A Dissertation on

"ANALYSIS OF VARIOUS FACTORS INCLUDING SURGICAL APGAR SCORE AFFECTING OUTCOME IN TRAUMA PATIENTS UNDERGOING EMERGENCY LAPARATOMY"

Dissertation submitted to

THE TAMILNADU Dr. MGR.MEDICAL UNIVERISTY

CHENNAI

with partial fulfilment of the regulations

for the Award of the degree

M.S. (General Surgery)

Branch – I

MADRAS MEDICAL COLLEGE ,

CHENNAI.

APRIL-2015

BONAFIDE CERTIFICATE

Certified that this dissertation is the bonafide work of **Dr. A.PREM ANAND** on **"ANALYSIS OF VARIOUS FACTORS INCLUDING SURGICAL APGAR SCORE AFFECTING OUTCOME IN TRAUMA PATIENTS UNDERGOING EMERGENCY LAPARATOMY"** during his M.S. (General Surgery) course from JUNE 2012 to MAY 2015 at the Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai – 600003.

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ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude to the Dean, Madras Medical College and **Prof.Dr.P.RAGUMANI M.S**, Director, Institute of General Surgery , MMC & RGGGH, for allowing me to undertake this study on "**ANALYSIS OF VARIOUS FACTORS INCLUDING SURGICAL APGAR SCORE AFFECTING OUTCOME IN TRAUMA PATIENTS UNDERGOING EMERGENCY LAPARATOMY"**

I was able to carry out my study to my fullest satisfaction, thanks to guidance, encouragement, motivation and constant supervision extended to me, by my beloved Unit Chief **Prof. Dr. G.MUTHUKUMARAN, M.S**. Hence my profuse thanks are due for him.

I am bound by ties of gratitude to my respected Assistant Professors, **Dr.B.SATHYAPRIYA, DR.B.SANTHI, DR.M.KRISHNAMOORHY**in general, for placing and guiding me on the right track from the very beginning of my career in Surgery till this day. I would be failing in my duty if I don't place on record my sincere thanks to those patients who inspite of their sufferings extended their fullest co-operation.

I am fortunate to have my senior and junior postgraduates and my family members for their invaluable suggestions, relentless help for shouldering my responsibilities. Simply words cannot express its depth for their unseen contributions.. Lastly, my lovable thanks to my parents for their moral support.

DECLARATION

I , certainly declare that this dissertation titled, "**ANALYSIS OF VARIOUS FACTORS INCLUDING SURGICAL APGAR SCORE AFFECTING OUTCOME IN TRAUMA PATIENTS UNDERGOING EMERGENCY LAPARATOMY**", represent a genuine work of mine . The contribution of any supervisors to the research are consistent with normal supervisory practice, and are acknowledged.

I , also affirm that this bonafide work or part of this work was not submitted by me or any others for any award , degree or diploma to any other university board, neither in India or abroad . This is submitted to The Tamil Nadu Dr.MGR Medical University, Chennai in partial fulfilment of the rules and regulation for the award of Master of Surgery Degree Branch 1 (General Surgery).

Date :

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INTRODUCTION

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Hospitals and surgical teams strive to provide a consistently low incidence of major complications for patients undergoing any given operation. The prediction of complications is an essential part of risk management in surgical practice. Recognizing patients at high risk of developing a complication will contribute substantially to the quality of operation and of cost reduction in surgery. Marked variability of postoperative outcomes is usually found due to differences in patient's preoperative risk factors and intra operative factors.[1]

An ideal model to predict complication in surgical patients should be simple and readily applicable to all patients when operated. While developing a predictive model for complications in surgical patients, an accurate estimate of the incidence of these complications is needed. Therefore a proper definition of a complication, with a low detection threshold, is necessary.

However, the intraoperative variable response of the body in terms of vital parameters such as heart rate, blood pressure, arterial saturation and tissue perfusion, to the surgical stress, further contributes to variability in patients' risk of developing complications.[1]

In this study, we evaluated the surgical apgar score along with other factors in trauma patients undergoing emergency laparotomy and also its ability in predicting morbidity and mortality.

AIM OF THE STUDY

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Trauma is recognised as a serious public health problem. In fact it is the leading cause of death and disability in first fourth decade of life and third most common cause of death overall[51]. An injury affects more than just the patients life, it affects everyone who is involved with the person's life.Trauma is the most common cause of death in 0-44 years worldwide and by 2020 more than 10% people will die from trauma. The most common cause of blunt trauma is motor vehicle accident,speed is a critical factor ,10% increase in speed relates to 40% increase in case fatality[51].

Hence trauma was taken up for this study with the following objectives,

1.To correlate the Surgical Apgar score with the patient's outcome in the form of complications (morbidity) including death within 30 days of surgery (30 day mortality).

2.To estimate other factors like age,sex,duration of injury,mode of injury,associated injuries,co-morbidities,and inter-relation of these factors in influencing the overall outcome of patient undergoing emergency laparotomy following trauma.

REVIEW OF LITERATURE

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HISTORICAL ASPECTS:

Blunt injury as causes of intra abdominal injuries have been recognized since historical times. Aristotle was the first to record visceral injuries from blunt trauma. Hippocrates and Galen are said to have given correct description of the condition. By 1500 BC distinct triage and surgical protocol had been developed in Babylonia under the rule of Hammurabi as said by Edwin Smith Papyrus. In 1580 Ambriospare made a reference of traumatic herniation of stomach through diaphragm. The first operative repair of gastric injury was reported by Nollesan in the 18th century, and The first case of gastric injury, as well as resultant fistula, is credited to Schenk in the 16th century. "The ancient Chinese used a sharp blow on the region of the spleen as a method of assassination. Trausse in 1827 presented fracture of body of pancreas in blunt trauma Von Reckiling Hausen described artery thrombosis occurring as a result of blunt trauma. Prior to 1900, the mortality resulting from colonic injuries and bladder injuries was nearly 100%". In 1906 Solomon performed peritoneal lavage for the first time. Transection of stomach resulting from blunt trauma was first described by Plancaslillin. Barily reported 32 cases of rupture of spleen during the period 1894-1924.

“In 1934 Aenhium used puncture of abdominal wall as a diagnostic procedure in abdominal injuries. Branch in 1938 reported 2 cases of liver laceration treated by resection of left lobe”. Synthetic grafts was first used by Voorhees in 1952 and widely employed by Hughes (1954) and Spencer (1955).

“The development of emergency medical service is an important milestone in the history of clinical and surgical practice of trauma. Greeks required physicians to be present during the battle and Romans established the hospitals close to the battlefield”. Cincinnati General Hospital first instituted the ambulance system in 1865.

In 1965 Root first described the flushing of sterile solution through the peritoneal cavity to obtain peritoneal contents.

Advanced imaging techniques like spiral CT scan and MRI has made early detection of blunt abdominal injuries easier.

Introduction of assessment scores in trauma: -

The assessment of the potential risks of peri-operative mortality and morbidity is increasingly important for the provision of health care. ”There is a growing realization that healthcare providers (doctors) need to ensure appropriate installation or commission of all the available resources. By doing so, it would enable the most deserving patients to get most appropriate healthcare available in the hospital.[17”]

Adequate stratification and scoring of risk should, therefore, be considered essential to aid clinical practice. Assessment of patients for categorization may occur at various points throughout the patient’s journey through the hospital, i.e., from the OPD to WARD to OT toICU”. It can be grouped into three stages relating to the operation.

1. “Preoperative assessment: - this is when planning and intervention can help quantify the potential risks of a procedure for the patient by virtue of patient’s inbuilt physiological and acquired pathological comorbidities”.
2. “Peri-operative (physiological) assessment may determine the most suitable setting for further care of the patient i.e., admission into ICU, HDU, ward or day care surgical setup. This is based on the preliminary preoperative risk stratification conducted as the patient arrives to the hospital”

3. “Post-operative scores calculated from the patients Intraoperative variables and the responses to these variations, may alter the further management of postoperative patients.[19]“

“One of the prominent works was done on this by P. M. Markus, J. Martell et al who conducted a prospective study of 1077 consecutive patients undergoing major hepatobiliary or gastrointestinal surgery[18]. Both elective (*n* = 827) and emergency (*n* = 250) procedures were included.” The surgeon based on his gut-feeling of the procedure predicted the development of postoperative complications immediately after completion of surgery on a scale from 0 to 100 per cent.” These predictions were then compared with the actual outcome and with predictions made using the Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (POSSUM).”

The observed morbidity and mortality rates were 29.5 and 3.4 per cent respectively. POSSUM predicted a morbidity rate of 46.4 per cent and P-POSSUM a mortality rate of 6.9 per cent. The surgeon's gut-feeling was more accurate in the prediction of morbidity at 32.1 per cent”. On the basis of gut-feeling, surgeons usually over predict the morbidity rates in elective surgery, but underestimate in emergency settings.[18]

Postoperative morbidity and mortality as shown in figure 1 is associated with 3 major categories of risk factors. "1) Patient co morbidity, 2) The surgical procedure itself and 3) Risks directly related to anesthesia management. Patient co morbidity - Earlier studies identified the extremes of ages as a risk factor for perioperative adverse events." Infants (0-1 years) and older persons (65+ years) experience higher rates of postoperative mortality than persons of 2-64 years[18]. ASA is a well established surrogate measure of patient co morbidity [19]".

With the evolution of better monitoring techniques and well equipped laboratories, newer general and specialized surgical scoring systems have emerged as follows

"General:SAPS II, APACHE II, MODS (Multiple Organ Dysfunction Score)

TRIOS (Three days Recalibrated ICU Outcome Score), etc.

Specialized/ Surgical:

POSSUM (Physiologic and Operative Severity Score for the enumeration of Mortality and Morbidity.

MPM for cancer patients,

Glasgow Coma Score for neurosurgical patients,

NSQIP", etc.

However, they are not easily calculated at the bedside. Entering numerous data elements which include patient characteristics and lab data, that are not

uniformly collected making them more vulnerable for errors, thus losing reproducibility among various multidisciplinary teams involved in patients care.

"Prevailing methods of surgical quality assessment, such as the American College of Surgeons' National Surgical Quality Improvement Program (NSQIP),[2–4] evaluate surgical performance indirectly, i.e., by assessing the multiple preoperative risk factors and in addition attributes disparities between observed and expected complication rates to the treatment provided".

For example, in Surgeries for Small Bowel Obstruction, Preoperative factors predictive of postoperative morbidity includes history of CHF, cerebrovascular accident with neurologic deficit, history of chronic obstructive pulmonary disease, WBC <4500/mm^3, functional health status, preoperative creatinine >1.2 mg/dL, and advancing age (in decades). Intraoperatively, higher wound class and ASA class are also predictive of morbidity. Operative factors like simple small bowel resection in comparison to adhesiolysis alone has more incidences of morbidity and complications [6].

"Preoperative factors that clearly impact the mortality rate are history of disseminated cancer, preoperative hematocrit <38%, preoperative sodium >145 mEq/L, preoperative creatinine >1.2 mg/dL, dyspnea and advancing age (in decades)". The finding that elevated WBC occurs morefrequently in cases of adhesiolysis than in cases for bowel resection estimates the unreliable nature of

leukocytosis in differentiating inflammation and infection[6].

Intraoperative factors that predict mortality include advance ASA class and higher wound class.

In the operating room, surgeons have relied principally on "gut-feeling", instead of their objective assessment, of the operative course for postoperative prognostication[5]. Such prognostication models have rated the patients in broader categories and provide considerable clinical guide towards patients care.

Most believe that operative management contributes importantly to overall outcomes, but quantitative measurements of operative care are not available.[1]"Among intraoperative factors, the alterations in patient's condition, including hypotension,[7] hypertension, hypothermia, bradycardia,[8,9] tachycardia, and blood loss[10] have been independently linked with adverse perioperative outcomes." Some risk prediction methods have integrated these intraoperative variables for early prediction of postoperative morbidity and mortality. "Nevertheless a clear consensus on this most essential aspect of perioperative management of a surgical patient has not been reached.[11]"Hence, the question of how to directly evaluate performance and safety in the operating room still remains unanswered in surgeons mind.[12]"

To provide surgeons with a simple, objective, and direct method of rating, a ten-point Surgical Apgar Score was determined by Atul Gawande et al.[13] To

derive the score, more than two dozen parameters collected in the operating room were assessed, and it was discovered that just three intraoperative variables remained independent predictors of major postoperative complications and death. They were –"Lowest heart rate, lowest mean arterial pressure, and estimated blood loss. A score built from these three predictors has proved beyond doubt as astrong predictive model for categorizing the patients at risk of major postoperative complications and death in general and vascular surgery.[13]"

As this scoring system requires data that can be collected immediately upon completion of an operation for patients in any setting, regardless of resource and technological capacity, it is the simplestavailable scoring system for assessing the risk".

"Like the obstetrical Apgar score, [14] it cannot by itself assess the quality of care, as its three variables are influenced not only by the performance of surgical teams, but also by the patients' preoperative physiological status and the magnitude of the operations they undergo.[15]"

For the score to be a clinically useful predictor of postoperative complications, each component of it or the score as a whole should contribute to predict surgical outcome.

"Because of its simplicity, availability in real time, being immediately applicable for clinical decision making and inexpensively collectable, Apgar score

is therefore a powerful tool for early recognition of complications. Such an early predictability would thereby improve safety in surgery". Despite concordance between preoperative factors and measurement intraoperative factors, after accounting for preoperative risk, the Surgical Apgar Score remains a significant predictor of postoperative complications. "Because the feedback is almost immediate, this would help the surgical team in categorizing the patients in need of more and intense postoperative monitoring and care from those who pass an uncomplicated course."It would act as a mode of communication between the surgeons, residents, nursing staff about the immediate postoperative status and thereby assist decision making about, for example, planned admission after an OPD procedure/daycare procedure, admission to ICU or also the frequency of post op visits to the surgeon. Even in those with low surgical apgar scores but uncomplicated outcome, it would enable an early identification of problems, as such patients aresubjected to routine clinical surveillance and repeated reviews. Reliance on anesthesiologist's unbiased estimation further upgrades the reliability insulating against surgeon's bias.[16]

Higher ASA scores are associated increased risk of both 48h and 30d postoperative mortality. Nearly 35% of ASA grade V patients die within 48hrs and nearly 50% of those patients die within 30d postoperatively. Both 48hrs and 30d postoperative mortality rates are higher after emergency procedure or after operations resulting in post operative ICU"

admissions. “An emergency procedure imparts approximately 8 times increased risk if death within 48h and 3 times increased risk of death within 30 d postoperatively”. Postoperative ICU admission is associated with a 2-3 times increased risk of 48h or 30d postoperative mortality. Any surgery associated with a perioperative adverse event imparts a 12 times increased risk of death within 48h postoperatively and 4 times increased risk of death within 30d postoperatively[20].

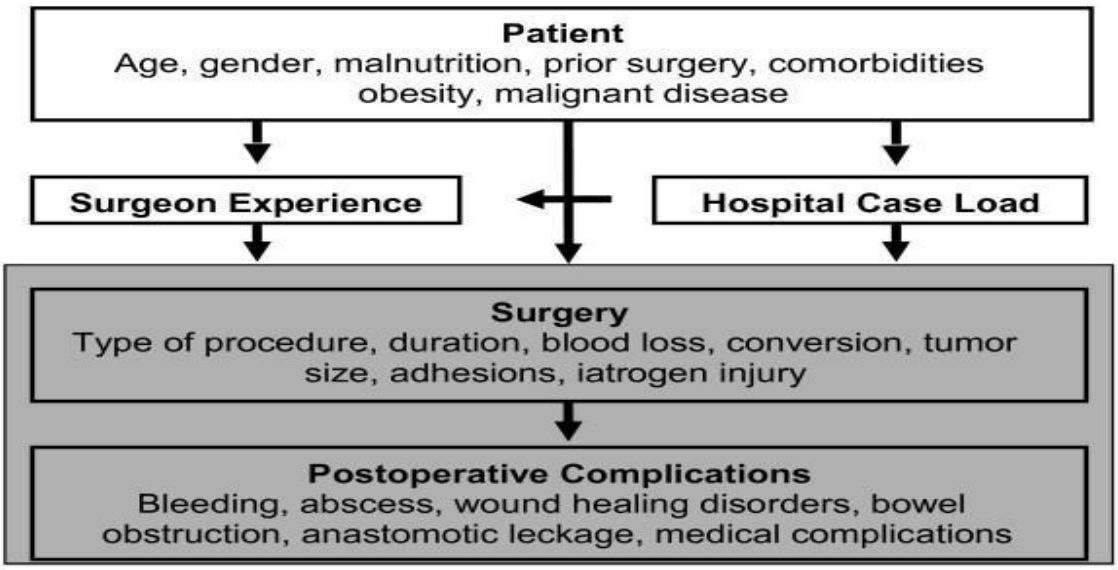


FIGURE 1- Various characteristics and the risk factors of the patient, availability of resources at the hospital and surgeons experience determines the outcome of a surgery including the postoperative complications and death.

"A variety of risk scoring systems are derived from different population of patients for a variety of purposes and each has their limitations. As surgical patients account for up to 70% of the workload of general intensive care units (ICUs), risk scoring systems that related to ICU and critically ill patients have also to be categorized".

Overview of Risk Scoring Systems and Models:-

A number of scoring systems exist which have been applied to patients who are acutely ill and with comorbidites. "In patients undergoing surgery, these risk scoring systems can be broadly categorized into three groups, which relate to the timing of the assessment in relation to the surgical procedure". Outcome is generally measured in terms of mortality as it is a definitive endpoint and easy to measure. A few scores predict both morbidity and mortality, while

Some indicate morbidity alone yet almost none seem to measure quality of life or return to pre-existing function.

"A brief discussion on the advantages, disadvantages, the feasibility and the reproducibility of some of these scores which are routinely practiced in the wards and ICU is worth mentioning."

Pre-operative Scores

American Society of Anesthesiologists Score(ASA):-

”In 1940-41, ASA asked a committee of three physicians (Meyer Saklad, M.D., Emery Rovenstine, M.D., and Ivan Taylor, M.D.) to study, examine and devise a system for the collection and tabulation of statistical data in anesthesia which could be applicable under any circumstances[21],”

“Widely used as a surrogate for operative risk assessment, the American Society of Anesthesiologists (ASA) score was originally devised to grade the patients “in relation to physical status only’’[22] . The ASA score is subjective and based on clinical evaluation only, although objective test results will indirectly affect the clinician’s assessment.[18]”

ASA American Society of Anesthesiologists Grading

I Healthy patient

II Mild systemic disease, no functional limitation

III Moderate systemic disease, definite functional limitation

IV Severe systemic disease that is a constant threat to life

V Moribund patient, unlikely to survive 24 h with/without operation

"Although not intended for use as a risk scoring system, the ASA score has been used for this purpose in part due to the simplicity of the tool, its universal use and allowance for individual patient parameters. " Limiting factors in its applicability are of the subjectivity, lack of specificity inherent in its design and wide inter-observer variability"." This classification system assumes that age of the patient has no relation to physical fitness, which is not true. Neonates and the elderly, even in the absence of any systemic disease, tolerate otherwise similar anesthetics poorly in comparison to young adults.[23,24.] "

The ASA score has been used to categorize pre-operative risk and is a good indicator of post-operative mortality[19]. It does not, however, provide a quantitative assessment of morbidity and mortality risk and is better at risk stratification.

