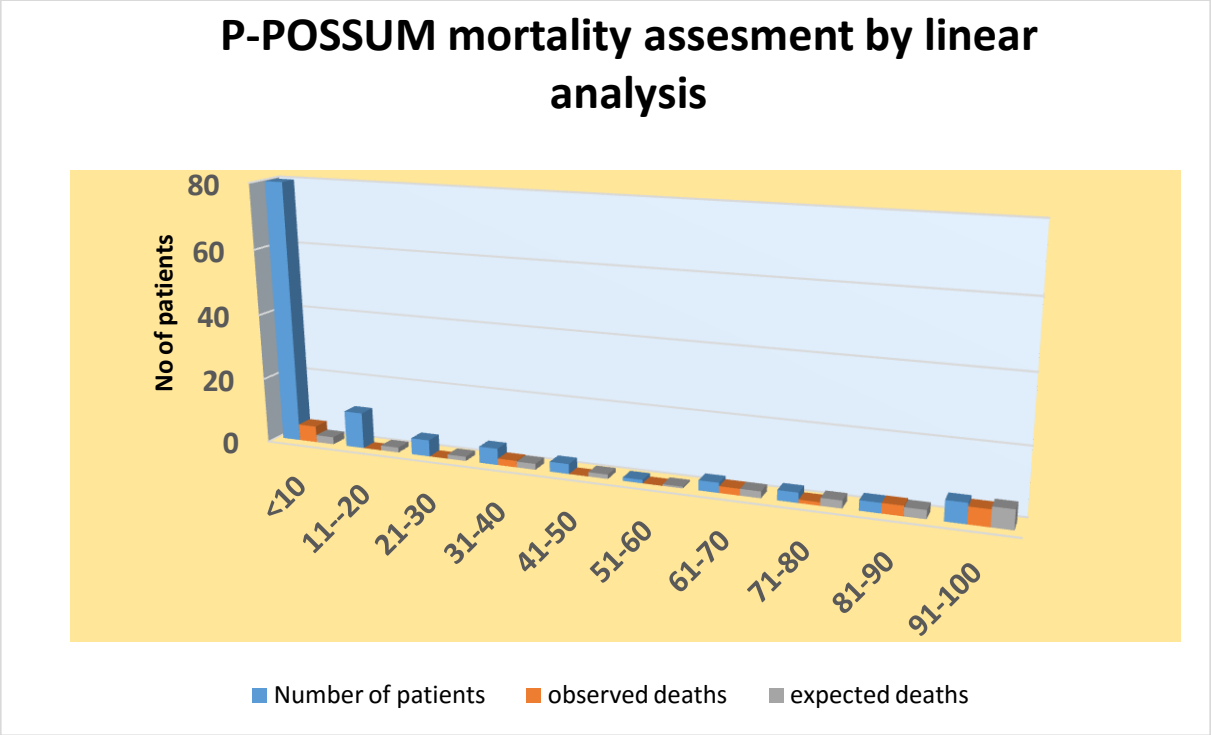

Figure 29 : Graph showing mortality assessment by linear analysis

By the method of mortality assessment using linear analysis, the risk groups were divided into 10 bands, comprising of 120 patients. Observed number of deaths was 18 and expected number by linear analysis was 21 as represented in Figure 29.

MORBIDITY ANALYSIS

POSSUM equation for morbidity using linear method of analysis estimated predicted morbidity rate of 59 while the observed rate was 41, an O: E ratio of 0.69 was noted. (Table 27)

Table 27 : Comparison of observed and predicted morbidity rate by using linear analysis

Morbidity group (%)	**Number of patients**	**Observed morbidity**	**Expected morbidity**	**O:E**
<10	11	1	1	1
11-20	13	1	1	1
21-30	11	1	2	0.5
31-40	10	2	3	0.66
41-50	10	4	4	1
51-60	7	2	3	0.66
61-70	11	4	5	0.8
71-80	8	3	6	0.5
81-90	11	3	8	0.37
91-100	28	20	26	0.76
0-100	120	41	59	0.69
Chi square x^2- 1.72, d.f -8, *P* - 0.989 [*P* <0.05=significant]				