Surgical Risk Scale: -

"Sutton et al[25] devised the Surgical Risk Scale (SRS) as a comparative surgical audit tool. When prospectively validated, it appeared to be effective at predicting mortality. "The ASA score is combined with the Confidential Enquiry into Peri-operative Deaths category and British United Provident Association operative grade resulting in a score from 3 to 15, each of which relates to a likely mortality score. " The use of the ASA makes it a partly subjective scoringsystem. The SRS has been shown to have a similar accuracy to Portsmouth Physiological and Operative Severity Score for EnUmeration of Mortality and Morbidity (P-

POSSUM) especially in higher risk patients yet was easier to calculate. [26]

Peri-operative Physiological Scores

Acute Physiological and Chronic Health Evaluation (APACHEII)

"The relatively complex scoring system, the Acute Physiological and Chronic Health Evaluation (APACHE) II (Knaus et al., 1985), has been derived from large American ICU patient databases.[27] "While it does not specifically assess surgical patients, Goffi et al[28] found that APACHE II could be used pre-operatively "with caution", in both elective and emergency surgical patients outside of the ICU or High Dependency Unit (HDU) setting. The second version of APACHE reduced the number of variables to 12 from the original 34 required. A further derivation, APACHE III does not seem to be more accurate than APACHE II in the ICU population and in some studies has been shown to be poorer when used to look at surgical patients and patients with gastrointestinal disease". [27] Overall, while widely used and well-understood, calculating APACHE II is complex and time consuming. Furthermore, the raw data is not always easily obtainable, particularly outside that of the ICU setting.

Simplified Acute Physiology Score:-

"The Simplified Acute Physiology Score (SAPS) is assigned after 24 h of ICU admission and is another derivation of APACHE". The second version, SAPS II, which uses the original 13 physiological variables, also factors in the type of admission (elective or emergency; medical or surgical) and chronic health

points (acquired immune deficiency syndrome, metastatic cancerand hematological malignancy).[29]"With its inherent weaknesses, APACHE II is preferred to SAPS II in most units".

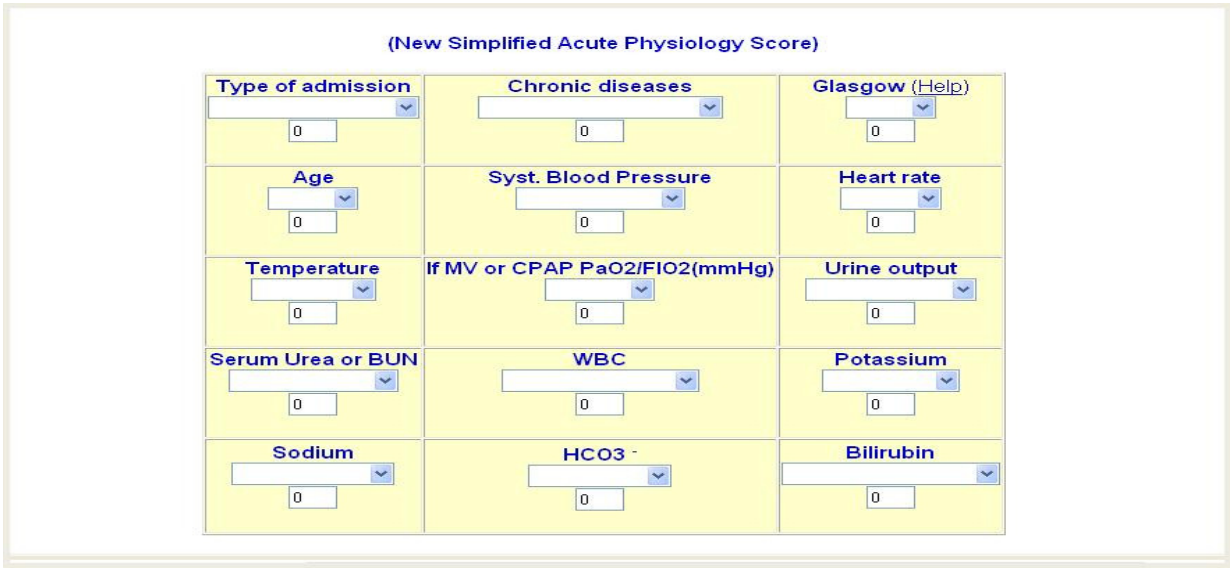


Figure 2 – New simplified Acute Physiology score

Post-Operative Scores

Mortality Prediction Model:-

"The Mortality Prediction Model (MPM) is normally scored at admission to ICU/HDU with data from within the first hour (MPM0) although older versions could be scored after 24 or 48 h (MPM24 and MPM48, respectively).[30] "The burden of data collection is low and relates to the following: emergency

admission, resuscitation, cancer, chronic renal failure, heart rate, systolic blood pressure, infection, previous ICU admission within 6 months, surgery, age and GCS. "The data allow for greater completeness and subsequently a higher degree of consistency.[31]" It does not use the worst criteria during the first 24 h unlike APACHE and, therefore, can provide a more defined way of comparing admissions to different ICUs.

"Limitations of the MPM are that some sub-groups are excluded (e.g. cardiac surgery, myocardial infarction and ICU readmissions) and while only recently updated, APACHE IV and SAPS III still obtain better discrimination".

Physiological and Operative Severity Score for EnUmeration of Mortality andMorbidity(POSSUM):-

"The POSSUM predicts the probability of surgical mortality for a range of surgical sub-populations and allows comparison of performance.[33] The 12 physiological factors can be determined pre-operatively (Table 1).

Physiological parameters	Operative parameters
Age	Mode of surgery
Cardiac status	Operation type/gradel
Respiratory status	Multiple procedures
Glasgow coma score	Peritoneal soiling
Pulse rate	Malignancy
Blood pressure	Intra-operative blood loss
Haemoglobin	
White cell count	
Serum sodium	
Serum potassium	
Urea	
Electrocardiogram	

Table – 1 – POSSUM PARAMETERS

Electively or peri-operatively, its use has not been validated with regard to outcome or need for ICU or HDU admission either. Furthermore, POSSUM has variable usage across different specialities, which has led to specialty-specific derivations of POSSUM, especially in esophageal [35] and colorectal surgery.[36,,] These have ideally increased predictive power at the expense of decreasing cross-specialty comparison.

Surgical Apgar Score : -

"It was not earlier than 1953, that a 10 point scoring system for evaluation of the condition of newborn was formulated by Virginia Apgar. A simple, effective grading system for predicting the performance of a newborn for the first 28 days.[14]" The simplicity of the Apgar score in obstetric practice led to its worldwide uptake as an assessment tool.

"Intraoperative blood loss, heart rate, and blood pressure are critical predictors of postoperative risk, is consistent with a variety of previous observations. " Hemodynamic stability[49] and the amount of blood loss [50] during surgery have long been recognized as important independent factors in patient outcomes. "What had not been recognized were the collective importance of these

variables, and their potential contribution to an easily-implemented intraoperative performance metric.Gawande et al. set out to describe a surgical model which they published in 2007. [13]"

"Under the National Surgical Quality Improvement Program, 303 randomly selected patients undergoing colectomy at Brigham and Women's Hospital, Boston were studied. "The primary outcomes measure was incidence of major complication or death within 30 days of operation. They validated the score in two prospective, randomly selected cohorts: 102 colectomy patients and 767 patients undergoing general or vascular operations at the same institution. " A 10-point score as shown in table 2 based on a patient's estimated amount of blood loss, lowest heart rate, and lowest mean arterial pressure during general or vascular operations, was associated with major complications or significant 30 day mortality.

"Similar to early scoring systems, it uses important physiological criteria which can be assessed objectively. Criticisms of this scoring system are that operative blood loss can be subjective although the authors argue the wide categories allow for reasonably accurateestimation. "The overall score can be used to discriminate which patients are likely to have a post-operative mortality or morbidity. The study showed that the incidence of major complications was 58.6% and 3.6% with the scores of <4 and >8 respectively. In multivariable

logistic regression, it was found that lowest heart rate, log EBL, and lowest mean arterial pressure (MAP) were each independent predictors of outcomes. ”

Table 2 – Description of the component parameters of the Surgical Apgar Score and its calculation at the end of the surgery.

Surgical apgar score	**No of points**				
Variables	0	1	2	3	4
Estimated blood loss, ml	>1000	600-1000	101-600	100	---
Lowest mean arterial pressure, mm Hg	<40	40-54	55-69	70	---
Lowest heart rate/min	>85[a]	76-85	66-75	56-65	55[a]

a.occurrence of pathologic bradyarrthymia, including sinus arrest, atrioventricular block or dissociation, junctional or ventricular escape rhythms, and systole, also receives 0 points for lowest heart rate.

b. lower the cumulative score, higher the chances of major complication rates and 30 day mortality rates.

The scoring system was also further validated by Scott E. Regenbogen, Jesse M. Ehrenfeld et al. who systematically sampled 4119 general and vascular surgery patients at Massachusetts General Hospital.[40,,] Of 1441 patients with scores of 9 to 10, 72 (5.0%) developed major complications within 30 days, including 2 deaths (0.1%). By comparison, among 128 patients with scores of 4 or

less, 72 developed major complications (56.3%) with 25 deaths. ” The mean lowest HRs were significantly lower (58 vs 63) and the mean lowest MAPs were significantly higher (65 vs 61) among patients with no complications compared with those with major complications. Estimated blood loss was significantly lower in operations with no major complications than in those resulting in major complications (25 vs 200 mL).

“This study showed that these 3-variable score achieves C statistics of 0.73 for major complications and 0.81 for deaths. This indicates that they are independently capable of predicting both morbidity and mortality and the accuracy improves when they are included in a score.”

The subjective element of the ASA score seems to emphasise that there is role for clinical judgement in assessing patients. ”To overcome interobserver bias, the surgical apgar score has been created to provide an objective score that is easy to measure and calculate. ”While it has been validated, more studies need to be performed before the Surgical Apgar Score becomes as widely taken up as APACHEII, NSQIP and P-POSSUM

PATHOPHYSIOLOGY OF BLUNT INJURY ABDOMEN:

Several pathophysiological processes will take place in a case of blunt abdominal injury. Understanding the mechanism of injury is important in the management of a patient with blunt abdominal trauma; injuries can be classified as high energy or low energy.

1. Blunt trauma over the abdomen causes damage from a combination of compression and shearing ,bursting forces. Sudden, pronounced increase in intra abdominal pressure caused by outward forces can cause rupture of the hollow viscera or can cause burst injury of solid organs.

2. Compression of abdominal viscera between applied force to the abdominal wall and the posterior thoracic cage of the vertebral column can produce a severe crush injury.

3. Abrupt shearing forces can cause tear of organs or vascular pedicles.

4. Oblique forces and deceleration injury can cause shearing of viscera where anchored, such as at site of the duodenojejunal flexure and peritoneal attachments of the bowel.

5. Deceleration injuries occur in high speed vehicular accidents and also in falls from great heights. On impact, the organs continue to move forward at terminal velocity, tearing the organs at their sites of attachment.

CLINICAL EXAMINATION

History and physical examination:

"When a patient presents to casualty with a history of blunt abdominal trauma, the first priority should be to treat the immediate life threatening conditions such as airway, circulation, pneumothorax and to arrest the internal bleeding. After the resuscitation, a brief but detailed history extracting as much information as possible obtained from the paramedics/ police/bystanders.

Motor vehicle accident is a common cause of blunt abdominal injury. Mechanism of injury and the position of the victim should be sought to know the probable intra abdominal injuries. Whether it was auto pedestrian accident or if it was head on vehicular collision, position of the victim, (driving or rear seat passenger) should be enquired. Type of accident: frontal impact, side impact, and sideswipe, rear impact or rollover type of accidents; whether the victim was wearing seat belts etc should be noted. Patient's level of consciousness at the site of accident, whether the patient was under the

influence of alcohol should be sought. If the patient is conscious h/o regarding his medications, past medical history and allergic to drugs are noted.

Systemic examination:

The major factor that determines the survival and functional outcome in most cases of blunt trauma of abdomen is the presence of the head injury. The systemic examination of the patient with blunt abdominal injury starts from assessing the level of consciousness and associated injuries to chest which may hinder the respiration. The severity of head injury can be rapidly assessed by determining three factors:

1. Level of consciousness.
2. Pupillary symmetry.
3. Lateralized weakness of the extremities.

Level of consciousness is best assessed by GCS score (Glasgow Coma Scale)[2], a system that evaluate eye opening, best motor response and verbal response. The GCS is determined by taking the best response in each category and totaling them. It ranges from 3 to 15 (mild: 13-15, Moderate: 9-12, severe $\leq$8). The presence of any of the following criteria suggests serious injury.

1. A GCS score less than 10.

2. A decrease in the GCS score by 3 of more regardless of the initial GCS score.

3. Pupillary inequality greater than 1mm regardless of the GCS score.

4. Lateralized extremity weakness regardless of the GCS score.

5. Markedly depressed skull fractures.

6. Open cranial wounds with brain exposed.

Haematomas, bleeding lacerations, tenderness or any deformities should be looked for. The gaping wound should be sutured to control bleeding. Nasopharynx bleed should be controlled by passing a Foley's catheter and inflating the bulb in the nasopharynx. Eardrum should be examined for bulge due to blood. Blood at the internal auditory meatus is a definitive presumptive evidence of basilar skull fracture.

Visual examination and signs for any trauma should be looked for. Nose and throat should be examined for adequacy of airways. Distended neck veins suggest cardiac tamponade, cardiac contusion. Swelling of the neck indicates bleeding in one of facial planes of the bronchial tree. Tenderness on the cervical spine suggests fracture especially associated with maxillo facial trauma.

Chest: The patient should be derobed completely. Careful inspection of the thorax should be done noting shape, size, symmetry corresponding movements of hemithorax should be noted. Any abrasions, contusions, external wounds,

dilated veins, retraction or bulging of the intercostal spaces, movements of both hemithorax any communicationg wounds with the peritoneal cavity should be noted. Trachea should be palpated for trail's sign. On percussion, hyperresonant note indicates pneumothorax. Dull note indicates hemothorax. Cardiac dullness and liver dullness area should be carefully noted as enlargement denotes significant injury in blunt abdomen patients.

Respiratory system should be auscultated for type of respiration, type of breath sounds (vesicular/bronchial/bronchovesicular) and for added sounds like crepitations. The cardiovascular system should be auscultated for the heart sounds and any abnormal sounds like murmurs. In early cardiac tamponade distant or muffled heart sounds may be the early clue. The voluntary muscle guarding will disappear on expiration. The muscle guarding usually corresponds to the area of tenderness. Tenderness may be due to parietal hematoma, contusions or due to intra-abdominal injuries. Rebound tenderness indicates peritoneal irritation. Generalized distension of the abdomen is a late feature of generalized peritonitis. The flanks should be palpated and the iliac crest and symphysis pubis compressed to establish the possibility of a pelvic fracture. The hip joints should also be internally and externally rotated. Absence of discomfort on performing these maneuver usually excludes a major pelvic fracture. On rectal examination sphincter tone, integrity of rectal wall and the presence of blood should be looked for. The presence of high riding or

non-palpable prostate supports the diagnosis of postmembranous disruption of the urethra. Testis and external genitalia should be examined carefully for tenderness, laceration. The presence or absence of blood at the penile meatus should be noted.

Percussion: Liver dullness, splenic dullness should be elicited. Presence of free fluid in the peritoneal cavity is determined by eliciting shifting dullness. When the patient is on his back the fluid gravitates down to the flanks and the intestine floats on the center of the abdomen, which will be resonant, and the flanks dull.

Auscultation: Auscultation of the abdomen offers little in the trauma patient. However presence of bowel sound in the chest means diaphragmatic rupture. The silent abdomen (absent bowel sound) is a pathagnomonic feature of silent/diffuse peritonitis.

Pelvis: External genitalia and rectum should be examined for any injury. On rectal examination sphincter tone, integrity of bowel wall and presence of blood should be noted. High riding prostate indicates post membranous rupture of urethra.

Vascular system: All the major arterial sites should be looked for hematomas and bleeding due to disruption. Distal pulses should be palpated. Four quadrant aspiration will reveal blood if there is hemoperitoneum. Commonest organs injured (international series).

The most common organ to be involved is the spleen. The following table shows the frequencies with which different abdominal organs are injured in a blunt abdominal trauma, according to international series.

INITIAL RESUSCITATION OF PATIENTS AT CASUALITY:

Injured patient may have multiple organs involved.

The goals of management are in the order of priority.

1. To save life

2. To save limb.

3. To minimize disability.

4. Cosmetic care.

Successful resuscitation requires an approach predicting, prioritizing injuries. There are four categories of injury depending on seriousness of injury.

1. **Exigent-** the most life threatening conditions, requiring instantaneous intervention (eg: laryngeal fracture with complete upper airway obstruction and tension pneumothorax)

2. **Emergency-** those conditions requiring immediate intervention, certainly within the first hour. (eg: ongoing hemorrhage and intracranial mass lesions)

3. **Urgent-** those conditions requiring intervention within first few hours (eg: ongoing hemorrhage and intracranial mass lesions)

4. **Deferrable-** those conditions that may or may not be immediately apparent but will subsequently require treatment. (eg: urethral disruption and facial fractures). This group is composed primary of patients who have sustained

blunt trauma to the abdomen that may or may not require surgical intervention and in whom the exact nature of the injury is not apparent.

Adequate airway:

This is the first and foremost important emergency measure of a severely injured patient. It may be obstructed in coma, trauma to head, face or neck, foreign body like clots, food, vomitus and laryngeal edema. Maintain airway by chinlift, jaw thrust, oral airway (in unconscious patients) and nasal airway. Protect airway from foreign bodies. Provide airway by endotracheal intubation or surgical intervention- needle cricothyroidectomy and tracheostomy. An emergency room should always have a laryngoscope and cuffed endotracheal tubes of various sizes. Endotracheal intubation is the most rapid method of obtaining an adequate airway. This is connected to an ambu bag for positive pressure breathing. Either wall suction or a portable suction machine should be available in the emergency room to remove pulmonary secretions, foreign bodies and frequently blood from the upper respiratory tract.

Breathing:

This implies normal ventilation, perfusion and pulmonary circulation. It will be disturbed in rib cage injuries, pleural space collections, tracheobrochial injuries or in lung contusions, metabolic disturbances and ARDS. Provide supplemental oxygen- by mask or nasal catheter at a rate of 8 liters/ min. Stabilize chest

defects. Assist ventilatory effort to maintain normal rate, rhythm and arterial blood oxygen and co2. Evacuate pleural space collections like air or blood by aspiration or intercostal drains connected to underwater sealed containers.

Circulation:

Generalized hypoperfusion (fatal if persistent) may result from oligemic, cardiogenic, endotoxic and neurogenic shock. Local limb hypoperfusion may result from injured blood vessels and may lead to tissue destruction and death of affected organ. Prevent further blood loss by direct pressure. Replace fluid losses- trendelenberg position, auto transfusion, whole blood transfusion. Resuscitate by IV sodium chloride or ringer lactate. Correct acidosis. If required (ph <7.25) inject sodium bicarbonate. Monitor sensorium, urine output, pulse rate, ECG and data from CVP line (if facilities are available). Shock is usually controlled while the patient's airway is cleared by another person. Internal hemorrhage will require immediate surgical intervention. Hypovolemic shock is best prevented or controlled by starting intravenous infusion in atleast 2 extremities. A balanced solution like Ringer's lactate is usually started until blood is available. Blood for typing and cross matching is also drawn. Response to therapy is monitored by skin perfusion, urine output and CVP readings.

Disability/ neurological assessment:

After an adequate airway has been obtained and hemorrhage has been controlled, a gross neurological evaluation is under taken. The level of consciousness, pupillary response and motor function of the four extremities should be verified. A progressing neurologic deficit following injury to spinal cord may indicate the necessity for an emergency laminectomy. It is worth noting that pupillary response can still be assessed in paralyzed patient.

Exposure for complete examination:

After having treated for most life threatening injuries, the next step is to re-examine the patient for the purpose of diagnosing other injuries. Complete physical examination is typically done in a head to toe manner and includes ordering and collecting data form appropriate laboratory and radiological investigation, for the placement of additional lines, catheter (nasogastric, Foley's) and monitoring devices.

DIAGNOSTIC METHODS

The following are the useful diagnostic methods in blunt abdominal trauma.

1. Four quadrant abdominal tap.
2. FAST
3. Plain radiography and contrast studies.
4. Ultrasound of the abdomen.
5. Abdominal CT scan.
6. Angiographic studies.

7. Radionuclide imaging.

8. Laparoscopy.

1. <u>Four quadrant abdominal tap:</u>

Simple needle aspiration has been used for a long time to diagnose abdominal injuries. Aspiration by a large bore needle (18G) is done in right and left hypochondrium and right and left iliac fossa. The accuracy is about 80% but it is argued to have inherent risk of causing visceral injuries. But this has been disproved at large. Aspiration of even a drop of blood that does not clot is diagnostic of hemoperitoneum. But a negative tap does not rule out hemoperitoneum.

2. <u>FAST:</u>

As quality ultrasound machines have become portable there is an increasing trend of their application in the initial evaluation of blunt abdominal trauma. Ultrasound can demonstrate the presence of free intraperitoneal fluid as well as the extent and precise location of solid organ hematomas.

- FAST sensitivity of 85% for detection of any intraabdominal injury.
- only intra abd surgical injury can be missed is mesenteric injury.
- Of the other missed injuries, extraperitoneal
- FAST in the hypotensive patient is an effective screening tool

Advantages: No use of radiation or contrast media.

Widely available.

Disadvantage:

Difficult to scan in presence of lower rib fracture, extensive skin lesions, soft tissue injuries and dressings. Studies have shown DPL was superior to ultrasound scan in assessing the need for surgical intervention.

Conclusion: Ultrasound of the abdomen can be used as complementary to DPL in the evaluation of blunt injury of abdomen.

3. Plain radiography and contrast studies:

Radiological procedures in a stable patient with blunt abdominal injury may be helpful especially when physical examination and lab investigations are inconclusive. Plain x ray abdomen should be done before other invasive tests such as paracentesis, in order to avoid confusion in detection of free air in the peritoneal cavity. Should include AP view chest, supine abdominal and erect abdominal or left lateral decubitus view, if the patient cannot stand.

Chest radiograph will help in detecting thoracic and diaphragmatic injuries. Air under the diaphragm will be found in patients with gastric, duodenal, small intestine and colonic perforations. Presence of rib, pelvic, vertebral body and transeverse spinous process fractures can be made out. General findings in case of blunt trauma would be:

a. Displaced bowel loops.

b. Enlargement or displacement of the viscera.

c. Presence of fluid where these should be made out.

d. Examination with water-soluble contrast reveals extravasation secondary to rupture, displacement and mucosal thickening due to edema and obstruction due to hematoma or incarceration.

e. Splenic outline can be made out.

f. Free intraperitoneal air is defined with horizontal beam films and is seen sub diaphragmatically on erect films and sub hepatic space on left lateral decubitus. Retroperitoneal air remains more localized and is not altered greatly with the change in the position of the patient. It is commonly associated with retroperitoneal rupture of duodenum. Also occurs with tears of retroperitoneal portion of the colon or rectum. The air has a streaky appearance over the psoas muscle and can extend to outline kidney and pancreas.

g. At least 800ml of intraperitoneal blood is required to be evident on plain abdominal radiograph. The following supporting signs may be observed.

The flank stripe sign: is a fluid dense zone separating the ascending or descending colon from the distinctly outlined lateral peritoneal wall and the colon is displace medially.

The dog ear sign: results from the accumulation of blood that gravitate between the pelvic viscera and the sidewalls of each side of the bladder.

The hepatic angle sign: is loss of definition of the usually clearly defined inferior and right lateral borders of the liver as blood accumulates between the hepatic angle and the right peritoneal wall.

Hemoperitoneum causes small bowel to shift towards the centre of the abdomen with the production of ground-glass appearance.

Diaphragmatic trauma: Plain x ray abdomen shows:

Malposition of the nasogastric tube is often the first sign of a ruptured left diaphragm.

Mediastinal shift to the side opposite of the injury, bowel loops above the diaphragm are seen.

In duodenal rupture both intra and retroperitoneal x ray studies are diagnostic. Free air or retroperitoneal air will be demonstrated as water soluble contrast will delineate the site. Intramural hematomas at the duodenum can be diagnosed by plain and contrast films.

In pancreatic injuries, enlargement of pancreas namely, widening of the duodenum sweep impression on the posterior aspect of the stomach, separation of the stomach from the transverse colon and depression of the transverse colon can be seen. Impression on splenic flexure gas shadow termed as colon cut off sign is also seen. Left psoas margin may be blurred.

4.Ultrasound of abdomen1:

As quality ultrasound machines have become portable there is an increasing trend of their application in the initial evaluation of blunt abdominal trauma. Ultrasound can demonstrate the presence of free intraperitoneal fluid as well as the extent and precise location of solid organ hematomas.

Advantages: No use of radiation or contrast media.

Widely available.

Disadvantage: Immediate availability of an experienced

Ultrasonographer.

Difficult to scan in presence of lower rib fracture, extensive skin lesions, soft tissue injuries and dressings. Studies have shown DPL was superior to ultrasound scan in assessing the need for surgical intervention.

Conclusion: Ultrasound of the abdomen can be used as complementary to DPL in the evaluation of blunt injury of abdomen.

5. Computarized tomography of abdomen (CT scan): This can provide important diagnostic information on abdominal injuries. It plays an important role in the evaluation of blunt abdominal trauma when applied in appropriate setting.

Four groups of patients are particularly suitable for CT scanning:

1. Patients with delayed (<12hours) presentation who are hemodynamically stable and do not have overt signs of peritonitis.

2. Patients in whom tapping results are equivocal and the results of repeated physical examination are unreliable.

3. Patients in whom tapping is difficult to perform (eg: morbid obesity, late term pregnancy or multiple previous laparotomies); peritoneal adhesions pose a technical problem to catheter placement.

4. Patients at risk for retroperitoneal injuries .

Advantages:

It is an excellent means to diagnose intraperitoneal hemorrhage. It gives excellent views of spleen and liver permitting precise anatomic diagnosis of solid viscus injury. It is also the best in diagnosis of retroperitoneal injury. Stomach, duodenum, pancreas can be diagnosed with high degree of accuracy. Intravenous contrast permits excellent imaging of the kidneys and ureters.

Disadvantages:

The retroperitoneal colon injury is rarely delineated.

CT scan is poor for the diagnosis of intraperitoneal hollow viscus injuries and early pancreatic injuries. Requires a proper set up and proper interpretation of films. Scanning abdomen takes a minimum of 45-60 minutes and it is difficult to monitor the patient during the investigation. In hemoperitoneum more than 100ml of blood in the cavity will be detected.

Routine investigations: Hemoglobin, hematocrit, blood grouping and Rh typing, serum amylase and alkaline phosphatase, urinalysis, blood urea, serum creatinine, blood sugar, chest x ray and ECG are to be done.

MANAGEMENT OF INDIVIDUAL ORGAN INJURIES

Small bowel injuries:

Owing to the large volume of peritoneal cavity occupied by the small bowel, it is the intra abdominal organ most frequently injured with penetrating trauma and it is the third most frequently injured organ (following the liver and spleen) in blunt trauma. Small intestinal injury occurs in 5-15% of cases in blunt abdominal trauma but the incidence varies according to socioeconomic status and geographic location. Three mechanisms involved in causing small bowel injuries are crushing, shearing and bursting injuries.

Crushing or direct impact injury: a violent force directly applied to the abdomen can crush intestines between the force and lumbosacral spine such as in seat belt injury. The characteristic injuries produced are large perforations with frank disruptions with mesenteric mutilation and associated injuries to other organs.

Shearing injury: shearing injuries occur with sudden deceleration in the lateral and horizontal plane during vehicle accidents where small bowel gets avulsed and torn from points of fixation, including the ligament of Trietz and ileocecal

valve, where the foreshortened mesentery serves as a tethering point. It may also occur following fall or jump from heights (vertical deceleration).

Bursting injuries: injuries occur when fluid filled loops of small intestine burst following a sudden increase in abdominal pressure due to formation of a temporary closed loop causing isolated small bowel injuries with punctuate or slit like rents.

Small bowel injury scale is as follows:

Grades Injury description

I Hematoma Contusion or hematoma without devascularisation

Laceration Partial thickness, no perforation

II Laceration Laceration<50% of circumference

III Laceration Laceration>50% of circumference without transection

IV Laceration Transection of small bowel

V Laceration Transection of the small bowel with segmental

Tissue loss or Devascularized segment.

Diagnosis: the diagnosis of blunt injury to the small intestines is often difficult due to lack or late appearance of physical signs. It may take several hours before classical signs of peritonitis are evident, given the typically slow leakage of intestinal contents, which are minimally irritant to the peritoneum. Impaired sensorium due to head injury may add to the difficulty.

Pain abdomen following blunt injury, tenderness, guarding, and rigidity of varying grade should arouse the suspicion of small gut injury till not proved otherwise by various diagnostic tests. An upright chest x ray will demonstrate gas under the diaphragm in 20-50% of cases.

Management:

There is no role of conservative management in small intestinal injury. Midline incision is preferred. The entire small intestine must be carefully examined from the ligament of Trietz to ileocecal valve, including all mural surfaces and mesenteric attachements.

Perforations: most perforations are closed by primary repair. Edges are debrided till it bleeds and two layers closure done. i.e inner layer of absorbable and outer layer of silk. When there are multiple perforations in a close area or the closure of large laceration results in narrowing, resection anastamosis is done. Resection anastamosis should not be performed in last 15cms of ileum due to precarious blood supply. Rather end to side ileocolic anastamosis is preferred. Peritoneal cavity must be liberally irrigated with warm saline and particulate matter removed. Drains are optional.

Mural damage without perforation: the management of contusions and intramural hematomas of the small intestines require assessment for consideration of resection and anastamosis verses leaving the intestines in situ and opting for observation and second look surgery. Clinical judgement by

observing the involved segment for signs of intestinal viability such as active peristalsis and color through out the procedure is important. Small mucosal hematoma (<1cm), nonexpanding may be turned in by a series of interrupted sutures. For larger mucosal hematoma transmural debridement/ segmental resection should be done whenever there is doubt regarding viability.

Mesenteric hematoma: assessment should be done to define the size, stability, i.e. is it expanding or non expanding, contained or has ruptured the mesenteric folds. Exploration is required for large, expanding and uncontained hematoma.

At exploration, the involved mesentery proximal to the hematoma (towards the base) should be examined and if possible site of vascular control defined. Manual compression is then applied to that hematoma, bisecting it. Following careful evacuation of clot, bleeding points are individually controlled with silk sutures. Viability of intestine distal to the area of vascular damaged must be determined and accordingly dealt with.

Injuries to the base of mesentery associated with large hematoma may cause severe bowel ischemia to the entire length of small bowel. Collateral flow is often inadequate to maintain viability. Resection under these circumstances is unsuccessful and vascular repair by interposition or patch graft of the involved vessels is mandatory. When large areas of ischemic bowel are in question one may opt for second look surgery/ re laparotomy.

Complications: post operative complications are missed injury, bleeding, suture line leak, anastomotic disruption, fistula formation, obstruction and abscess.

Missed injuries can be avoided if one carefully screens the whole intestine from ligament of Trietz to ileocecal junction. One should be careful towards the mesenteric border of the intestines where small perforation may be missed.

Hemorrhage: intraluminal blood loss may occur at suture lines, anastamosis, or areas of bowel contusion. Hemoglobin may fall, tachycardia may be present and patient may have malena or hematochezia depending on the amount of blood loss. If the patient does not respond to conservative treatment reexploration should not be delayed.

Suture line disruption and fistula: diagnosis is often difficult in postoperative period. Patient, who was progressing well, develops pain abdomen, distension, absent or decreased bowel sounds, tachycardia and fever are the indicators of suture line leak. When disruption has taken place, prompt recognition is mandatory and treatment consists of reexploration after resuscitation; edges are debrided and anastamosis performed. Sometimes intra abdominal sepsis is far advanced and the bowel loops are adherent and friable. Temporary jejunostomy/ ileostomy may be life saving.

Fistula formation is rare and if there is no distal obstruction these heal spontaneously.

Colon and rectal injuries:

Colon and rectal injuries: blunt abdominal trauma to the colon is rare and constitutes about 4-6% of all blunt abdominal injuries usually caused by road traffic accidents. The injury involves more than one organ system.

Mechanism of injury: the bowel may be compressed against vertebral column or burst by a sudden blow against a distended loop. Sudden deceleration may tear the bowel or disrupt its mesentery. Crush injury may damage the colon or rectum in two ways. Pelvic fracture may produce perforation of the rectum by bone spicules, and occasionally, an explosion injury associated with valsalva at the time of crush may occur. Mortality rate ranges from 3-10%.

The extra peritoneal rectum is usually injured in association to the pelvis. This portion of the rectum is more or less fixed to the pelvis; thus may sustain severe injury in common with pelvic fracture. The site of trauma in intra peritoneal injury to the large bowel is usually near the junction of the mobile and fixed portion such as junction of the sigmoid and descending colon. Injury may be to the bowel or mesentery. Injuries to the mesentery results in hemorrhage; if to the bowel; it results in contusion, intra mural hematoma or laceration (partial or complete). Most of the injuries will be recognized and dealt as acute problem. Few may manifest later as colocutaneous fistula and post traumatic stenosis.

Injuries to extra peritoneal rectum are due to:

1. Fractured pelvis lacerating the rectum by a bony spicule.

2. Avulsion at the rectum as a result of tremendous bursting force. Avulsion may be partial or complete. Organ injury scale for colon and rectum is as follows.

Colon injury scale:

Grade Injury description

I Hematoma Contusion or hematoma without devascularisation

Laceration Partial thickness, no perforation

II Laceration <50% of circumference

III Laceration >50% of circumference without transection

IV Laceration Transection of the colon

V Laceration Transection of the colon with tissue loss

Advance one grade for multiple injuries upto grade III

Diagnosis of the injuries:

Following injury varying intensity of pain in abdomen is present. Tenderness, guarding and rigidity may or may not be present. Shock is due to blood loss as a result of other associated injuries and not due to colonic injuries. Occasionally, symptoms of peritonism may take few hours or days to develop. There may be blood on finger on per rectal examination or tenderness in pelvic peritoneum may be noticed. When bleeding is present per rectal examination should be followed by proctoscopy and rigid sigmoidoscopic examinations. Plane x ray may show gas under the diaphragm. USG abdomen may not

contribute much. Enema with water soluble contrast CT scan in selected cases may be done where the symptoms are minimal and the diagnosis is doubtful. High index of suspicion and repeated clinical examination is mostly rewarding. Clinical deterioration in the patient's status, increased abdominal tenderness, an evolving pattern of sepsis, and development of paralytic ileus or mechanical obstruction are common findings in patients with either a missed injury or delayed perforation. And majority of colon injuries are diagnosed intra operatively.

Surgical options available are:

1. Primary closure without colostomy.
2. Primary closure with de functioning colostomy.
3. Resection and anastamosis.
4. Exteriorisation of injured colon/colostomy.
5. Exteriorised repair.

A number of factors have been identified which contribute to postoperative complications and influence the choice of procedure.

Risk factors:

Shock, fecal contamination, associated injuries, interval from injury to repair, mechanism of injury, severity of colon injury and location of injury.

Methods of repair:

Primary repair (simple suture): simple suture is resumed for clean low velocity injuries that require debridement and involve less than 25% of the colon circumference. The criteria are minimum blood loss, minimum fecal contamination, within 8 hours of injury.

Accepted contraindications for primary closure are:

• Prolonged or persistence hypotension

• Greater than 6 hour delay between injury and surgical intervention

• Gross fecal spillage

• Extensive damage to abdominal or retroperitoneal muscle

• Significant hemoperitoneum

• Multiple coexistence visceral injuries

• Devitilization of more than one fourth of the colon wall

• Impairment of blood supply to the injured segment

• Colon injury grade 3 or more

Most of the authors report primary repair in 50-65% of their patients. The technique involves thorough and meticulous debridement of the wound edges followed by a standard two layer closure (an inner layer of running or interrupted absorbable sutures followed by an outer layer of interrupted silk Lembert sutures). Prior to facial closure, the abdomen is liberally irrigated with saline and all particulate matter is removed. Drains are normally not indicated.

The skin and subcutaneous tissue may be closed primarily with or with out a subcutaneous drain/ or by delayed primary method.

Primary resection and anastamosis: this procedure is ideal when there are extensive wounds of the right colon. Right hemicolectomy with ileocolic anastamosis can be accompanied with reasonable dispatch and an acceptable rate in the majority of patients. Hemodynamically unstable patients should have ileostomy, if, taking time for anastamosis will jeopardize their survival. Primary anastamosis may be performed in the left colon following resection of extensively damaged portion but it should be protected by a proximal colostomy.