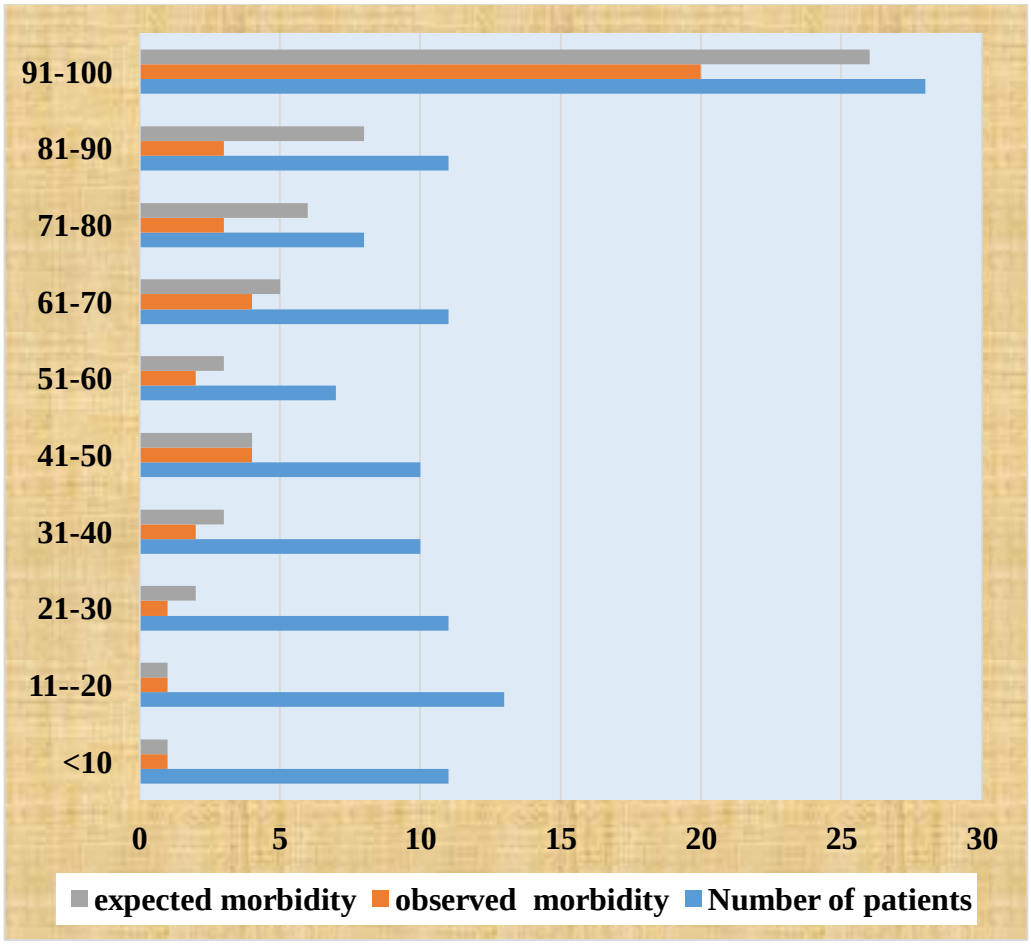

Figure 30 : Graph showing morbidity analysis by POSSUM using linear method

In our study group which comprised 120 patients undergoing elective and emergency laparotomy, 41 patients developed complications, with predicted value of 59. Maximum numbers of complications were noted in patients in the risk group of 91- 100% as shown in Figure 30

Table 28: Complications encountered during follow up period

Sl. No	Complications	No of Patients
1	Haemorrhage	0
2	Chest infection	19
3	Wound infection	23
4	UTI	7
5	Deep infection	0
6	Septicaemia	5
7	PUO	0
8	Others	0
9	Superficial wound dehiscence	5
10	Deep wound dehiscence	9
11	Anastomotic leak	4
12	DVT	5
13	Pulmonary embolism	1
14	CVA	0
15	MI	0
16	Cardiac failure	1
17	Impaired renal function	11
18	Hypotension	12
19	Respiratory failure	0
20	Other pulmonary comp.(pleural effusion)	0
21	Others	0

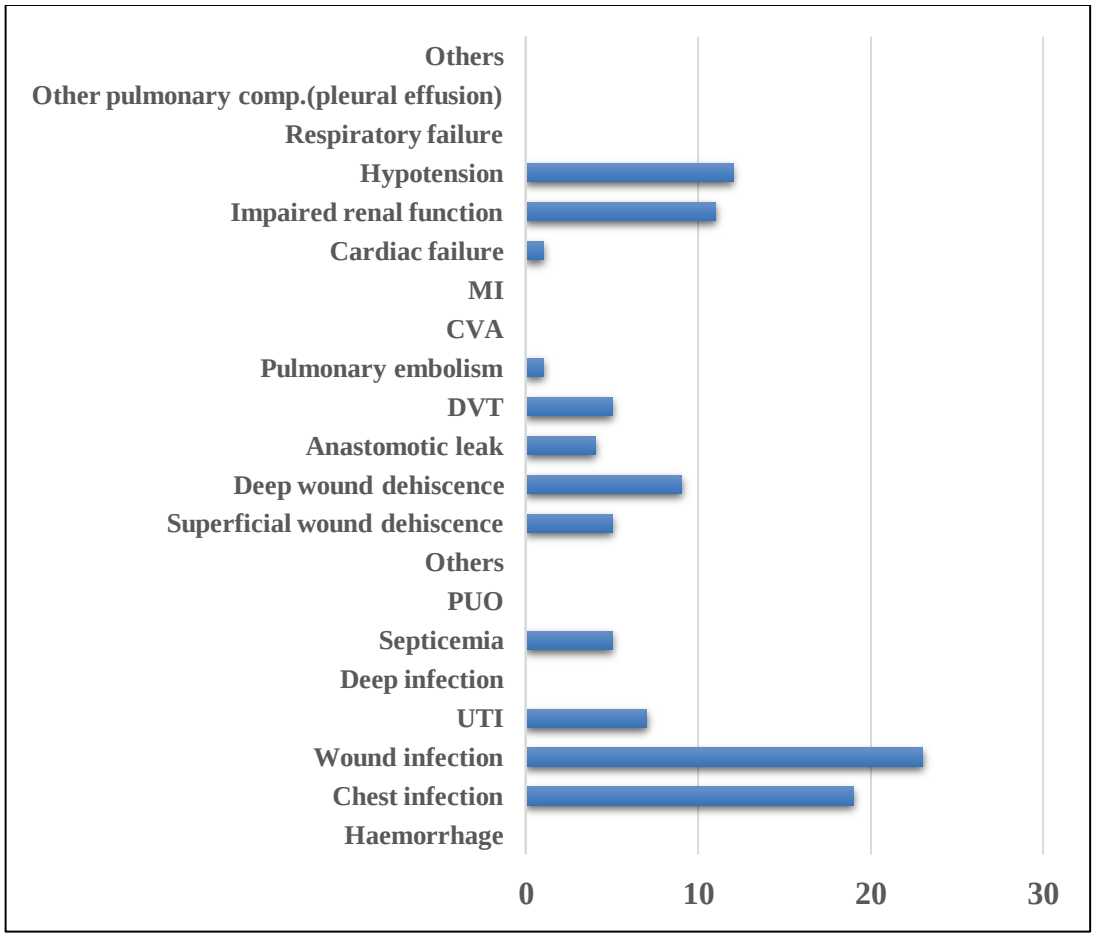

Figure 31 : Graph showing complications encountered during the follow up period

In the present study of 120 patients subjected to laparotomy for a multitude of causes, 41 patients developed complications (Table 28). Significant complications encountered were chest infections in 19 patients and wound infections in 23 patients, wound dehiscence was noted in 14 patients.UTI was diagnosed in 7 patients. Other complications were hypotension for prolonged periods in 11 patients and pulmonary embolism and cardiac failure in 1 patient each were noted as shown in Figure 31.

DISCUSSION

In the present era of advanced medical care and access to specialty services within arm's reach, surgical practice is under strong scrutiny. The performance of a surgeon is established through comparative audit rates of morbidity and mortality. It is essential for the surgeon to be able to have a preoperative assessment of the probability of success of any surgical procedure undertaken in his clinical practice. Also, to allay apprehension of the patient and his kith and kin, a pre operative evidence based risk prediction is of paramount importance and is the principal issue faced by clinicians world over, in their day to day surgical practice.

Adjudging the patient's risk of morbidity and mortality risk on the basis of pre operative evaluation becomes an easier task, if there is an evidence based system of assessment of such parameters. On one hand, it is possible to ascertain these risks using crude mortality rates, but the use of such raw statistics is most frequently inaccurate and misleading. Furthermore, each patient has variable presentations and each of the procedures that he/ she may be subjected to has variable rates of success in the hands of individual surgeons. Thus, the use of a simple, fast, evidence based, convenient and effortless method of risk assessment goes a long way in assessment, individualization and management of critically ill patients.

The POSSUM and P-POSSUM risk adjusted scoring systems satisfy all of these requirements and have been proposed as optimal scoring systems for risk prediction of mortality and morbidity.

However, these scoring systems had to be correlated to the conditions of patients in the regional population, more so in a developing country such as ours, especially in the rural setup, where poor general health conditions exist, malnutrition is a frequently encountered problem and most patients have delayed presentations to hospitals. In our study, we incorporated the P-POSSUM scoring system to assess its applicability in predicting anticipated mortality rates of patients undergoing abdominal surgeries, under regional population conditions and also to aid in identification of risk factors that are associated with poor outcome in this high risk population.

The study population comprised of a total of 120 patients who were subjected to laparotomy for diverse etiologies, depending on the severity of presentation either on an emergency basis or an elective basis. In all 18 mortalities were recorded during the study period (3 in the elective population, comprising a crude mortality rate of 6.97 percent and 15 in the emergency population comprising a mortality rate of 19.48 percent). Study done by Tekkis et al[14] obtained mortality rates comparable to our study (total deaths of 15 of which elective 3.9%; emergency 25% and overall mortality rate of 11.1%).

On application of the P-POSSUM equation of mortality, 14 deaths with an O: E ratio of 1.28 was predicted upon using the exponential method of analysis, while the linear method of analysis predicted 21 deaths with an O: E ratio of 0.84 which was comparable to analysis by other studies as shown in Table 29.

Study conducted by Tekkis et al[15] obtained results of O: E = 0.89 by using linear method of analysis, and 0.67 upon using the exponential method of analysis.

Study conducted by Mohil et al[19] obtained results of O: E = 0.66, chi square = 5.33, '9 d.f.", p =0.619 by using the linear method of analysis and O: E = 0.88, chi square = 1.88, 9 d.f., p =0.966 on utilization of exponential method of analysis.

Study conducted by Yii and Ng [18] obtained results of O: E = 1.28 on utilization of linear method of analysis.

Mortality analysis, using P-POSSUM scoring system, under predicted deaths in our study group upon using exponential analysis for calculation of such rates. Linear analysis method used for estimation of the mortality rates predicted a near observed value in line with the mortality noted in our study population. However, no statistical significance could be established with both methods of assessment, though linear analysis clearly established its clinical significance.

Table 29 : Comparison of mortality with similar studies

Study group	Observed deaths	Expected deaths (linear analysis)	O:E ratio	Chi square value	*P* value
Midwinter et al[19]	14	27	0.51	9.00	0.17
Tekkis et al[14]	11.1	11.3	0.98	0.715	0.715
Ramesh et al[36]	9	9	1	2.8	0.424
Mohil et al[19]	16	24	0.66	5.33	0.619
Yii and Ng[18]	6.1	4.8	1.28	-	-
Our study	18	21	0.84	3.15	0.677

The morbidity rates calculated using the linear method of analysis using the POSSUM equation over predicted the rates with an expected rate of 59, while in reality the observed rate noted was only 41 patients of the study population (Chi square x^2- 1.72, d.f -8, p- 0.989).Comparison with other similar studies is shown in Table 30 .

Table 30: Comparison of morbidity rates with other studies

Study group	Observed morbidity	Expected morbidity	O:E ratio	Chi square value	*P* value
Midwinter et a[19]	126	114	1.10	14.5	0.11
Vijay et al[20]	153	273	0.55	68.69	<0.000
Vollmer et al[35]	41	51	0.81	-	-
Our study	41	59	0.69	1.72	0.989

Analysis of risk factors showed statistical significance with reference to parameters studied including blood pressure (p value <0.001) , pulse rate (p value <0.001), GCS (p value - 0.034), serum sodium (p value <0.001), operative severity (p value <0.001), blood loss (p value <0.001), and peritoneal soiling (p value <0.001).

On the complications front, we encountered with higher frequency among others, complications such as wound infection, wound dehiscence and chest infections. Gross peritoneal contamination which was a result of perforation of hollow viscera leading to local contamination of the wound site could be recognized as the principal attributing factor for such complications in our study population.

Impaired immunity, leucocytosis or leucopenia corresponding to the degree of sepsis or infection, anemia, impaired hemostasis leading to blood loss, elevated blood urea levels as a result of some degree of renal impairment which in turn is a result of altered blood pressure in the immediate post operative period, all of which lead to delayed wound healing or hyponatremia in itself leading to altered physiological response may all be attributed as the causes of mortality or morbidity.

Timely and ample efforts on the part of the treating surgeon or the surgical team can lead to a decrease in the rates of mortality and also, in those patients where mortality is not an immediate risk; reduce the rate of complications, thereby causing a net reduction in the adverse outcome rate.

CONCLUSION

On using linear method of analysis of the P-POSSUM scoring system, no significant difference between the observed and expected deaths were noted which clearly suggests that the P-POSSUM scoring system when applied, using the correct method of analysis, can accurately predict the anticipated mortality rate in patients undergoing abdominal surgeries.

We found significant number of complications in our study, which are a cause for concern, mandating the need for even better quality of care. However, the POSSUM predicted score for morbidity over predicted the risk of morbidity in our study.

Among the subset of risk factors studied, a significant value was noted for blood pressure; pulse rate; GCS; Blood urea levels; Serum sodium; operative severity; total intra operative blood loss and peritoneal soiling in our study, suggesting optimization of these risk factors wherever possible could further enhance the surgeon's efforts to reduce mortality rate among high risk patients.

Our study therefore emphasizes and validates the accuracy and applicability of P-POSSUM scoring system in patients undergoing abdominal surgeries, in predicting anticipated mortality rates which are comparable to the observed rates and also takes note, the ability of the scoring system in identifying risk factors for adverse outcome.

SUMMARY

- In the prospective study conducted by us, 120 patients underwent laparotomy which included both elective and emergency surgeries. 18 deaths were noted during the period of the study extending from December 2014 to June 2016.