Colostomy: indications for colostomy are: when the condition of the patient precludes taking the time to make a repair or anastamosis; when a distal anastamosis may be tenuous, when extensive distal destruction of the colon would require a low rectal anastamosis. It may be accomplished by:

1. Exteriorization.
2. Defunctioning colostomy
3. End colostomy and Hartmann procedure.

Exteriorization of the colon: it is the most rapid method available for managing a colon injury. Even in the fixed portions of the colon, mobilization can be accomplished quickly. If exteriorization is selected as an option, a small

lateral incision is made and the two limbs of the mobilized colon are brought out as a double barreled colostomy.

Defuctioning colostomy: it is performed by separating the limbs and bringing each out as a single stoma.

Closure of colostomy: colostomy closure at 1 to 2 postoperative months is associated with a lower morbidity. Prior to closure, colonoscopy and barium enema should be employed to confirm an adequate lumen and complete healing.

Exteriorized repair: this procedure should be reserved for the rare patient on whom primary repair is in question. It is usually done when there is anti mesenteric injury from the mid ascending colon down to the sigmoid.

Rectal injuries:

Blunt injury to rectum is typically a crushing or compressive force applied to the pelvis or lower abdomen, as would occur when the victim has been struck or run over by a motor vehicle. Patients with massive blunt pelvic trauma should be viewed with a strong index of suspicion. Abdominal x ray should be obtained to see for retroperitoneal air. Procto sigmoidoscopy is done for direct visualization of the injury.

Peritoneal irritation, gross blood on rectal examination or full thickness injury noted on proctosigmoidoscopy is indication for operation. Patients with an

expanding abdominal girth or gross positive peritoneal lavage should be operated on.

Management:

Early definitive surgical management is indicated in any patient with following condition:

• Endoscopically visualized anorectal injury, regardless of associated injuries.

• A possible anorectal injury; clinically suspected but not identified.

• Open pelvic fracture, whether or not anorectal injury has been identified.

Management of rectal injury rests on the three D's:

• Diversion

• Debridement

• Drainage

Diversion: this is the most important step in the management of the injured rectum. A total diverting loop colostomy is adequate. Some surgeons use diverting colostomy, only when the injury is above the levators or dentate line. For anorectal injuries, below the dentate line, routine colostomy is not indicated.

Debridement and suturing: if anorectal injury is readily accessible to transanal approach, wound approximation using a single layer of running 3/0

absorbable suture may be attempted. If the sphincter mechanism has been injured, muscle approximation is performed using interrupted horizontal mattress 3/0 absorbable sutures. The anal mucocutaneous junction is left open for drainage purposes. Rectal injuries can be closed relatively easily through the abdominal incision by opening the peritoneum and freeing the upper rectum as is done in elective resection. Repair of intraperitoneal rectal injury may be undertaken using the same criteria as in colon injury.

Drainage: should be presacral and through the perineum by penrose type drains or suction drainage and should be brought out just anterior to the coccyx.

Distal wash out: is accomplished by irrigating the distal colostomy stoma with dilute povidone solution through dilated anus until effluent is clear.

Bladder injuries: Urinary bladder is located deep within the bony pelvis and hence blunt trauma to bladder is rare. It commonly occurs following application of blunt external force to a fully distended bladder and usually associated with fracture pelvis. Classically described as intraperitoneal or extraperitoneal injury; depending on the site of injury. Extraperitoneal injuries occur in 75% of the cases and are generally in association with fractures of the pelvis. About 8 to 10% of pelvis fractures cause bladder injury due to laceration by the bony fragments. Intraperitoneal injury to the bladder occurs in about 25% of cases and follows application of blunt force to a fully distended bladder or in motor cycle accidents or fall from height.

Clinical features: Presentation of bruising over the lower abdomen, tenderness which is not well localized. Extravasation of urine and inability to void urine or hematuria may be present.

Diagnosis: Plane X ray pelvis confirms presence of fracture pelvis and the position of the fracture fragments. Cystogram is diagnostic. 250-300 ml of sterile contrast material is used to distend the bladder. Free flow of contrast in the peritoneal cavity is classical, highlighting the bowel loops in intraperitoneal rupture. Drainage films with empty bladder will establish presence of residual extravasation of urine in extraperitoneal rupture of the bladder.

Management:

Extraperitoneal rupture: Open primary repair of the bladder in one or two layers with absorbable sutures is preferable.

Intraperitoneal rupture: Open primary repair of the bladder in one or two layers with absorbable sutures is preferable. It allows for inspection of the abdominal viscera for associated injuries which can also be taken care of.

Spleen

Splenic injury occurs from direct blunt trauma. Most isolated splenic injuries, especially in children, can be managed nonoperatively. However, in adults, especially in the presence of other injury, age >55 years, or physiological instability, splenectomy should be considered. The spleen can be packed, repaired

or placed in a mesh bag. Splenectomy may be a safer option,especially in the unstable patient with multiple potential sites of bleeding and who is >55 years of age, due to risk of rebleed. In certain situations, selective angioembolisation of the spleencan play a role.

Following splenectomy, there are significant though transientchanges to blood physiology. The platelet and white count rises and may mimic sepsis

LIVER INJURY:

Blunt liver trauma occurs as a result of direct injury. The liver is a solid organ and compressive forces can easily burst the liver substance. The liver is usually compressed between the impacting object and the rib cage or vertebral column. Most injuries are relatively minor and can be managed non-operatively. Many are not even suspected at the time.

Penetrating trauma to the liver is relatively common. Bulletshave a shock wave and when they pass through a solid structure, such as the liver, they cause significant damage some distance from the actual track of the bullet. Not all penetrating wounds require operative management and a number may stop bleeding spontaneously.

In the stable patient, CT is the investigation of choice. Itprovides information on the liver injury itself, as well as on injuries to the adjoining major vascular and biliary structures. Close proximity injury and injury in which there is a suggestion of a vascular component should be reimaged, as there is a significant

risk of the development of subsequent ischaemia.

Liver injury can be graded and managed using the AmericanAssociation for the Surgery of Trauma (AAST) Organ Injury Scale (OIS)

Management

The operative management of liver injuries can be summarised

as ‘the four Ps’:

1push;

2 Pringle;

3 plug;

4 pack.

At laparotomy, the liver is reconstituted as best as possible in its normal position and bleeding is controlled by direct compression (push). The inflow from the portal triad is controlled by a Pringle’s manoeuvre, with direct compression of the portal triad, either digitally or using a soft clamp . This has the effect of reducing arterial and portal venous inflow into the liver, although it does not control the backflow from the inferior vena cava and hepatic veins. Any holes due to penetrating injury can be plugged directly and, after controlling any arterial bleeding, the liver can then be packed (see below under Damage control

surgery).

Bleeding points should be controlled locally when possible and such patients should subsequently undergo angioembolisation. It is not usually

necessary to suture penetrating injuries of the liver. If there has been direct damage to the hepatic artery, it can be tied off. Damage to the portal vein must be repaired, as
tying off the portal vein carries a greater than 50 per cent mortality rate. If it is not technically feasible to repair the vein at the time of surgery, it should be shunted and the patient referred to a specialist centre. A closed suction drainage system must be left *in situ* following hepatic surgery.

Penetrating injuries and deep tracts can be plugged using silicone tubing or a Sengstaken–Blakemore tube.
Finally, the liver can be definitively packed, restoring the anatomy as closely as possible. Placing omentum into cracks in the liver is not recommended .

MATERIALS AND METHODS

MATERIALS AND METHOD

SOURCE OF DATA

108 randomly selected patients admitted at Madras Medical College & Rajiv Gandhi Government General hospital,Chennai undergoing emergency laparotomyprocedures following trauma during time period from May 2013 to August 2014 were included in the study.

INCLUSION CRITERIA

Patients undergoing emergency laparotomy inMadras Medical College & Rajiv Gandhi Government General hospital,Chennai under general surgery department following trauma.

Post-operative patients requiring intensive perioperative monitoring in the age group of 15 – 75 years.

EXCLUSION CRITERIA

Patients managed conservatively following trauma even if there is evidence of intra-abdominal injury and critically ill patients

Various determinants such as age, sex, comorbid conditions,duration of illness, pre-op diagnosis , intra-op diagnosis, procedure executed, the surgical apgar score, the post op morbidity including complications till 30 days and the 30 day mortality are tabulated and analysed.

CLINICAL EXAMINATION

History and physical examination:

When a patient presented to casualty with a history of blunt abdominal trauma, the first priority was given to treat the immediate life threatening conditions such as airway, circulation, pneumothorax and to arrest the internal bleeding. “Patient was examined for pallor and vital parameters were recorded continuously.

Systemic examination: The systemic examination of the patient with blunt abdominal injury was done from assessing the level of consciousness and associated injuries to chest ”. The severity of head injury was rapidly assessed.

“Level of consciousness was assessed by GCS score (Glasgow Coma Scale)[2], a system that evaluate eye opening, best motor response and verbal response.

The gaping wound was sutured to control bleeding. Nasopharynx bleed was controlled by passing a Foley's catheter and inflating the bulb in the nasopharynx." Eardrum was examined for bulge due to blood.

"Visual examination and signs for any trauma was looked for. Nose and throat were examined for adequacy of airways. Tenderness on the cervical spine was examined for fracture especially associated with maxillo facial trauma.

Chest:

Careful inspection of the thorax was done noting shape, size, symmetry corresponding movements of hemithorax was also noted. Any abrasions, contusions, external wounds, dilated veins, retraction or bulging of the intercostal spaces, movements of both hemithorax any communicationg wounds with the peritoneal cavity were noted."

Other injuries

Absent discomfort on performing these maneuver usually excludes a major pelvic fracture. "On rectal examination sphincter tone, integrity of rectal wall and the presence of blood was looked for. The presence of high riding or non-palpable prostate was looked for as it supports the diagnosis of postmembranous disruption of the urethra". Testis and external genitalia was examined carefully for tenderness, laceration. The presence or absence of blood at the penile meatus was also noted.

Pelvis: External genitalia and rectum was examined for any injury. On rectal examination sphincter tone, integrity of bowel wall and presence of blood was noted. High riding prostate was examined.

Vascular system: All the major arterial sites was looked for hematomas and bleeding due to disruption. Distal pulses was palpated.

INITIAL RESUSCITATION OF PATIENTS AT CASUALITY:

Injured patient had multiple organs involved and quick initial clinical assessment was done in casuality before subjecting the patient for radiological investigations.

DIAGNOSTIC METHODS

The following were the useful diagnostic methods in blunt abdominal trauma.

1. Four quadrant abdominal tap:

Simple needle aspiration wasdone to diagnose abdominal injuries. Aspiration by a large bore needle (18G) was done in right and left hypochondrium and right and left iliac fossa.

2. FAST:

FAST was done in trauma patients before shifting the patients for radiological investigations,and noted for free fluid abdomen and solid organ injury.

4. **Plain radiography and contrast studies:**

Plain Xray abdomen erect and Xray of long bones was done for all trauma patients before other invasive tests such as paracentesis, in order to avoid confusion in detection of free air in the peritoneal cavity.

4.Ultrasound of abdomen:

Ultrasound was done for all patients and examined forthe presence of free intraperitoneal fluid as well as the extent and precise location of solid organ hematomas.

5. Computarized tomography of abdomen (CT scan):

CT was done mainly for the following

1. Patients who were hemodynamically stable and do not have overt signs of peritonitis.

2. Patients in whom tapping results are equivocal and the results of repeated physical examination were unreliable.

3. Patients in whom tapping was difficult to perform (eg: morbid obesity, late term pregnancy or multiple previous laparotomies); peritoneal adhesions pose a technical problem to catheter placement.

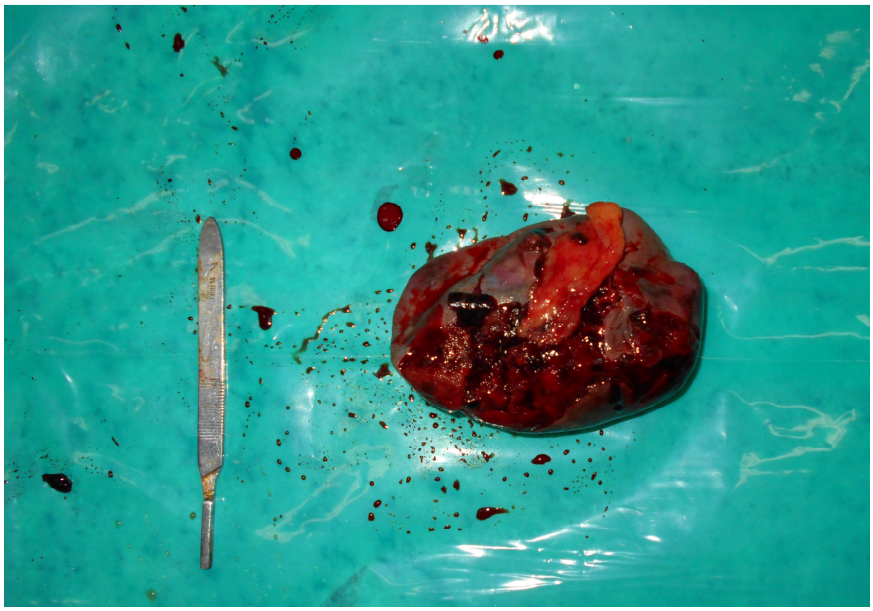
4. Patients at risk for retroperitoneal injuries .

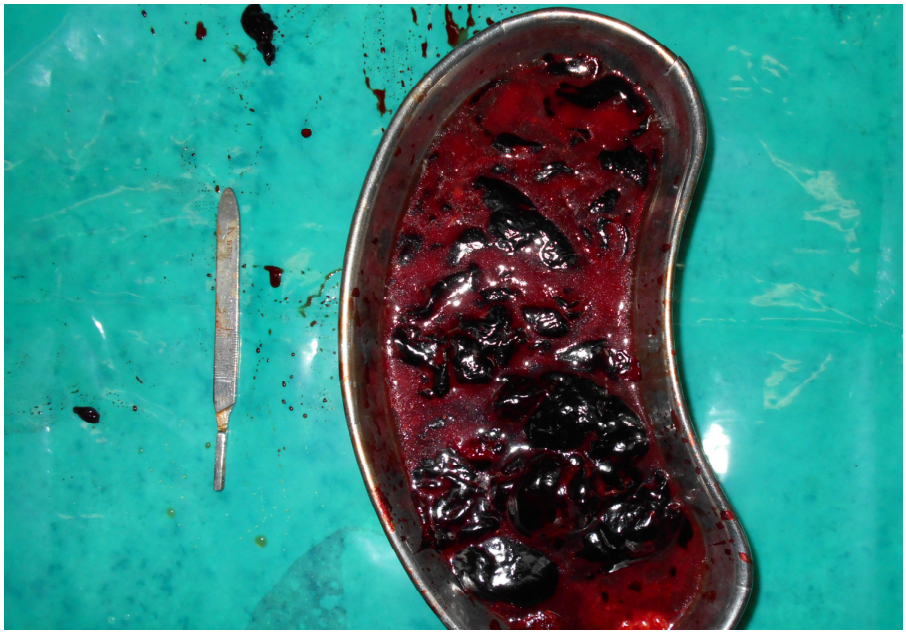
Respective speciality and superspeciality opinion sought for further management of the trauma patients based on investigations.

Based on investigations the following emergency procedures were done

SPLENECTOMY

Emergency splenectomy was the most common emergency procedure done in patients undergoing laparotomy following trauma.

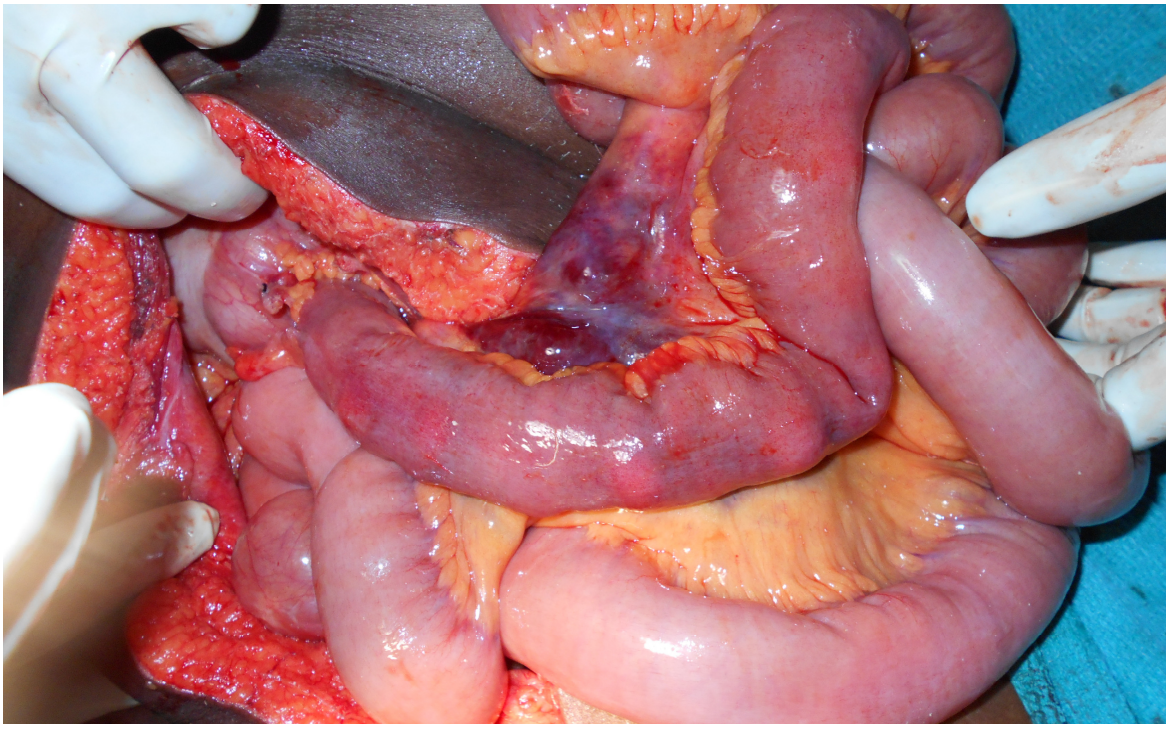




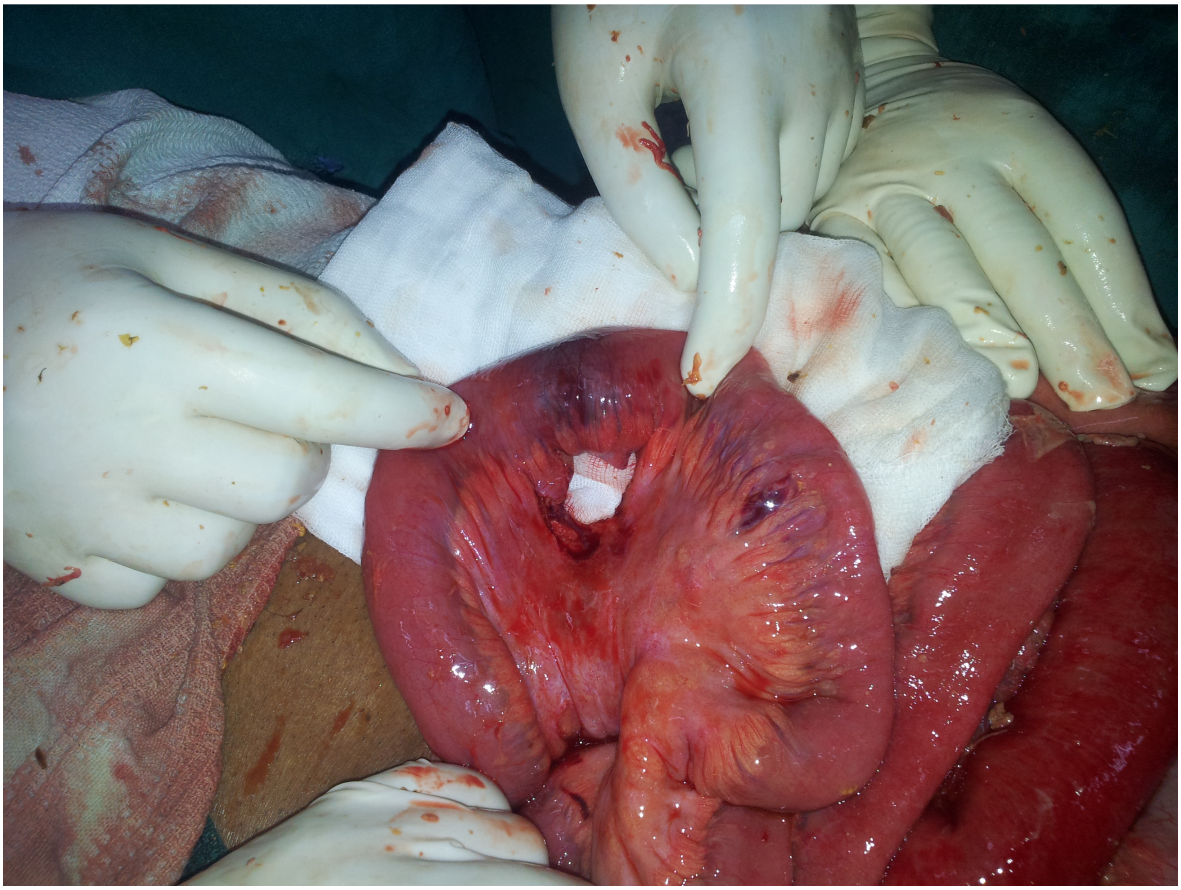
37 year old male underwent emergency splenectomy and the figure shows shattered spleen and clots removed from abdomen

MESENTRIC TEAR/CONTUSION-PRIMARY REPAIR

Assessment was done to define the size, stability, i.e. expanding or non expanding, contained or has ruptured the mesenteric folds. At exploration, the involved mesentery proximal to the hematoma (towards the base) was examined and bowel examined for viability.