- Patients were scored using P-POSSUM scoring system, physiological scoring was done during admission to the hospital and operative scoring documented intraoperatively. Follow up period included the first 30 days post surgery for any complications and the outcome was noted. The observed mortality rate was then compared with the P-POSSUM predicted expected mortality rate.

- P-POSSUM score analyzed using the linear method of analysis predicted 21 deaths with an O: E ratio of 0.84.

- On analysis of results using the exponential method P-POSSUM predicted 14 deaths with an O: E ratio of 1.28 suggesting a gross under prediction using this method.

- The observed deaths were 18 with a crude mortality rate of 15 percent.

- Morbidity analysis was done using linear method with the POSSUM equation, it over predicted the rate of complications. The observed morbidity rate was 41 patients in all while the predicted rate was 59 with an O: E ratio of 0.69.

- The present study shows that when the correct method of analysis i.e. the linear analysis is used P-POSSUM scoring system, its validity in predicting accurately the optimal risk expected and the precise outcome of surgery either long term risk free survival or mortality is achievable.

- If the findings reported in our study are validated on a larger data set, it may be possible to use POSSUM scoring system to advance emergency services and provide better quality of care to patients.

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ANNEXURE I

PROFORMA

1. NAME: I.P. NO:

2. AGE: D.O.A:

3. SEX: D.O.O:

4. RELIGION:

5. OCCUPATION:

6. RESIDENCE:

7. HISTORY AND EXAMINATION

8. PHYSIOLOGICAL SCORING

Physiological parameter	1	2	4	8
Age				
Cardiac signs Chest radiograph				
Respiratory History Chest radiograph				
Blood pressure(mm hg)				
Pulse(beats/min)				
Glass coma scale				
Haemoglobin(g/dl)				
White cell count($x10^{12}$/l)				

Urea (mmol/l)				
Sodium(mmol/l)				
Potassium(mmol/l)				
Electrocardiogram				

9. PRE-OPERATIVE TREATMENT

10. OPERATIVE PROCEDURE:

11. OPERATIVE SEVERITY SCORE:

Operative parameter	1	2	4	8
Operative severity				
Multiple procedures				
Total blood loss				
Presence of malignancy				
Peritoneal soiling				
Mode of Surgery				

12. POST OPERATIVE TREATMENT

13. MORTALITY

Observed: Date of death

Predicted:

14.MORBIDITY

Observed Predicted

COMPLICATIONS RECORD SHEET

NAME:

I.P.NO.:

AGE / SEX:

DIAGNOSIS:

OPERATION:

OUTCOME:

Hemorrhage:

- Wound
- Deep

Infection:

- Chest
- Wound
- Urinary tract
- Deep
- Septicaemia
- Pyrexia
- Other

Wound dehiscence:

- Superficial
- Deep
- Anastomotic leak :

Thrombosis:

- Deep vein thrombosis
- Pulmonary embolism
- Other
- Cerebro vascular accident
- Myocardial infarction

Cardiac failure:

Impaired renal function: (Urea increase > 5 mmol/l, from preoperative level)

Hypotension: (< 90mmHg for 2 h)

Respiratory failure:

Any other complication:

In the event of death give date:

ANNEXURE II

CONSENT FORM FOR OPERATION / ANAESTHESIA

I _____ Hosp No. _____ in my full senses here by give my complete consent for _____ or any other procedure deemed fit which is a / and diagnostic procedure / biopsy / transfusion / operation to be performed on me / my son / my daughter / my ward _____ age _____ under any anaesthesia deemed fit. The nature and risks involved in the procedure have been explained to me to my satisfaction. For academic and scientific purpose the operation / procedure may be televised or photographed.

Signature / Thumb impression of
Patient / Guardian

Date:

Name:

Designation:

Guardian:

Relationship:

Full Address:

ANNEXURE 3

KEY TO MASTER CHART

SL.No. – Serial Number

IP.No. – Inpatient number

Sex: M – Male, F – Female

AGE (years): 1 = < 60, 2 = 61-70, 4 = > 71

CVS – Cardiovascular signs: 1 = Normal, 2 = Cardiac drugs or steroids, 4 = Edema; Warfarin, Borderline cardiomegaly, 8 = JVP, Cardiomegaly

RS – Respiratory signs: 1 = Normal, 2 = SOB exertion, Mild COAD, 4 = SOB stairs, Moderate COAD, 8 = SOB rest, any other changes.

BP – Systolic Blood pressure (mm/Hg): 1 = 110-130, 2 = 131-170 or 100-109, 4 = > 171 or 90-99, 8 = < 89.

PR – Pulse rate (beats / min) : 1 = 50-80, 2 = 81-100 or 40-49, 4 = 101-120, 8 = > 121 or < 39.

GCS – Glasgow Coma score: 1 = 15, 2 = 12-14, 4 = 9-11, 8 = < 8.

Hb %– Hemoglobin in gm/dL: 1 = 13-16, 2 = 11.5-12.9 or 16.1-17, 4 = 10-11.4 or 17.1-18, 8 = < 9.9 or > 18.1.

WBC – White blood count (x 10^{12}/L) : 1 = 4-10, 2 = 10.1-20 or 3.1-3.9,4 = > 20.1 or < 3.

BU – blood urea nitrogen (mg/dl): 1 = < 7.5, 2 = 7.6 -10, 4 = 10.1-15, 8 = > 15.1.

S.Na^+ - Sodium (mEq/L): 1 = > 136, 2 = 131-135, 4 = 126-130, 8 = < 125.

S.K^+ - Potassium (mEq/L): 1 = 3.5-5, 2 = 3.2-3.4 or 5.1-5.3, 4 = 2.9-3.1 or 5.4-5.9, 8 = < 2.8 or > 6.

ECG – Electrocardiogram: 1 = Normal, 4 = atrial fibrillation (60-90), 8 = any other change.

TPS – Total physiological score

DIAGN – Diagnosis : 1) Bowel obstruction,2) Duodenal perforation ,3) Gastric perforation,4) Blunt injury abdomen, 5) Gall bladder pathology, 6) Ileal perforation 7) Large bowel pathology,8) Others,9) Gastric malignancy, 10) Appendicular pathology ,11) Jejunal perforation.

OS – Operative severity: 1 = minor, 2 = intermediate, 4 = major, 8 = major +

MP – Multiple procedures: 1 = 1, 4 = 2, 8 = > 2.