1.Mesenteric contusion seen in 30 year old male who underwent emergency laparotomy following trauma,bowel segment was relatively unhealthy compared to normal bowel



40 year old male,RTA- Mesenteric tear close to bowel leading to gangrene of bowel segment,managed by resection and end to end anastomosis

LIVER LACERATION/CONTUSION

Liver laceration or contusion is another important injury following trauma

Packing the liver with abdominal pads and resuscitation remains to be the most important management in these patients.

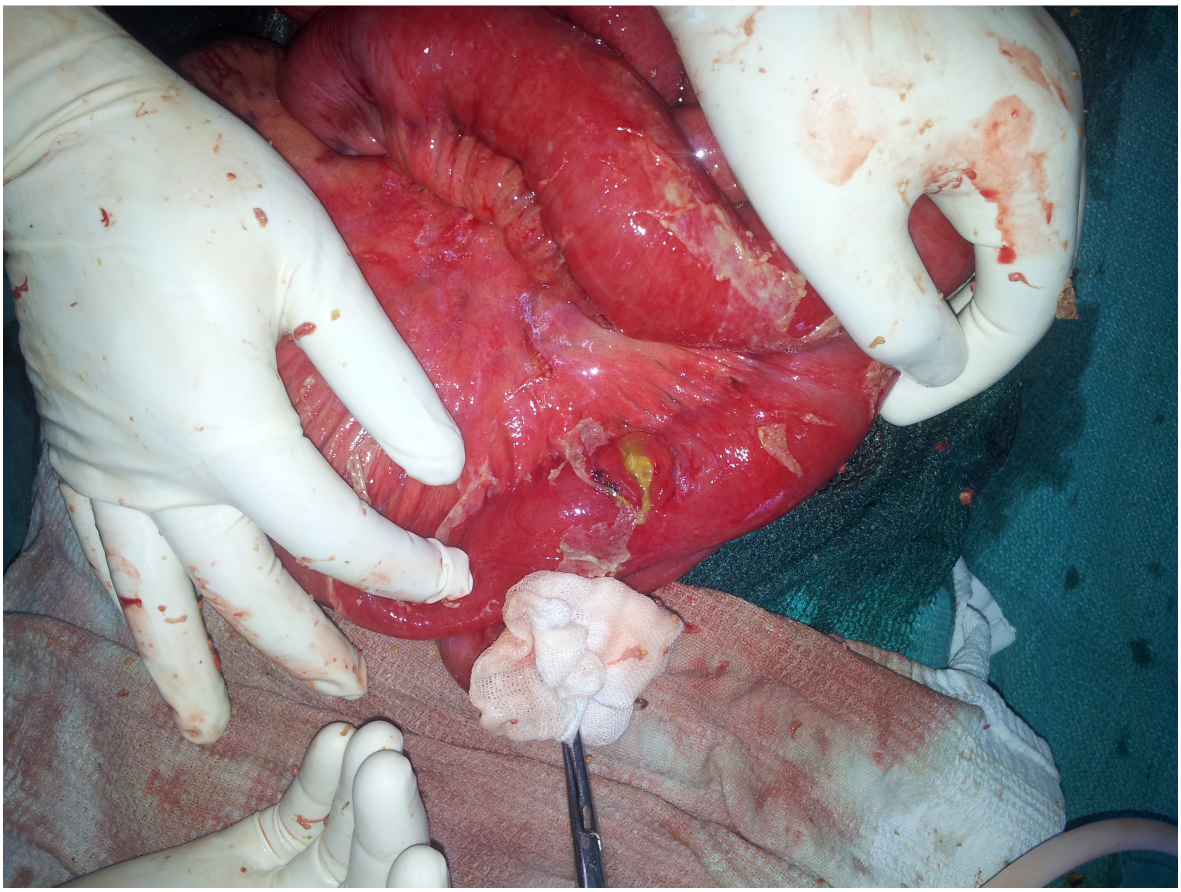
The mortality and morbidity in these patients are also high and most of these are associated with chest injury.

RETROPERITONEAL HEMATOMA

Retroperitoneal hematoma was seen in patients with solid organ injuries and were managed conservatively.

SMALL BOWEL AND COLONIC INJURIES:

Bowel laceration was sutured in two layers and colonic injuries was managed with colostomy with peritoneal drainage done.



40 year old male RTA- jejunal perforation following blunt injury abdomen managed by resection and anastomosis

Bladder injuries:

Urinary bladder injury was managed with primary repair and supra-pubic cystostomy was done.

SURGICAL APGAR SCORE

"Using parameters like i) **ESTIMATED BLOOD LOSS, ii) LOWEST HEART RATEAND iii) LOWEST MEAN ARTERIAL PRESSURE"**during the surgical procedure, thesurgical Apgar score was calculated as shown in the table 2. The cumulative scores are separated

into 3 categories .

Table 2 – Surgical Apgar Score

Surgical apgar score	**No of points**				
Variables	0	1	2	3	4
Estimated blood loss, ml	>1000	600-1000	101-600	100	---
Lowest mean arterial pressure, mm Hg	<40	40-54	55-69	70	---
Lowest heart rate/min	>85[a]	76-85	66-75	56-65	55[a]

[a] occurrence of pathologic bradyarrthymia, including sinus arrest, atrioventricular block or dissociation, junctional or ventricular escape rhythms, and systole, also receives 0 points for lowest heart rate.

b. lower the cumulative score higher the major complication rates and 30 day mortality rate

Data such as lowest heart rate and Lowest mean arterial pressures reached during the procedure are collected from the anesthesiologist's records (electronic/manual).

Estimated blood loss is calculated using the formulae [42]

Blood Loss = $[(EBV \times (H_i - H_f)) / ((Hct_i + Hct_f)/2)] + (500 \times T_u)$

Where: 1. Estimated blood volume (EBV) is assumed to be 70 cm^3/kg

2. H_i and H_f represent pre and post operative haemoglobin
3. Hct_i and Hct_f represents pre and post operative hematocrit, and
4. T_u is the sum of autologous whole blood (AWB), packed red blood cells (PRBC), and cell saver (CS) units (FFP, CRYOPRECIPITATE) transfused.

Relevant investigations are performed either invasively or non invasively and these identify the patients developing complications.

The following were the most common post-operative complications

1. Acute renal failure,
2. Bleeding that requires a transfusion of 4U or more of red blood cells within 72 hrs after surgery,
3. Cardiac arrest requiring cardiopulmonary resuscitation,
4. Coma of 24 hrs or longer,
5. Deep vein thrombosis,

6. Wound disruption,
7. Deep or organ-space surgical site infection,
8. Sepsis,
9. Septic shock and
10. Systemic inflammatory response syndrome

Superficial surgical site infection and urinary tract infection were not considered major complications.

STATISTICAL ANALYSIS:

All analyses were performed using the SPSS statistical software version 22. We analyzed categorical predictors using x^2 tests.

We performed univariate logistic regression to examine the relationship between major complication or death and the Surgical Apgar and calculated C statistics with significant p value of <0.05. The results were averaged (mean + standard deviation) for each parameter forcontinuous data and numbers and percentage for categorical data. Proportions were compared using Chi-square test of significance. We used x^2tests and the Cochran- Armitage trend test toevaluate the relationship between the score and the incidence of outcomes in emergency laparotomy procedures following trauma.

RESULTS

RESULTS

108 cases of emergency laparotomy following trauma in MMC & RGGGH during time period of May 2013- August 2014 were taken up for study and findings were tabulated as follows

1 - SEX WISE DISTRIBUTION OF CASES:-

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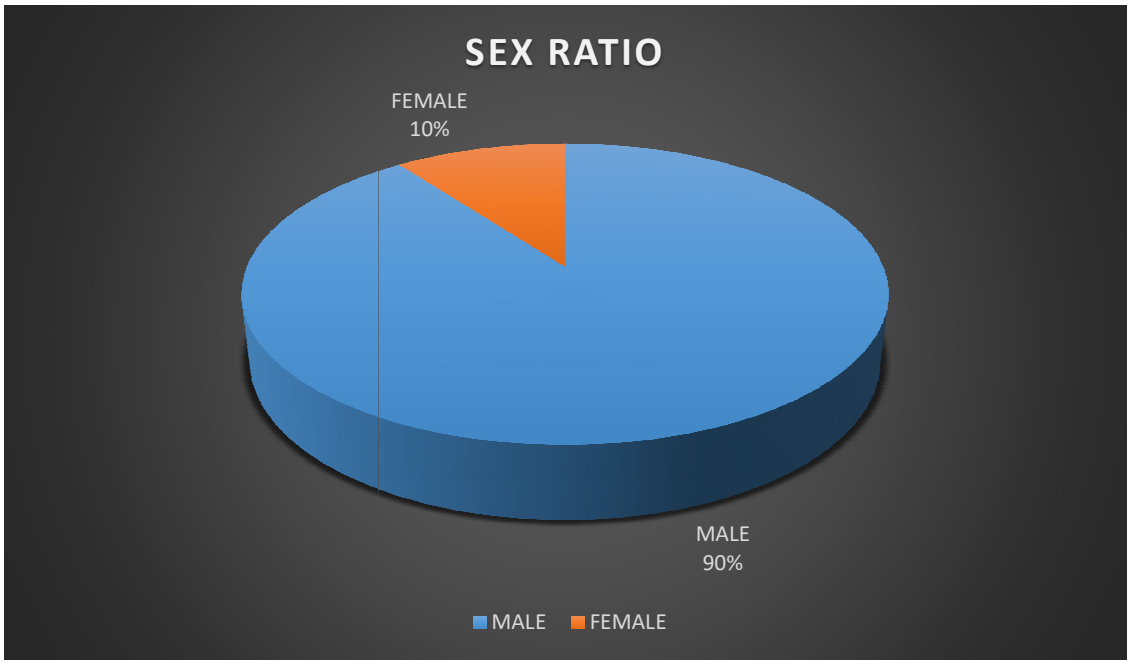
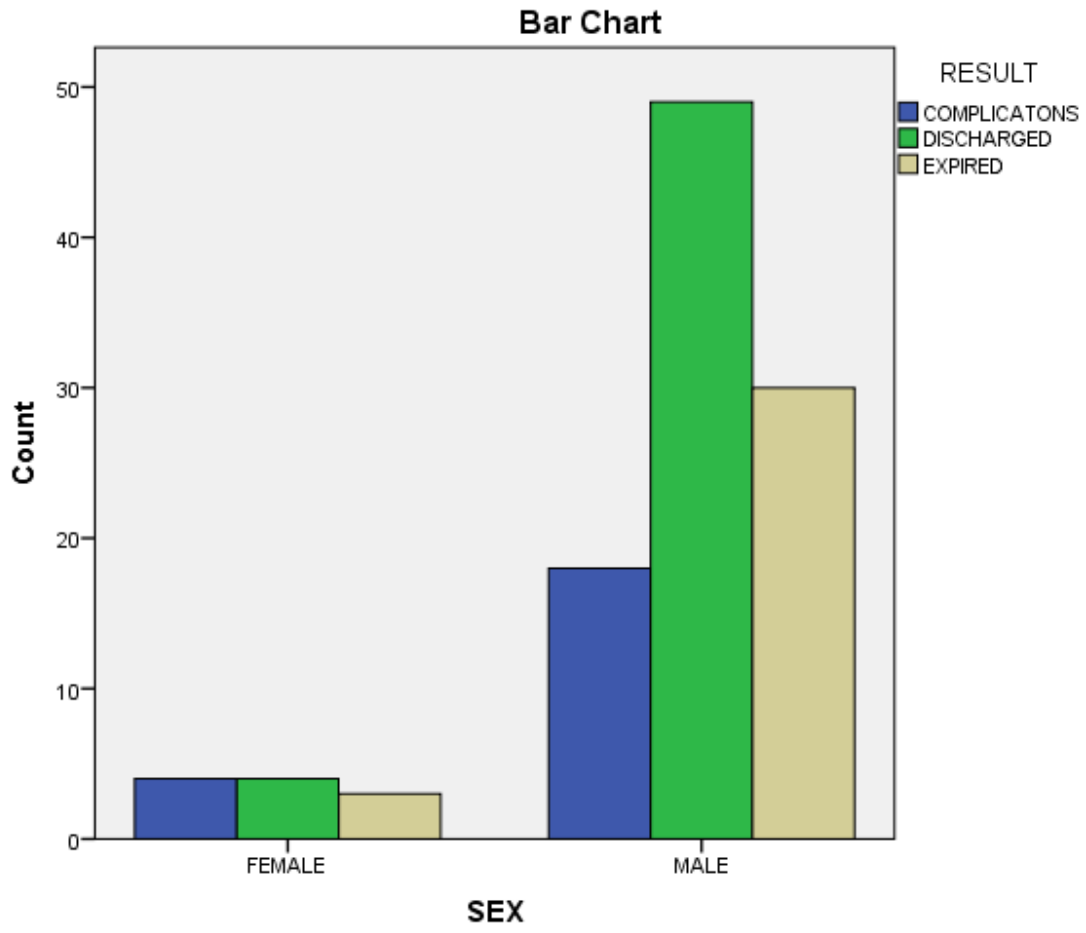


2.RELATION BETWEEN SEX AND PROGNOSIS

SEX AND PROGNOSIS

Count

		RESULT			
		COMPLICATONS	DISCHARGED	EXPIRED	Total
SEX	FEMALE	4	4	3	11
	MALE	18	49	30	97
Total		22	53	33	108

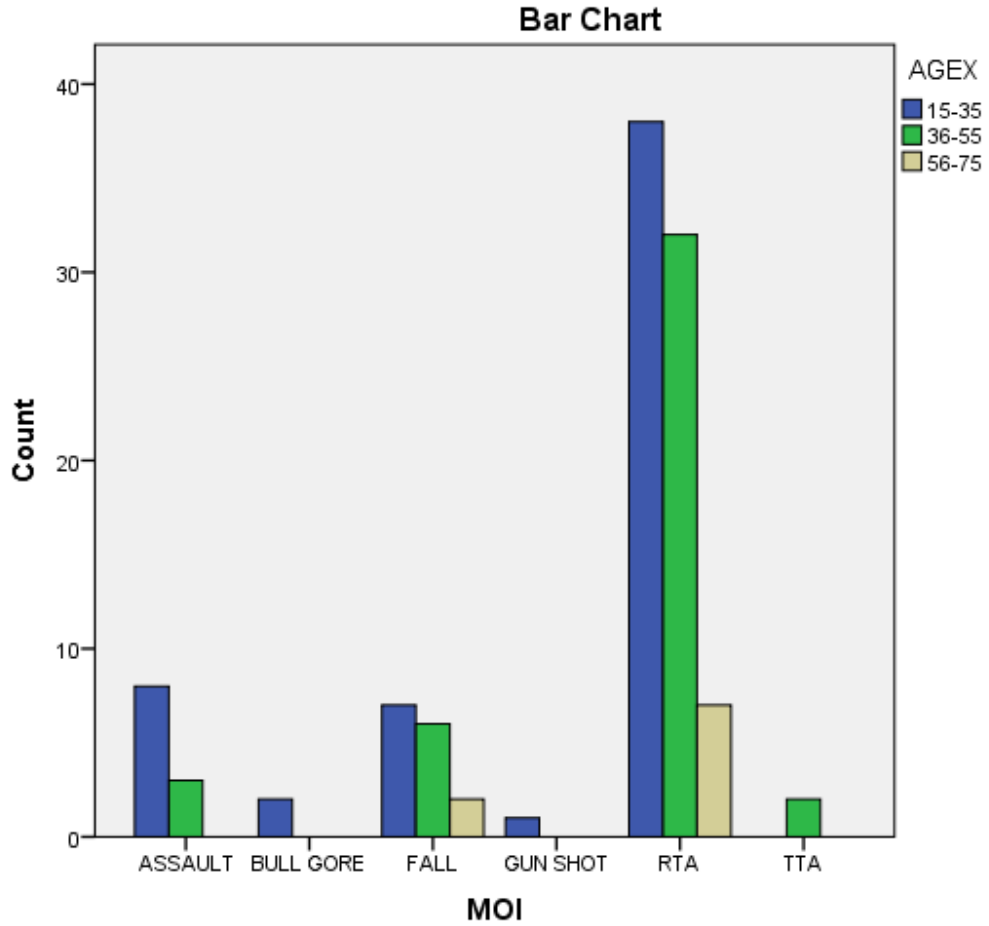


3.RELATION BETWEEN AGE AND MODE OF INJURY

MODE OF INJURY AND AGE

Count

		AGEX			
		15-35	36-55	56-75	Total
MODE OF INJURY	ASSAULT	8	3	0	11
	BULL GORE	2	0	0	2
	FALL	7	6	2	15
	GUN SHOT	1	0	0	1
	RTA	38	32	7	77
	TTA	0	2	0	2
Total		56	43	9	108