BL – Blood loss (ml): 1 = < 100, 2 = 101-500, 4 = 501-999, 8 = >1000

PS – Peritoneal soiling: 1 = No, 2 = Serious, 4 = Local pus, 8 = Free bowel content, pus or blood.

MA – Malignancy: 1 = No, 2 = primary cancer only, 4 = node metastases, 8 = Distant metastases.

MS – Mode of Surgery: 1 = elective, 4 = emergency < 24 hours, 8 = emergency < 2 hours.

Com – Complications: a. Haemorrhage, b. Chest Infection, c. Wound Infection d. Urinary tract Infection ,e. Deep Infection, f. Septicaemia, g. Puo, h. Other , ; Wound dehiscence : i. Superficial, j. Deep , k. Anastomotic leak, ; Thrombosis; l.Deep vein thrombosis(dvt), m. Pulmonary embolism (pe), n. Cerebrovascular accident(cva), o. Myocardial infarction(mi), p.Cardiac failure, q. Impaired renal function : (Urea increase > 5 mmol/l, from preoperative level), r .Hypotension : (< 90mmHg for 2 h), s. Respiratory failure, t .other pulmonary complication u .others

OM – Observed mortality: = death; **EM** – Expected mortality; **EMBD**- Expected morbidity

MASTERCHART- Portsmouth POSSUM Scoring for Surgical Assessment in Patients Undergoing Abdominal Surgeries

SL.NO	IP.NO	SEX	AGE	PHYSIOLOGICAL PARAMETERS													DIAGN	OPERATIVE SEVERITY PARAMETERS						TOS	COM	EMBD	OM	EM
				AGE	CVS	RS	BP	PR	GCS	Hb%	WBC	BU	S.Na^+	S.K^+	ECG	TPS		OS	MP	BL	MA	PS	MS					
1	304816	F	76	4	1	1	2	2	1	4	4	1	2	4	1	27	1	4	1	1	4	1	1	12	b	66.6		6.68
2	299685	M	26	1	1	1	1	1	1	1	1	4	2	2	1	17	2	4	1	1	1	2	4	13	b,d	32.74		1.52
3	291877	M	19	1	1	1	1	8	1	1	1	2	2	1	1	21	3	4	1	2	1	4	4	16	j	62.01		4.6
4	242998	M	45	1	1	4	4	4	1	2	4	8	4	2	1	36	6	4	1	2	1	8	4	20		97.47		53.15
5	1021598	M	44	1	1	1	4	2	1	2	1	1	1	1	1	17	5	2	1	1	1	1	1	7		13.47		0.6
6	1021566	M	47	1	1	1	1	1	1	8	1	1	1	4	1	22	5	2	1	1	1	1	1	7		25.73		1.4
7	182076	M	65	2	2	2	2	8	1	4	4	4	2	2	1	34	9	4	1	4	8	4	4	25	b,c,q,r	98.63	D	63.71
8	212515	M	33	1	1	1	2	1	1	2	4	2	1	1	1	18	1	4	1	1	1	1	1	9		21.08	D	0.97
9	82063	M	20	1	1	1	1	4	1	1	2	2	1	1	1	17	10	2	1	1	1	1	1	7		13.47		0.6
10	82054	M	20	1	1	1	1	1	1	1	2	1	1	1	1	13	10	2	1	1	1	1	1	7	c	7.59		0.31
11	245304	M	60	1	2	1	4	2	1	4	4	2	1	4	1	27	8	2	1	1	1	1	1	7	b,m	43.54	D	5.19
12	80320	F	65	2	1	1	1	1	1	1	2	1	1	1	1	14	10	2	1	1	1	1	1	7		8.79		0.36
13	288647	M	65	1	2	4	8	4	1	8	4	4	1	2	1	40	6	4	1	1	1	2	4	13	c,j	95.07		43
14	257761	F	25	1	1	1	2	2	1	4	2	8	4	1	1	28	2	4	1	1	1	1	4	12		70.66		7.82
15	218010	M	30	1	1	1	1	2	1	1	1	1	1	1	1	13	10	2	1	1	1	1	4	10		12.68		0.49
16	270644	M	62	2	2	4	4	2	1	8	2	4	2	2	1	34	4	4	1	8	1	8	8	30	c	99.47		79.21
17	250488	M	33	1	1	1	1	1	1	2	1	4	2	1	1	17	2	4	1	2	1	2	4	14		37.05		1.77
18	296209	F	42	1	1	1	2	2	1	1	1	4	2	1	1	18	10	4	1	4	1	8	8	26	b,c	87.1		12.03
19	280998	F	55	1	1	1	2	8	1	4	1	1	2	2	1	25	3	4	1	2	1	4	4	16	d	75.88		8.67
20	229451	M	65	1	1	2	2	2	1	8	1	2	2	1	1	24	3	4	1	1	1	4	4	15		68.57		6.42
21	277742	M	75	4	2	4	1	1	1	1	2	1	2	2	1	22	10	4	1	2	1	1	4	13		52		3.46
22	76398	F	18	1	1	1	1	1	1	4	1	1	2	1	1	16	10	2	1	1	1	1	1	7		11.71		0.51
23	1020060	M	61	2	1	1	1	1	1	2	1	1	2	1	1	15	5	2	1	1	1	1	1	7		10.16		0.43
24	1021818	M	63	2	2	1	1	1	1	2	2	1	1	1	1	16	5	2	1	1	1	1	1	7		11.71		0.51
25	214530	F	48	1	1	1	1	1	1	2	4	2	2	1	1	18	1	4	1	1	1	2	4	13		36.35	D	1.79
26	99911	F	40	1	1	1	2	2	1	4	4	2	2	1	1	22	10	2	1	1	1	1	1	7		25.73		1.4

SL. NO=SERIAL NUMBER; IP.NO=IN PATIENT NUMBER; CVS=CARDIOVASCULAR SIGNS; RS=RESPIRATORY SIGNS; BP=BLOOD PRESSURE; PR=PULSE RATE; GCS=GLASGOW COMA SCALE; HB%= HEMOGLOBIN PERCENTAGE; WBC=WHITE BLOOD COUNT; BU=BLOOD UREA; S.NA^+=SERUM SODIUM; S.K^+=SERUM POTASSIUM; ECG=ELECTROCARDIOGRAM; TPS=TOTAL PHYSIOLOGICAL SCORE; DIAGN=DIAGNOSIS; OS=OPERATIVE SEVERITY; MP=MULTIPLE PROCEDURES; BL=BLOOD LOSS; MA=MALIGNANCY; PS=PERITONEAL SOILING; MS=MODE OF SURGERY; TOS=TOTAL OPERATIVE SCORE; COM=COMPLICATIONS; EMBD=EXPECTED MORBIDITY; OM=OBSERVED MORTALITY; EM=EXPECTED MORTALITY