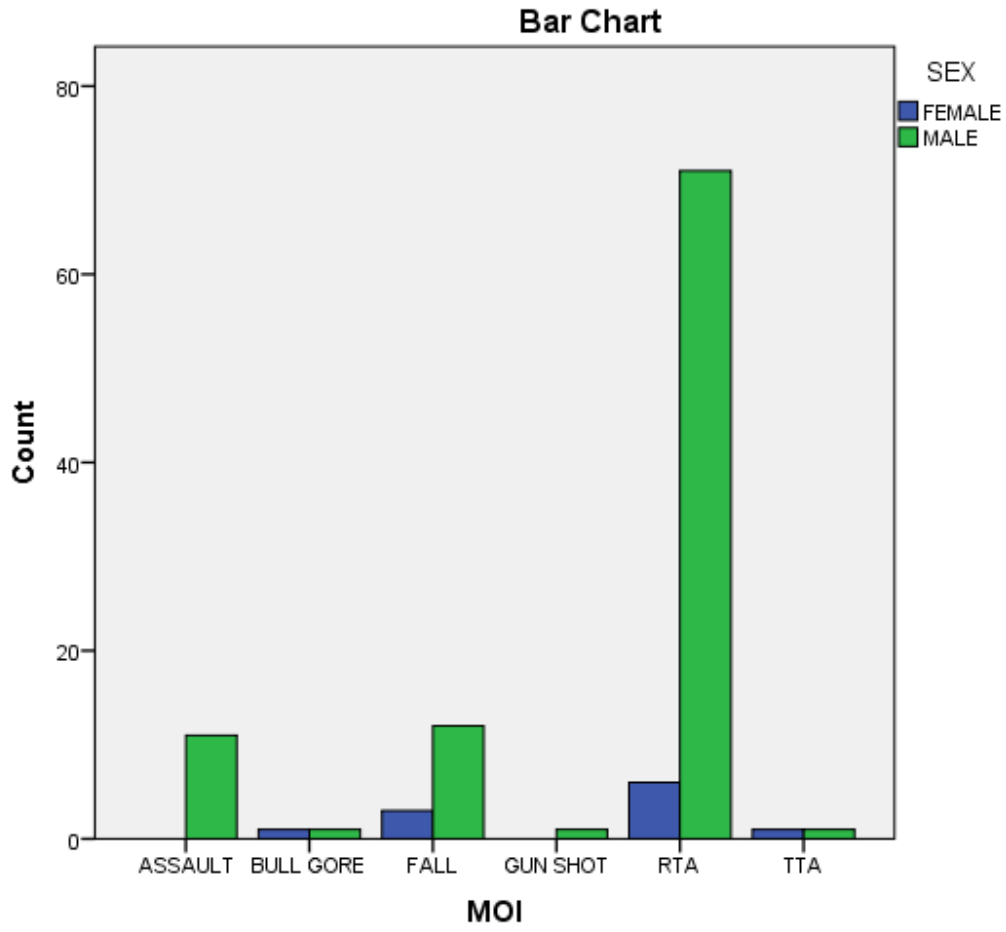


4.RELATION BETWEEN MODE OF INJURY AND SEX

MODE OF INJURY AND SEX

Count

		SEX		
		FEMALE	MALE	Total
Mode of injury	ASSAULT	0	11	11
	BULL GORE	1	1	2
	FALL	3	12	15
	GUN SHOT	0	1	1
	RTA	6	71	77
	TTA	1	1	2
Total		11	97	108

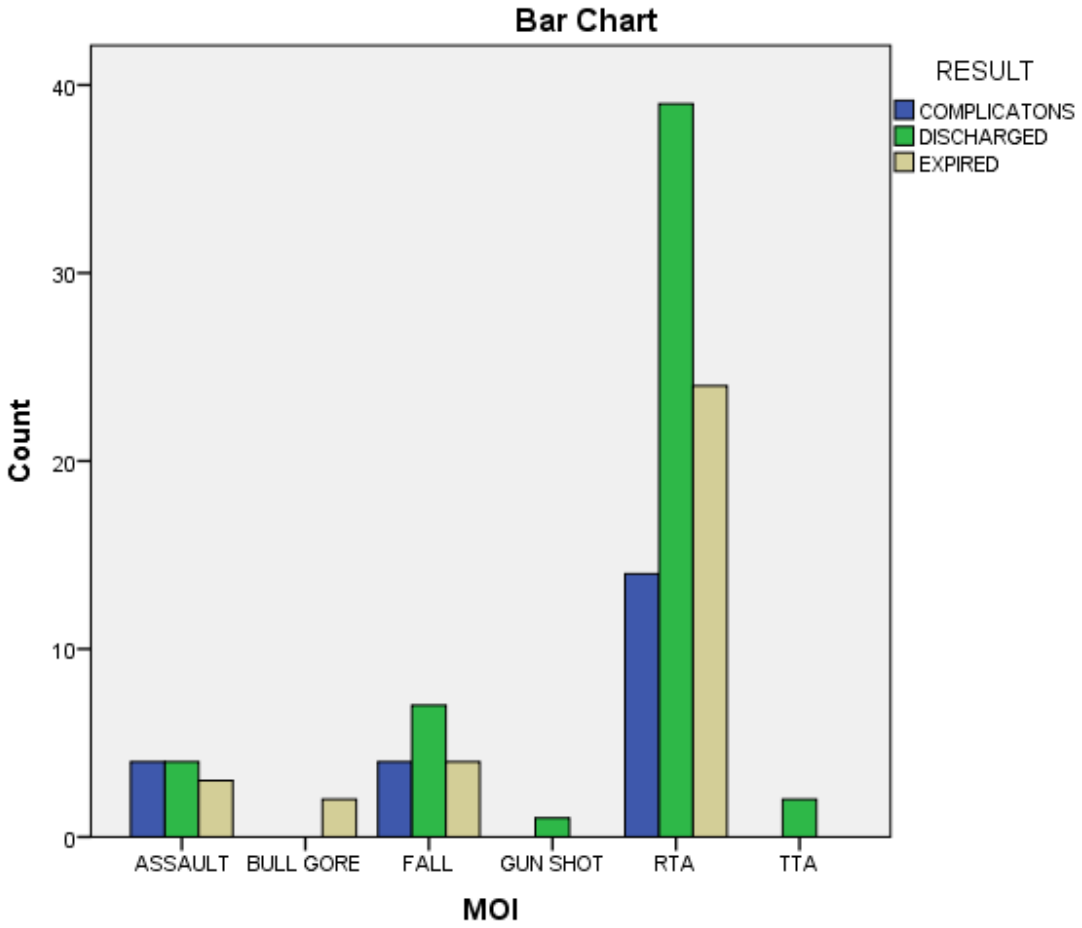


5. RELATION BETWEEN MODE OF INJURY AND PROGNOSIS

MODE OF INJURY AND PROGNOSIS

Count

		RESULT			
		COMPLICATONS	DISCHARGED	EXPIRED	Total
MODE OF INJURY	ASSAULT	4	4	3	11
	BULL GORE	0	0	2	2
	FALL	4	7	4	15
	GUN SHOT	0	1	0	1
	RTA	14	39	24	77
	TTA	0	2	0	2
Total		22	53	33	108

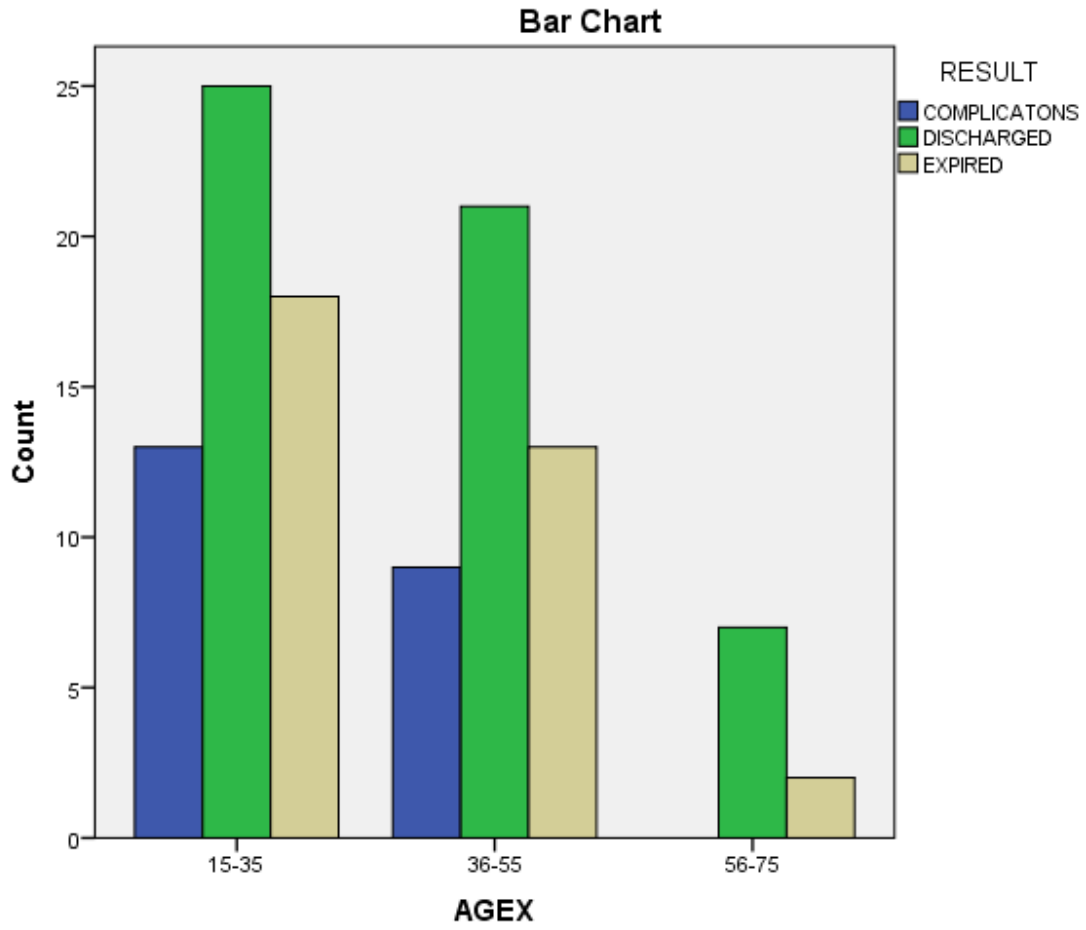


6.RELATION BETWEEN AGE AND PROGNOSIS OF PATIENT

AGEX AND PROGNOSIS

Count

		RESULT			
		COMPLICATONS	DISCHARGED	EXPIRED	Total
AGE	15-35	13	25	18	56
	36-55	9	21	13	43
	56-75	0	7	2	9
Total		22	53	33	108

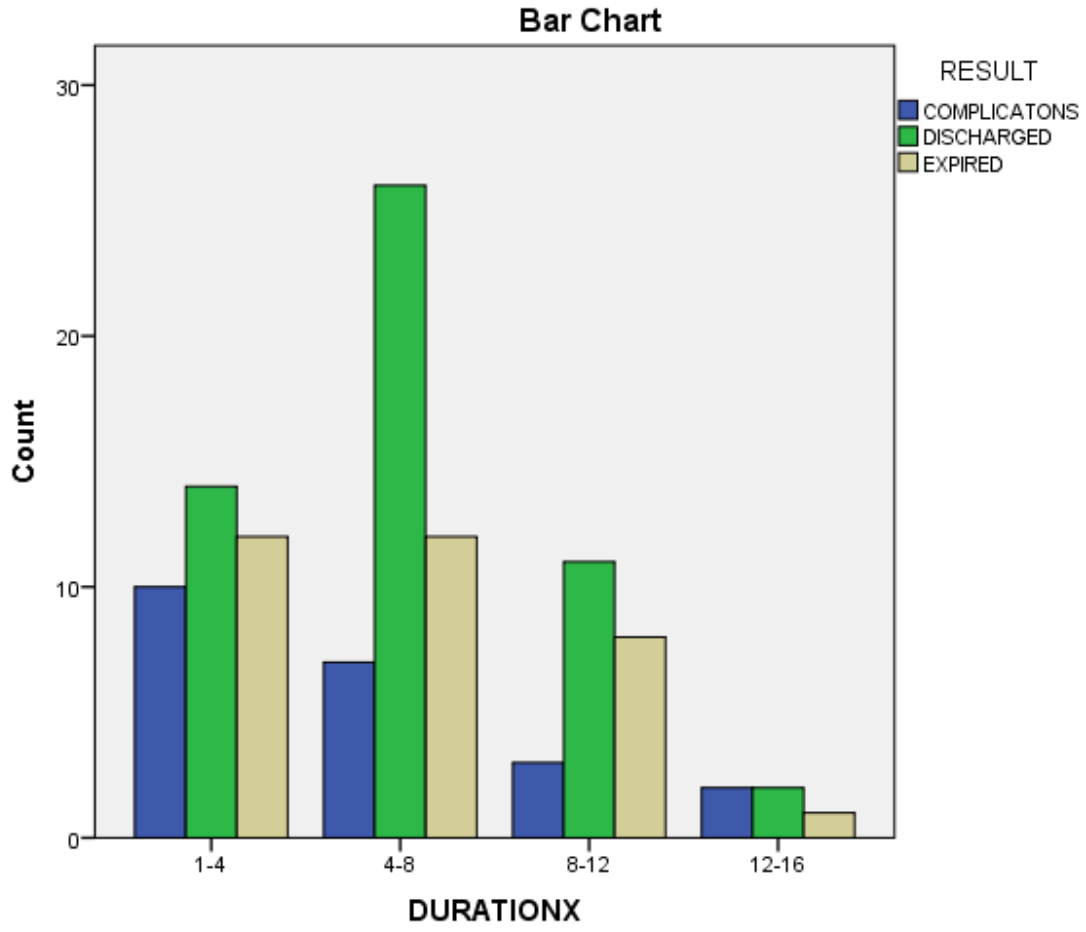


7.RELATION BETWEEN DURATION OF INJURY AND PROGNOSIS

DURATION OF INJURY AND PROGNOSIS

Count

		RESULT			
		COMPLICATONS	DISCHARGED	EXPIRED	Total
DURATION OF INJURY	1-4	10	14	12	36
	4-8	7	26	12	45
	8-12	3	11	8	22
	12-16	2	2	1	5
Total		22	53	33	108

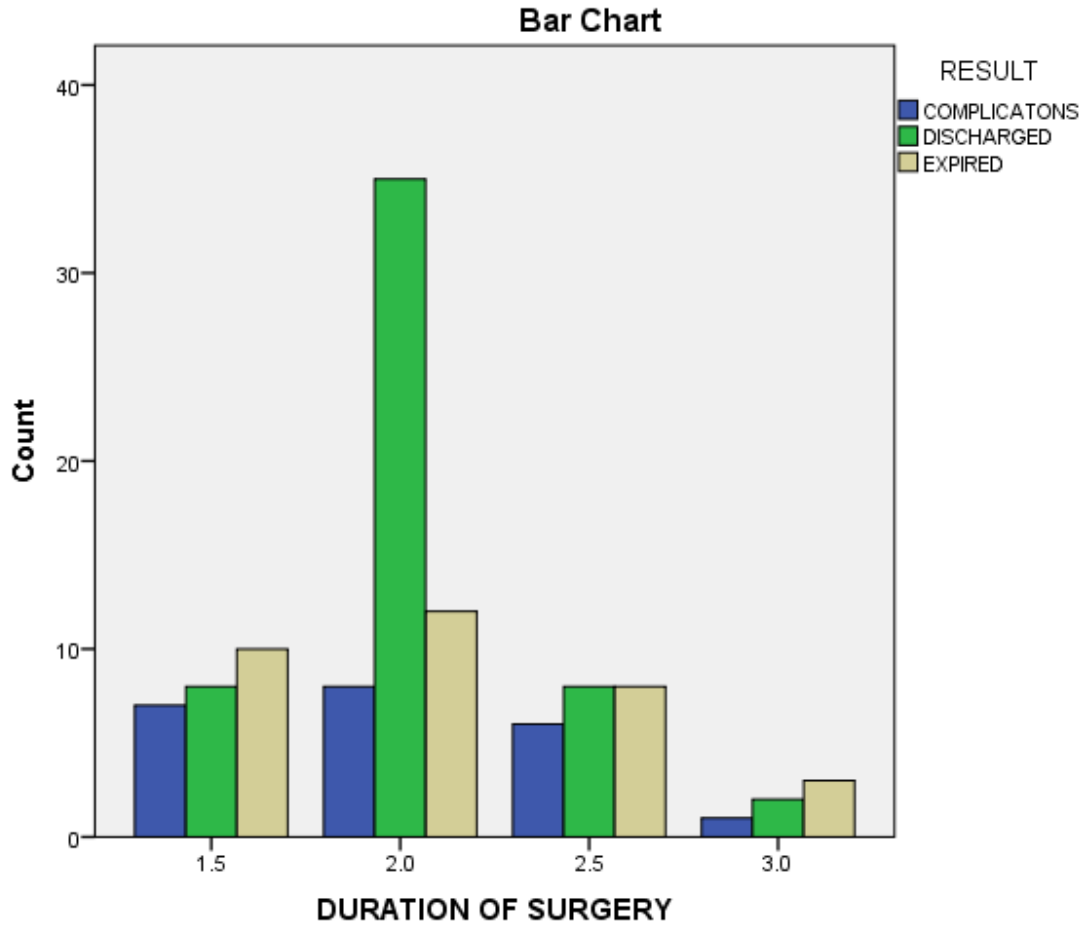


8..RELATION BETWEEN DURATION OF SURGERY AND PROGNOSIS

DURATION OF SURGERY AND PROGNOSIS

Count

		RESULT			
		COMPLICATONS	DISCHARGED	EXPIRED	Total
DURATION OF SURGERY	1.5	7	8	10	25
	2.0	8	35	12	55
	2.5	6	8	8	22
	3.0	1	2	3	6
Total		22	53	33	108