MASTERCHART- Portsmouth POSSUM Scoring for Surgical Assessment in Patients Undergoing Abdominal Surgeries

SL.NO	IP.NO	SEX	AGE	PHYSIOLOGICAL PARAMETERS													DIAGN	OPERATIVE SEVERITY PARAMETERS						TOS	COM	EMBD	OM	EM
				AGE	CVS	RS	BP	PR	GCS	Hb%	WBC	BU	$S.Na^+$	$S.K^+$	ECG	TPS		OS	MP	BL	MA	PS	MS					
27	1019690	M	57	1	1	1	1	1	1	1	2	1	4	1	1	16	5	2	1	1	1	1	1	7	b,c	11.71		0.51
28	158019	F	30	1	1	1	1	1	1	4	1	1	1	1	1	15	10	2	1	1	1	1	1	7		10.16		0.43
29	64165	M	55	1	1	1	1	2	1	2	1	8	1	1	1	21	3	4	1	1	1	2	4	13	b,d,j	48		2.94
30	74389	F	28	1	1	1	4	2	1	8	4	2	1	1	1	27	2	4	1	1	1	2	4	13		70.68		7.72
31	72525	M	23	1	1	1	1	1	1	1	2	1	2	1	1	14	2	4	1	1	1	4	4	15	j	30.58		1.25
32	208706	M	71	4	2	2	1	1	1	4	1	8	2	4	1	31	7	8	1	2	8	4	1	24	b,c,d,j	97.37		47.51
33	145459	F	45	1	1	1	8	4	1	8	2	2	1	8	1	38	1	4	1	4	1	8	8	26	c	99.4	D	80.13
34	213721	M	36	1	1	1	1	4	1	4	1	8	2	1	1	26	7	8	4	2	8	8	8	38	j	99.58		77.28
35	239287	M	72	4	1	1	1	1	1	4	1	4	1	1	1	21	7	8	1	2	4	1	1	17		66.37		5.33
36	66475	M	56	1	1	2	1	2	1	1	1	2	8	1	1	22	3	4	1	2	1	2	4	14		56.71		4.02
37	194244	M	33	1	1	1	1	1	1	2	1	1	1	1	1	13	10	2	1	1	1	1	4	10		12.68		0.49
38	250982	M	22	1	1	1	8	8	1	1	2	1	1	1	1	27	8	4	1	4	1	8	8	26	b,j	96.61		38.54
39	75625	M	36	1	1	1	1	1	1	1	2	1	1	1	1	13	10	2	1	1	1	1	1	7		7.59		0.31
40	75097	F	33	1	1	1	1	1	1	1	1	2	1	1	1	13	10	2	1	1	1	1	1	7		7.59		0.31
41	264162	F	47	1	1	1	1	2	1	2	1	2	1	2	1	16	5	2	1	1	1	1	1	7		11.71		0.51
42	89462	F	56	1	1	1	2	2	1	4	4	1	2	1	1	21	5	2	1	1	1	1	1	7		22.79		1.18
43	60975	F	45	1	1	1	1	2	1	1	1	2	1	1	1	14	5	2	1	1	1	1	1	7		8.97		0.36
44	241034	M	56	1	4	2	1	1	1	1	1	2	8	1	4	31	3	4	1	2	1	4	4	16	b,c	88.99		20.75
45	289147	M	20	1	1	1	1	1	1	4	4	1	2	1	1	19	2	4	1	2	1	4	4	16		54.24		3.32
46	105901	M	23	1	1	1	2	1	1	4	1	1	2	1	1	17	3	4	1	1	1	4	4	15	q,r	41.58		2.06
47	164375	M	69	1	2	1	2	1	1	1	2	1	2	2	1	17	6	4	1	2	1	2	4	14	i	37.05		1.77
48	88770	M	46	1	1	1	4	8	1	2	1	2	2	2	1	26	3	4	4	2	1	4	8	23	b,k,i	93.21		24.96
49	114212	M	40	1	1	1	1	4	1	1	2	8	2	2	1	25	6	4	1	1	1	4	4	15		71.91		7.52
50	51448	M	65	2	2	1	2	2	1	1	1	2	1	1	1	17	2	4	1	1	1	2	4	13		32.74		1.52
51	274511	F	58	1	2	2	2	1	1	4	2	2	2	2	1	22	3	4	1	2	1	4	4	16		65.7		5.4
52	275118	M	45	1	2	2	8	8	1	4	4	8	4	4	1	47	1	4	1	2	1	4	8	20	c,k,q	99.95	D	87.95

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MASTERCHART- Portsmouth POSSUM Scoring for Surgical Assessment in Patients Undergoing Abdominal Surgeries