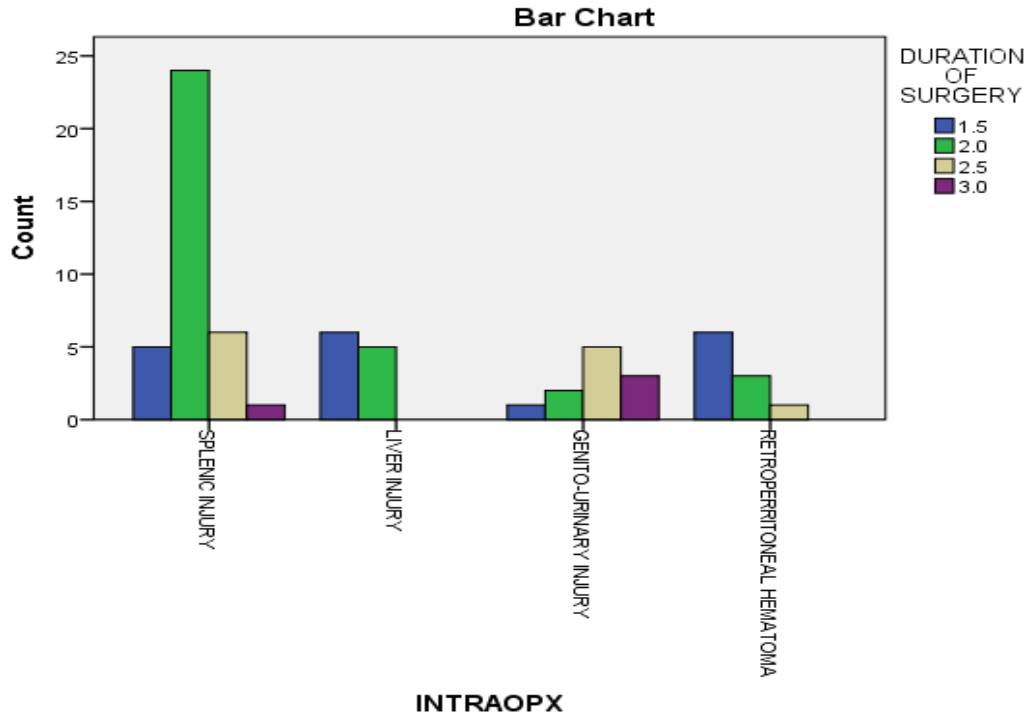


9.RELATION BETWEENINTRA-OPERATIVE DIAGNOSIS AND DURATION OF SURGERY

INTRA-OPERATIVE DIAGNOSIS AND DURATION OF SURGERY

Count

		DURATION OF SURGERY				Total
		1.5	2.0	2.5	3.0	
lintra-op diagnosis	SPLENIC INJURY	5	24	6	1	36
	LIVER INJURY	6	5	0	0	11
	GENITO-URINARY INJURY	1	2	5	3	11
	RETROPERRITONEAL HEMATOMA	6	3	1	0	10
Total		18	34	12	4	68

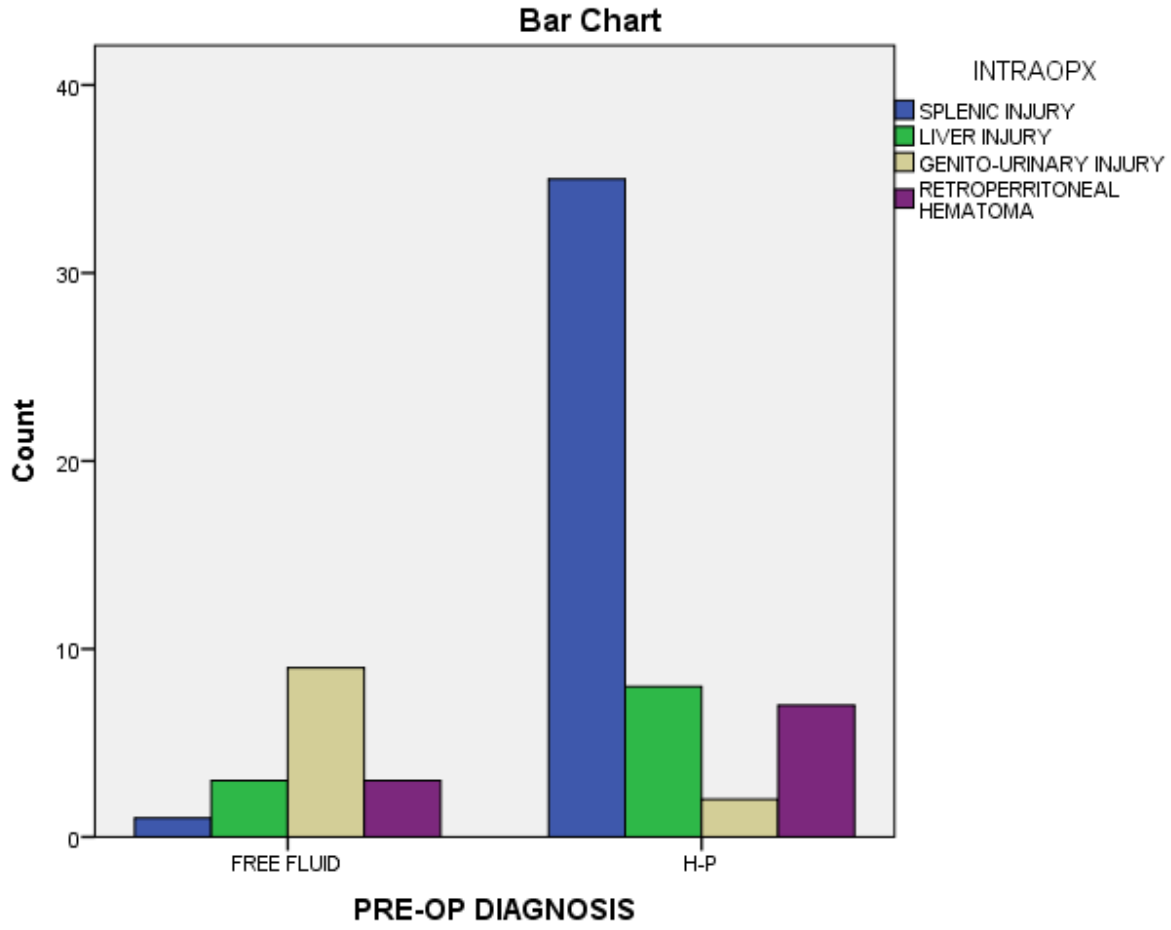


10. RELATION BETWEENPRE-OPERATIVE DIAGNOSIS AND INTRA-OPERATIVE DIAGNOSIS

PRE-OPERATIVE DIAGNOSIS AND INTRA-OPERATIVE DIAGNOSIS

Count

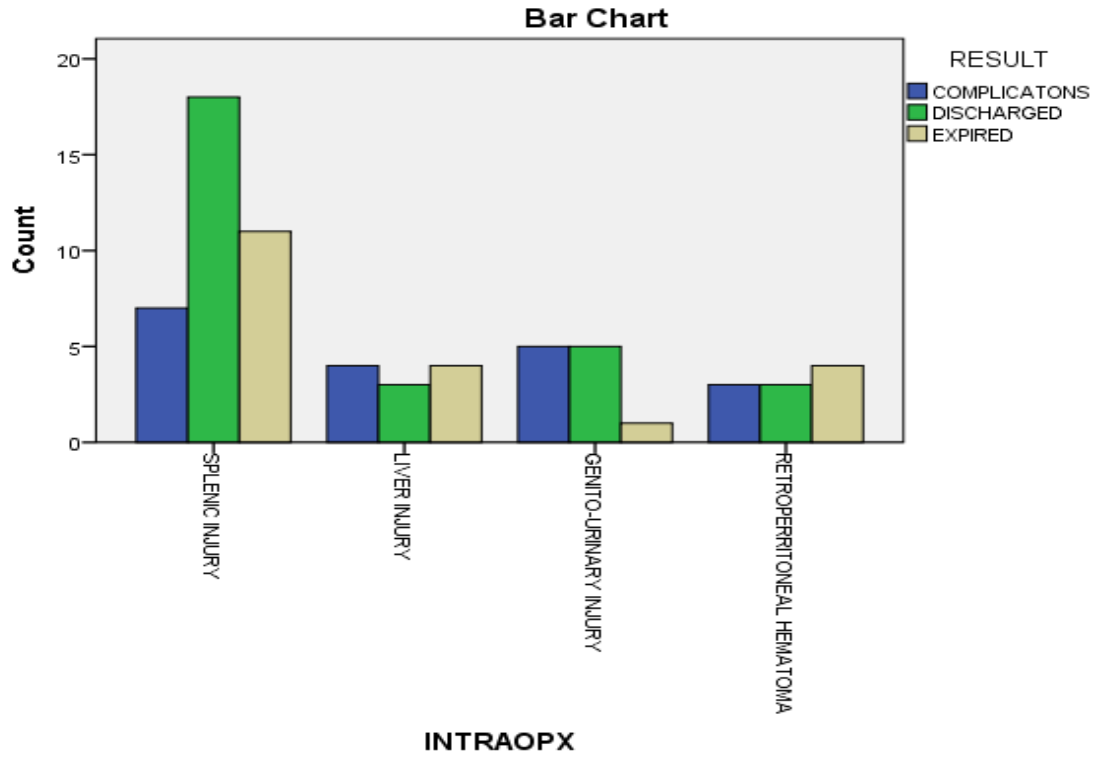
		INTRAOPX				
		SPLENIC INJURY	LIVER INJURY	GENITO-URINARY INJURY	RETROPERRITONEAL HEMATOMA	Total
PRE-OP DIAGNOSIS	FREE FLUID	1	3	9	3	16
	H-P	35	8	2	7	52
Total		36	11	11	10	68



12. RELATION BETWEENINTRA-OPERATIVE DIAGNOSIS AND PROGNOSIS

INTRA-OPERATIVE DIAGNOSIS AND PROGNOSIS

		RESULT			
		COMPLICATONS	DISCHARGED	EXPIRED	Total
Intra-op diagnosis	SPLENIC INJURY	7	18	11	36
	LIVER INJURY	4	3	4	11
	GENITO-URINARY INJURY	5	5	1	11
	RETROPERRITONEAL HEMATOMA	3	3	4	10
Total		19	29	20	68

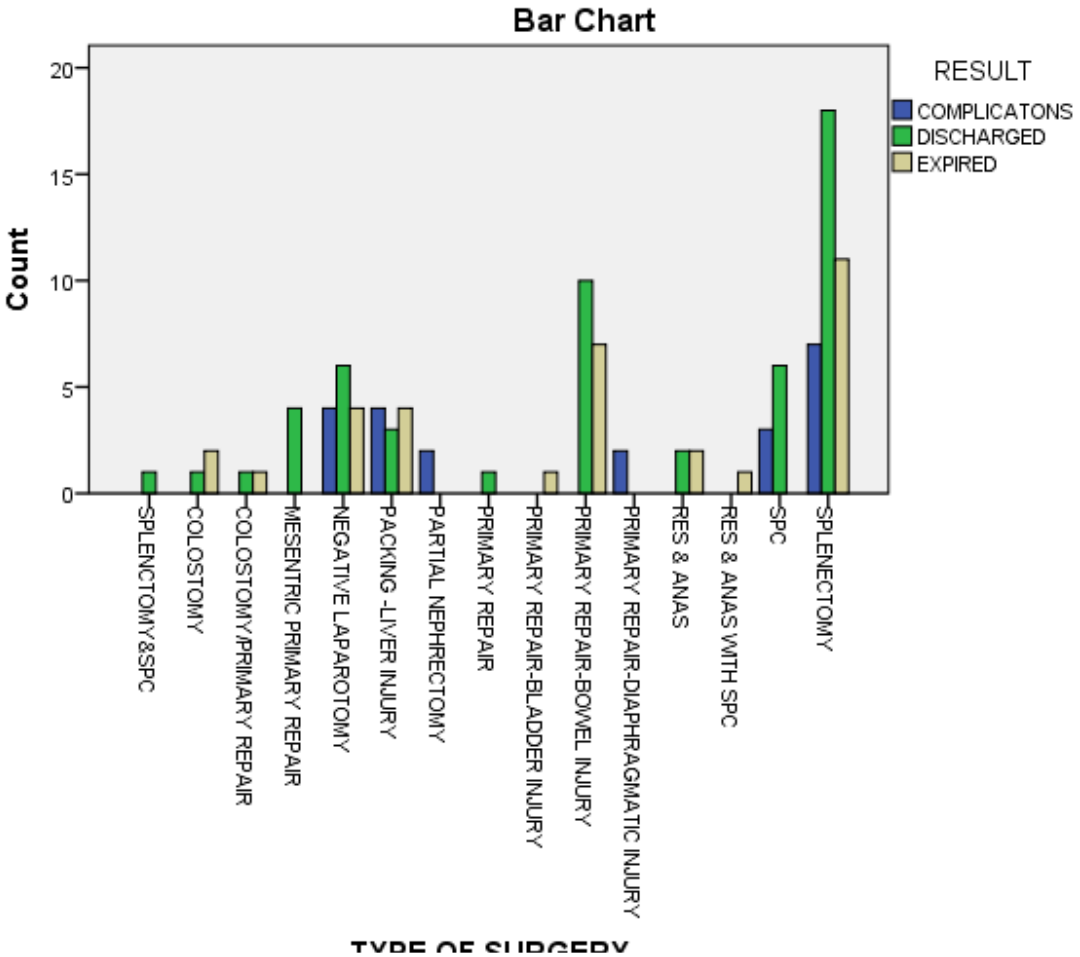


13. RELATION BETWEEN TYPE OF SURGERY AND PROGNOSIS

TYPE OF SURGERY AND PROGNOSIS

Count

		RESULT			
		COMPLICATONS	DISCHARGED	EXPIRED	Total
TYPE OF SURGERY	SPLENCTOMY&SPC	0	1	0	1
	COLOSTOMY	0	1	2	3
	COLOSTOMY/PRIMARY REPAIR	0	1	1	2
	MESENTRIC PRIMARY REPAIR	0	4	0	4
	NEGATIVE LAPAROTOMY	4	6	4	14
	PACKING -LIVER INJURY	4	3	4	11
	PARTIAL NEPHRECTOMY	2	0	0	2
	PRIMARY REPAIR	0	1	0	1
	PRIMARY REPAIR-BLADDER INJURY	0	0	1	1
	PRIMARY REPAIR-BOWEL INJURY	0	10	7	17
	PRIMARY REPAIR-DIAPHRAGMATIC INJURY	2	0	0	2
	RES & ANAS	0	2	2	4
	RES & ANAS WITH SPC	0	0	1	1
	SPC	3	6	0	9
	SPLENECTOMY	7	18	11	36
Total		22	53	33	108

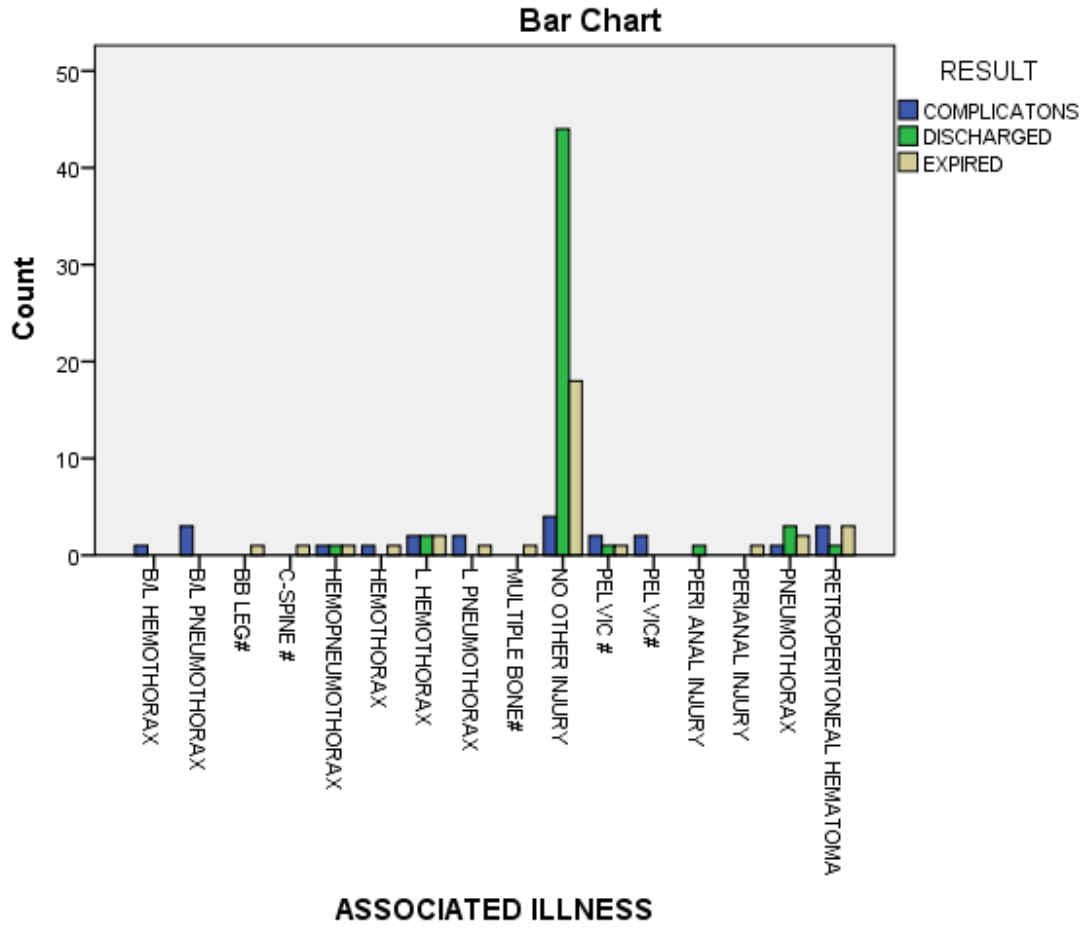

Bar Chart
RESULT
COMPLICATONS
DISCHARGED
EXPIRED
Count
20
15
10
5
0
SPLENCTOMY&SPC
COLOSTOMY
COLOSTOMY/PRIMARY REPAIR
MESENTRIC PRIMARY REPAIR
NEGATIVE LAPAROTOMY
PACKING -LIVER INJURY
PARTIAL NEPHRECTOMY
PRIMARY REPAIR
PRIMARY REPAIR-BLADDER INJURY
PRIMARY REPAIR-BOWEL INJURY
PRIMARY REPAIR-DIAPHRAGMATIC INJURY
RES & ANAS
RES & ANAS WITH SPC
SPC
SPLENECTOMY
TYPE OF SURGERY

14. RELATION BETWEEN ASSOCIATED ILLNESS AND PROGNOSIS

ASSOCIATED ILLNESS AND PROGNOSIS

Count

		RESULT			
		COMPLICATONS	DISCHARGED	EXPIRED	Total
ASSOCIATED INJURY	Thoracic injury	13	6	7	26
	Fractures	4	1	4	9
	NO OTHER INJURY	4	44	18	66
	RETROPERITONEAL HEMATOMA	3	1	3	7
Total		22	53	33	108