SL.NO	IP.NO	SEX	AGE	PHYSIOLOGICAL PARAMETERS													DIAGN	OPERATIVE SEVERITY PARAMETERS						TOS	COM	EMBD	OM	EM
				AGE	CVS	RS	BP	PR	GCS	Hb%	WBC	BU	$S.Na^+$	$S.K^+$	ECG	TPS		OS	MP	BL	MA	PS	MS					
53	273691	F	63	1	1	1	1	4	1	1	2	8	1	1	1	23	3	4	1	2	1	4	8	20		82.78		11.17
54	239731	M	35	1	1	1	2	4	1	8	4	2	2	4	1	31	6	2	4	1	1	1	1	10	j,k	72.11		9.37
55	182042	M	65	2	2	2	2	2	1	2	1	8	1	1	1	25	9	4	8	2	8	2	4	28	b,f,q,r	96.27	D	34.87
56	167161	F	22	1	1	1	2	2	1	2	1	1	2	1	1	16	3	4	1	2	1	4	4	16		42.31		2.03
57	222516	M	39	1	1	1	4	2	1	4	4	4	4	4	1	31	6	4	1	2	1	4	4	16		88.99		20.75
58	231027	M	50	1	4	2	4	4	1	8	4	8	8	1	1	46	3	4	1	4	1	8	8	26	r	99.83		93.98
59	70436	M	30	1	1	1	4	1	1	1	2	8	1	1	1	23	2	4	1	2	1	4	4	16		69.21		6.34
60	122632	F	30	1	1	1	8	2	1	4	4	1	2	2	1	28	2	4	1	4	1	4	4	18		87.97		17.69
61	159450	M	61	2	2	2	2	2	1	1	1	1	2	1	1	18	5	2	1	1	1	1	1	7		15.45		0.71
62	73535	M	23	1	1	1	1	1	1	2	1	1	1	1	1	13	10	2	1	1	1	1	1	7		7.59		0.31
63	68336	M	24	1	1	1	1	1	1	1	2	1	1	1	1	13	10	2	1	2	1	1	1	8		9.03		0.36
64	152049	F	36	1	1	1	1	4	1	1	4	2	2	2	1	21	10	2	1	1	1	2	1	8		26.31		1.38
65	168380	F	25	1	1	1	1	1	1	1	1	1	1	1	1	12	10	2	1	1	1	1	1	7		6.54		0.26
66	177929	F	40	1	2	2	2	1	1	2	2	4	2	1	1	21	7	4	1	2	1	8	4	20	c,i,r	77.73	D	8.23
67	204779	M	25	1	1	1	8	8	4	8	4	8	8	8	4	63	4	8	1	8	1	8	8	34		100	D	99.9
68	208648	M	64	1	2	2	4	2	1	8	2	2	1	1	1	27	1	4	1	1	1	1	1	9	b,c	53	D	4.3
69	1021477	M	60	1	2	2	1	1	1	2	2	1	1	2	1	17	9	4	1	1	8	1	1	16		46.26		2.39
70	165693	M	76	4	4	2	8	8	1	8	4	2	2	2	1	46	4	4	1	8	1	8	8	30		99.92	D	96.67
71	1019489	F	51	1	1	1	1	1	1	4	2	1	2	1	1	27	5	2	1	1	1	1	1	7		13.47		0.6
72	62096	M	32	1	1	1	1	1	1	1	4	1	1	1	1	15	5	2	1	1	1	1	1	7		10.16		0.43
73	156387	M	38	1	1	1	1	4	2	2	2	2	8	2	1	27	7	4	1	4	1	8	8	26	c	96.61		38.54
74	151695	F	25	1	1	1	1	4	1	2	1	1	2	2	1	18	10	2	1	1	1	1	4	10		24.42		1.13
75	61400	M	71	4	2	2	2	2	1	8	2	1	2	1	1	28	3	4	1	4	1	4	8	22	c,d,q	93.99		28.55
76	61392	M	20	1	1	1	1	2	1	2	2	1	1	1	1	15	3	4	1	2	1	2	8	18		47.55		2.33
77	237610	M	75	4	2	2	2	2	1	8	2	8	4	1	8	44	3	4	1	2	1	4	4	16	f,i	98.48	D	70.26
78	229451	M	65	2	1	2	2	2	1	8	1	4	2	1	1	27	2	4	1	1	1	2	4	13		70.68		7.72

SL. NO=SERIAL NUMBER; IP.NO=IN PATIENT NUMBER; CVS=CARDIOVASCULAR SIGNS; RS=RESPIRATORY SIGNS; BP=BLOOD PRESSURE; PR=PULSE RATE; GCS=GLASGOW COMA SCALE; HB%= HEMOGLOBIN PERCENTAGE; WBC=WHITE BLOOD COUNT; BU=BLOOD UREA; $S.NA^+$=SERUM SODIUM; $S.K^+$=SERUM POTASSIUM; ECG=ELECTROCARDIOGRAM; TPS=TOTAL PHYSIOLOGICAL SCORE; DIAGN=DIAGNOSIS; OS=OPERATIVE SEVERITY; MP=MULTIPLE PROCEDURES; BL=BLOOD LOSS; MA=MALIGNANCY; PS=PERITONEAL SOILING; MS=MODE OF SURGERY; TOS=TOTAL OPERATIVE SCORE; COM=COMPLICATIONS; EMBD=EXPECTED MORBIDITY; OM=OBSERVED MORTALITY; EM=EXPECTED MORTALITY

MASTERCHART- Portsmouth POSSUM Scoring for Surgical Assessment in Patients Undergoing Abdominal Surgeries

SL.NO	IP.NO	SEX	AGE	PHYSIOLOGICAL PARAMETERS													DIAGN	OPERATIVE SEVERITY PARAMETERS						TOS	COM	EMBD	OM	EM
				AGE	CVS	RS	BP	PR	GCS	Hb%	WBC	BU	$S.Na^+$	$S.K^+$	ECG	TPS		OS	MP	BL	MA	PS	MS					
79	194827	M	43	1	1	2	1	8	1	2	2	2	1	1	1	23	3	4	1	2	1	4	4	16	b,c,q,r	69.21		6.34
80	62610	M	25	1	1	1	1	1	1	1	1	2	4	1	1	16	8	4	1	1	1	2	8	17		47		2.36
81	215038	M	65	1	1	2	2	2	1	2	1	8	2	1	1	24	1	4	1	1	1	1	8	16		72.51		7.42
82	214743	F	38	1	1	1	1	1	1	1	1	1	1	1	1	12	8	4	1	1	1	1	1	9		9.28		0.35
83	238099	M	65	2	1	1	2	1	1	1	1	1	1	1	1	14	3	4	1	2	1	2	4	14		26.07		1.07
84	60724	M	36	1	1	1	8	4	1	1	1	1	2	1	1	23	3	4	1	2	1	4	8	20		82.78		11.17
85	194798	M	45	1	1	1	1	2	1	1	1	1	2	1	1	14	3	4	1	2	1	4	4	16		34.75		1.45
86	89989	M	70	2	2	2	1	8	1	8	2	2	2	1	1	32	3	4	1	2	1	4	4	16		90.47		23.67
87	158412	F	42	1	2	1	1	1	1	2	1	1	1	1	1	14	10	4	4	2	1	1	1	13		23.15		0.99
88	153041	F	61	2	2	4	1	1	1	8	2	1	1	2	1	26	5	2	1	1	1	1	1	7		39.65		2.71
89	80693	F	45	1	1	1	1	1	1	1	1	1	2	1	1	13	5	2	1	1	1	1	1	7		7.59		0.37
90	94672	M	58	1	2	1	2	2	1	2	2	1	2	2	1	19	1	4	1	2	1	2	4	14		44.77		2.46
91	93158	M	80	4	4	4	1	1	1	2	1	2	2	1	1	24	1	4	1	1	1	1	4	12		55.23		4.13
92	167548	M	28	1	1	1	2	2	1	8	2	2	4	1	1	26	4	4	1	2	1	4	4	16		78.41		10.11
93	90981	M	56	1	1	1	1	1	1	8	4	4	1	1	1	25	1	4	1	2	1	2	4	14	c,i,r	67.92		6.51
94	1021577	F	50	1	1	2	1	1	1	2	1	1	1	1	1	14	5	2	1	1	1	1	1	7		8.79		0.36
95	139403	F	22	1	1	1	8	8	2	8	2	8	2	1	1	43	6	4	1	2	1	4	4	16	f,q,r	98.22		66.61
96	146708	F	65	2	4	4	8	8	2	8	4	8	1	4	4	57	1	4	4	4	1	8	4	25	b,c,d,i,k	99.97	D	98.85
97	115223	F	35	1	2	4	1	1	1	1	2	2	4	1	1	21	1	4	1	1	1	1	4	12	c,q,r	43.29		2.53
98	209538	M	43	1	1	1	1	1	1	2	4	1	1	1	1	16	11	4	1	1	1	4	4	15		37.75		1.74
99	150461	M	36	1	1	1	8	8	2	8	2	1	1	2	1	35	10	4	1	2	1	4	8	20	c	97.04		48.93
100	1021542	M	55	1	2	2	1	1	1	8	1	1	1	1	1	21	8	4	4	2	1	2	1	14		52.75		3.42
101	206576	F	75	4	2	2	4	2	1	4	2	2	1	1	4	29	9	4	4	2	8	2	4	24	b,i,q,r	96.41	D	39.22
102	156387	M	38	1	1	2	8	1	4	1	2	4	8	2	4	38	7	4	1	8	1	8	8	30	b,c,j,q,r	99.72	D	88.23
103	104389	M	55	1	2	4	2	1	1	8	1	2	1	1	1	25	9	8	4	2	8	1	1	24		93.4		24.69
104	209556	M	67	2	4	4	8	8	2	4	2	8	2	2	4	50	11	4	1	4	1	8	8	26	c,f,p,q,r	99.91	D	96.58

SL. NO=SERIAL NUMBER; IP.NO=IN PATIENT NUMBER; CVS=CARDIOVASCULAR SIGNS; RS=RESPIRATORY SIGNS; BP=BLOOD PRESSURE; PR=PULSE RATE; GCS=GLASGOW COMA SCALE; HB%= HEMOGLOBIN PERCENTAGE; WBC=WHITE BLOOD COUNT; BU=BLOOD UREA; $S.NA^+$=SERUM SODIUM; $S.K^+$=SERUM POTASSIUM; ECG=ELECTROCARDIOGRAM; TPS=TOTAL PHYSIOLOGICAL SCORE; DIAGN=DIAGNOSIS; OS=OPERATIVE SEVERITY; MP=MULTIPLE PROCEDURES; BL=BLOOD LOSS; MA=MALIGNANCY; PS=PERITONEAL SOILING; MS=MODE OF SURGERY; TOS=TOTAL OPERATIVE SCORE; COM=COMPLICATIONS; EMBD=EXPECTED MORBIDITY; OM=OBSERVED MORTALITY; EM=EXPECTED MORTALITY

MASTERCHART- Portsmouth POSSUM Scoring for Surgical Assessment in Patients Undergoing Abdominal Surgeries

SL.NO	IP.NO	SEX	AGE	PHYSIOLOGICAL PARAMETERS													DIAGN	OPERATIVE SEVERITY PARAMETERS						TOS	COM	EMBD	OM	EM
				AGE	CVS	RS	BP	PR	GCS	Hb%	WBC	BU	$S.Na^+$	$S.K^+$	ECG	TPS		OS	MP	BL	MA	PS	MS					
105	379192	M	55	1	1	2	8	8	2	2	4	8	1	1	4	42	7	4	1	4	8	8	8	26	b,f	99.63	D	87.53
106	174652	M	45	1	1	8	2	1	2	2	2	1	1	1	1	23	7	4	4	4	1	8	8	29		96.37		33.66
107	72084	M	60	2	2	2	2	8	1	1	2	4	1	1	1	27	5	2	1	1	1	1	1	7		43.54		3.19
108	406541	M	68	2	2	4	1	1	1	2	2	1	1	1	4	22	9	4	4	2	8	1	1	20		80.38		9.6
109	126613	M	70	4	4	4	1	1	1	8	4	1	1	1	1	31	5	4	1	4	1	2	1	13	d,i	82.05		14.13
110	148146	M	74	4	1	2	1	1	1	2	1	1	1	1	1	17	7	4	1	2	1	2	1	11		24.97		1.12
111	165502	M	32	1	1	1	1	1	1	1	2	1	1	1	1	13	10	4	1	1	1	4	4	15		27.29		1.06
112	136718	F	60	1	4	4	1	1	1	2	2	2	1	1	8	28	8	4	1	1	1	1	1	9	c,i	56.95		5.06
113	69707	M	45	1	1	1	1	8	1	4	2	4	1	4	1	29	3	4	1	2	1	4	4	16		85.45		15.73
114	78248	M	69	2	8	4	8	4	1	1	4	8	2	2	8	52	2	4	1	2	1	8	8	24	b,c,i	99.91	D	96.93
115	206729	F	45	1	1	1	1	1	1	8	2	2	4	1	1	24	3	4	1	2	1	4	4	16		72.51		7.42
116	168525	M	60	2	2	1	2	4	2	1	2	4	1	1	1	23	3	4	1	2	1	4	8	20		82.78		11.17
117	83194	M	35	1	1	1	1	2	1	1	2	1	4	1	1	17	3	4	1	2	1	2	4	14		37.05		1.77
118	156822	M	60	1	2	4	1	2	1	1	2	4	2	1	4	25	4	4	1	4	1	8	8	26		95.39		30.9
119	89140	M	48	1	1	1	2	1	1	1	1	1	1	1	1	13	7	4	1	2	1	4	4	16		31.22		1.23
120	142487	F	33	1	1	1	4	1	2	2	2	8	2	1	1	26	8	4	4	2	1	4	4	19		86.53		15.18

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