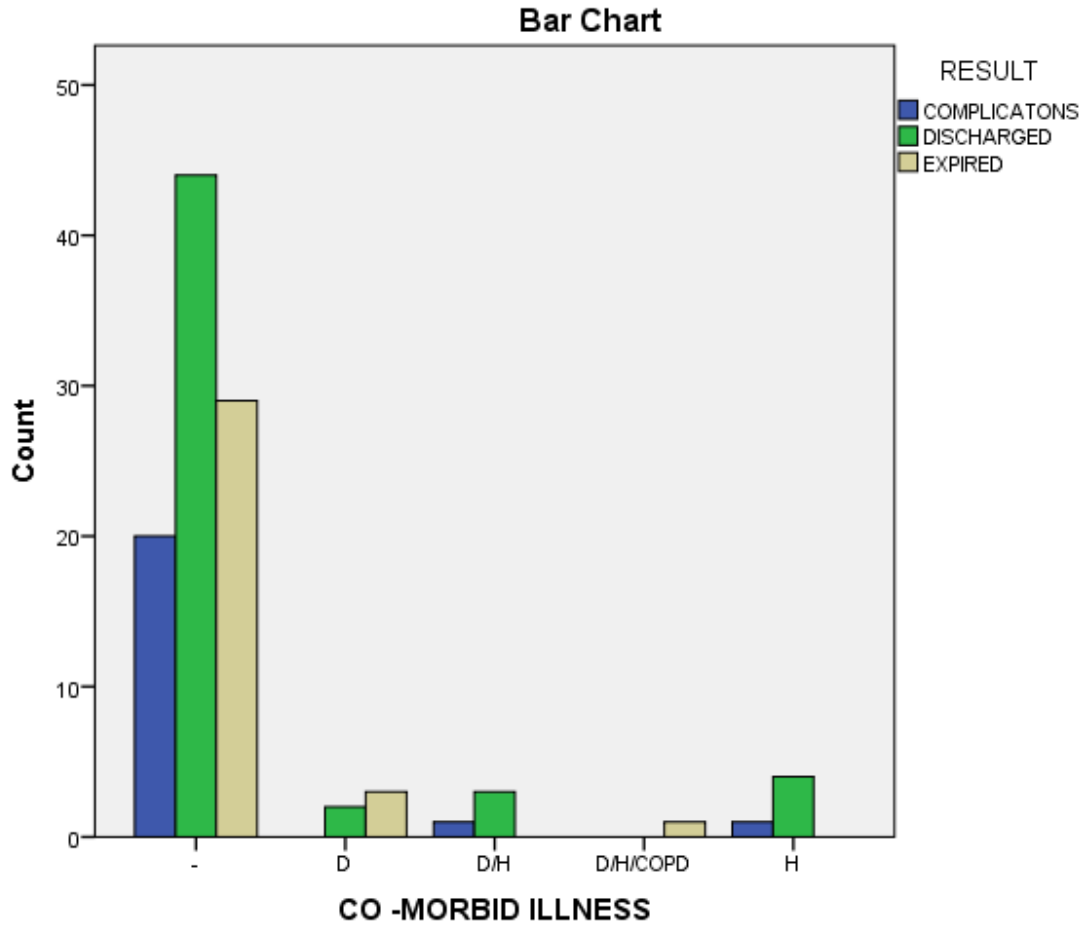


15. RELATION BETWEEN CO-MORBID ILLNESS AND PROGNOSIS

CO-MORBID ILLNESS AND PROGNOSIS

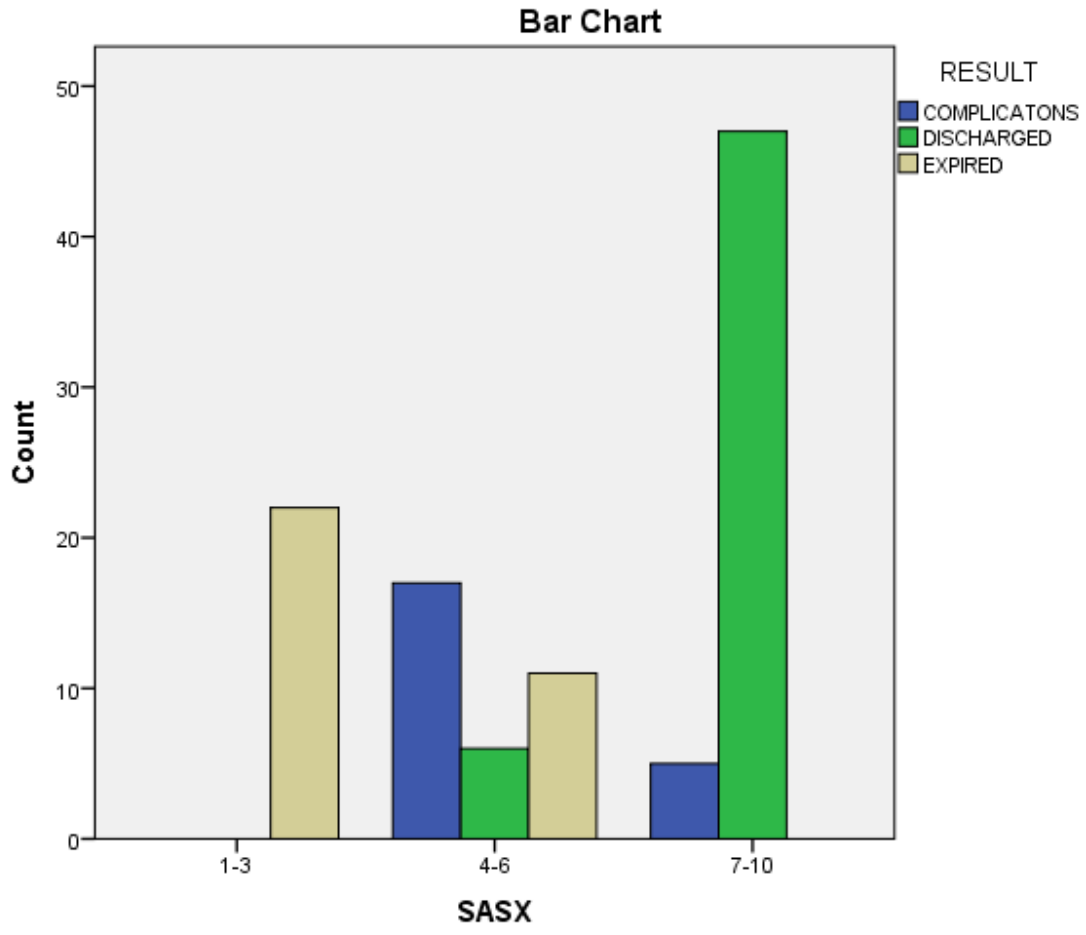
Count

		RESULT			
		COMPLICATONS	DISCHARGED	EXPIRED	Total
CO -MORBID ILLNESS	-	20	44	29	93
	D	0	2	3	5
	D/H	1	3	0	4
	D/H/COPD	0	0	1	1
	H	1	4	0	5
Total		22	53	33	108



16. RELATION BETWEEN SURGICAL APGAR SCOREAND PROGNOSIS

SURGICAL APGAR SCOREAND PROGNOSIS					
		RESULT			
		COMPLICATONS	DISCHARGED	EXPIRED	Total
SCORE	1-3	0	0	22	22
	4-6	17	6	11	34
	7-10	5	47	0	52
Total		22	53	33	108



Chi-Square Tests for surgical apgar score and prognosis

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	108.457[a]	4	.000
Likelihood Ratio	121.584	4	.000
N of Valid Cases	108		

a. 1 cells (11.1%) have expected count less than 5. The minimum expected count is 4.48.

DISCUSSION

DISCUSSION

In our study a simple surgical score based on estimated blood loss, lowest heart rate, and lowest mean arterial pressure during an operationand other factors were made and its usefulness in predicting prognosis of patient and rate of major complications and death after surgery was done.

All 108 cases admitted in the department of general surgery following trauma during time period of May 2013 to august 2014 were evaluated as described earlier in the materials and methods. All the patients were appropriately assessed andmanaged according to standard guidelines for the respective disease.

90% of the surgical cases in our study were male patients (table 1) and mainly the reason is the males were involved in road traffic accident more than women and accidental fall appears to be the most common of injury in females. Most of the studies on the apgar score by Gawande et al and Scott et al show a male preponderance of cases of 56% to 65% in different cohort of study[40]. However there has been no association between gender, the score and the prognosis in our studies. The sex ratio was also different from previous studies done by Davis et al.

S NO	STUDY	Male	Female
1	DAVIS ET AL(2008)	70%	30%
2	PRESENT STUDY(2014)	90%	10%

Of the age reference range most death occurred in age of 15-35 and 36-55 representing the reproductive and earning members of the family, reason for most death in this age group is primarily due to usage of vehicles and high velocity impacts accounting for polytrauma and death in these patients.

Assault and bull gore also affect this age group in this study.there is a 30% mortality in the above age group evaluated from admission and this coincides with the overall mortality index in this study.

Assault was mainly seen in young males and Road Traffic Accidents showed a similar incidence in age group of 15-35 and 36-55. Accidental fall also was more comm--on in age group of 15-35 and 36-55 mainly due to fall after consumption of alcohol.Assault and bull gore injury was also seen in trauma patients and they were managed with laparotomy after essential investigations.there was a 30 percent mortality in patients undergoing laparotomy in both sexes, suggesting injuries doesn't have sex difference in prognosis. Road traffic accidents was seen in 72% trauma patients which was similar in study

conducted by Davis et al.

S NO	STUDY	ROAD TRAFFIC ACCIDENT	TTA	FALL FROM HEIGHT	ASSAULT/OTHER INJURY
1	DAVIS ET AL(2008)	70%	-	6%	17%
2	KHANNA ET AL(2010)	57%	-	15%	33%
3	PRESENT STUDY(2014)	72%	1%	3%	24%

Duration of injury was calculated as time interval between the injury and time of arrival to trauma ward . Patients with polytrauma had higher mortality and duration of injury had less impact on the prognosis. Duration of injury was more significant in patients in whom bowel injury was missed and taken for laparotomy at a later time causing sepsis from intra abdominal contamination. In this study the relationship between duration of injury was significant mainly in the hollow viscous injury patient as early intervention could prevent development of sepsis. Although early intervention in other trauma cases was also important in preventing morbidity and mortality. There were no previous studies available.

Patients with external chest trauma were evaluated for intrathoracic trauma using CT-chest and patients with hemothorax,pneumothorax or hemopneumothorax were managed with intercostal drainage tubes.

Pre-operatively patient was investigated and ultrasound examination and

CT done based on patient trauma. Patients were taken up for surgery based on findings of free fluid abdomen and hemoperitoneum. Although both will have similar finding in radiological investigations,patients with solid organ injury was reported as hemoperitoneum,and patients reported with free fluid were found to have bowel injury and mesenteric contusion more than solid organ injury. Patients with massive hemoperitoneum were found to have splenic and liver injury and mesenteric tear and were managed appropriately with emergency laparotomy. Patients with massive blood loss and polytrauma had low SURGICAL APGAR SCOREand had poor prognosis than patients with low blood loss and single organ injury.

Duration of surgery extended from 1.5 hours to 3hours based on management of intra-opertaive findings and managing them. Based on total number of patients taken up for surgery the death and morbidity was more in patients in surgery in whom the operative time was longer as they were exposed to longer duration of hypotension and anaesthesia.

In our study there was polytrauma in more than 42 patients and patients with polytrauma developed mortality and morbidity more than isolated trauma patients. Splenic and liver injuries were most commonly associated with chest injuries in form of hemo or pnemo or hemopneumothorax, two cases presented with diaphragmatic injury and was managed with primary repair and intercostal drainage and post-opertive ventilatory support. Genito urinary injuries was mostly

associated with pelvic fracture and retroperitoneal hematoma.Since severely injured polytrauma cases were not taken up for laparotomy, the incidence of head injury in this study was under reported as compared to previous studies. ,our study had similar incidence of chest trauma,orthopaedic injuries similar to Davis Et Al, incidence of polytrauma was more than previous studies.

In our study patients with splenic injury had average duration of surgery around 2hours and patients with bowel,bladder and renal injury had longer operative periods around 3hours. There were no previous study available .

S NO	STUDY	HEAD %	THORACIC %	ORTHOPEDIC %	POLYTRAUMA %
1	DAVIS ET AL(2008)	9	27	15	6
2	KHANNA ET AL(2010)	12	24	27	-
3	PRESENT STUDY(2014)	1	23	12	40

Of the emergency laparotomy patients splenectomy was the most commonly performed surgery. There was 30% mortality in patients taken up for splenectomy and majority of these patients had associated injuries particularly

chest injury and also had low SAS. Hollow viscous perforation was also common in the trauma patients and this results from the compressive force or the shear strain in the bowel caused due to acceleration or decelaration injury. Liver injury was managed with packing and were removed after 48 hours after resucitation with blood and ventilator support. But liver injury patients developed post-operative morbidity and mortality more than other age groups.

S NO.	STUDY	SPLENIC/LIVER INJURY %	BOWEL INJURY %	MESENTRIC INJURY %	GENITO URINARY INJURY%
1	CUSHIERI ET AL(2009)	40	9	5	4
2	KHANNA ET AL(2010)	61	57	47	-
3	PRESENT STUDY(2014)	44	28	30	10

SURGICAL APGAR SCORE of 1-3 had higher mortatilty and morbidity with 22 death .SURGICAL APGAR SCORE of 4-6 had 11 death and 17 patients

developing post-operative complications.SURGICAL APGAR SCOREscore of 7-10 had no deaths and 5 patient developing post-operative complication. thus surgical apgar score was useful in predicting post-operative and mortality.

The most common co morbidities noted were hypertension, smoking , diabetes mellitus , pulmonary disease like COPD and patients with bowel injury and polytrauma developed deep seated infections and wound complications,and sepsissecondary to hollow viscus perforation. Hypertension, diabetes mellitus, pulmonary disease, were significantly associated with postoperative complications and death in this study.[43]

Another study by Atul gawande et al, where a cohort of 303 colectomy cases were analyzed do not show any significant correlation with cardiovascular disease, pulmonary disease, preoperative sepsis, malignancy, or blood transfusion. [13]

A study on the emergency surgical admissions by Capewell et al showed that 46% to 57% of all surgical admissions are emergency in nature.[44]

Of the 108 patients, there was a 30% 30 day mortality, 19% major complications (< 30 days) and 51% having no major complications. Mean surgical apgar score was 6.03(+/-1.49SD). The difference in surgical outcome between patients in different score group was also statistically significant. 10 patients in

age group of 15-35 had SURGICAL APGAR SCOREof 1-3 and mortality was 17% which was less than over all mortality of 33% in the study,thus young age patients with poly trauma managed to survive well compared to other age groups.

Hollow viscous perforation and splenectomy accounted for 40% of mortality among total number of cases. Hence bowel injury with late presentation and liver injury had higher mortality and morbidity compared to other injury and similar in mortality and morbidity to patients with splenectomy associated with polytrauma.

It was also noted that in every 3 point score category, the incidence of both major complications and death was significantly greater than that of patients in the next- higher category. A similar result with a relative risk of major complication amongst low scored operations, compared with those in the high scored operation was noted in the study by Atul A Gawande et al. [13]

The most common complication noted in the study was 1) acute renal failure, 2) post of pneumonia , 3) wound disruption , 4)deep or organ space surgical site infection, and 5) sepsis.

Four patients was given transfusion of >4 units of packed cell in a day and 2 of them succumbed due to Disseminated intravascular coagulation. Of the 33 deaths in the study period, 23 patients died of cardiopulmonary arrest due to

cardiovascular event, ARDS and sepsis.7 due to polytrauma associated sepsis and deep seated wound infection, 2 died of disseminated intravascular coagulation and a patient succumbed due to aspiration pneumonitis.

The relative risk of predicting a major complication was significantly higher in all the subgroups of the apgar score for emergency surgeries. Study by Atul gawande etal., showed a statistically significant result with an odds ratio of 4.8(95% CI, 2.41-9.57) for emergency procedures. [13]Other studies have shown complication rates of 43%and a mortality of 4% in emergency GI procedures.[45]

In this regard, even the P-POSSUM has no morbidity prediction equation, as a result of the original authors' lack of confidence in the reporting of perioperative complications.[46]

Subsequent studies have shown P-POSSUM to both over-predict and under-predict mortality[47] in different settings.

A study by Knaus WA et al on APACHE III risk prediction model, have shown that the overall predictive accuracy of the first-day APACHE III equation within 24 h of ICU admission following a major surgery would be given a risk estimate for hospital death that was within 3 percent. [48]

The age group selected ranged from 15 to 75 years, in this study, patients with age group of less than 40 years constituted majority of the surgical population constituting more than 49%.

There was significant difference in the sex wise distribution of surgical cases in emergency trauma cases.

In our study the older age groups had low apgar score and hence the increased incidence of a major complication or 30 day mortality than younger population with similar low apgar score and similar injury.

It was seen in this study that Comorbidities like Hypertension, diabetes mellitus, pulmonary disease, and sepsis were significantly associatedwith postoperative complications and 30 day mortality

Our study showed Pearson Chi-square value of 108.451 with degree of freedom of 4 had Chi-square value of <0.0001 and Likelihood ratio of 121.584 and degree of freedom of 4 and Chi-square value of <0.0001 , hence our study shows the SURGICAL APGAR SCORE was useful in predicting overall morbidity and mortality

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	108.457[a]	4	.000
Likelihood Ratio	121.584	4	.000
N of Valid Cases	108		

a. 1 cells (11.1%) have expected count less than 5. The minimum expected count is 4.48.

There was a higher incidence of major complications in the surgical procedures done on emergency basis. However, it was evident in ours study that the major complications and 30 day mortality were seen to be higher in emergency surgical groups with low Apgar score. Further study needs to be conducted on the emergency subgroups, in particular for surgical apgar score to be validated with other scoring systems .

CONCLUSION

CONCLUSION

The aim of this study was done to evaluate the efficacy of surgical apgar score in predicting the morbidity and 30 day mortality in various emergency surgical procedures.

In our study, surgical Apgar score has proved to be an important tool in early detection of the complications and also in predicting mortality and morbidity with accuracy.

In our study,road traffic accidents was found to be the most common cause of trauma. Men were more affected than females. Incidence of injury was higher in age of 15-55 years.

Patients with more than 56 years and splenic injury with massive blood loss intra-operatvely had low surgical apgar scores at the end of surgical procedure. This group of patients was at higher risk of having a major complication or death during the follow up period.

When compared to isolated organ injury,patients with polytrauma had low surgical apgar score and high mortality and morbidity.

Patients with younger age groups had better prognosis compared to older age groups with same nature of injury,

Patients with certain comorbid factors like hypertension, diabetes mellitus, respiratory diseases and sepsis were at risk of having a major complication or death during the follow up period.

Patients with Low surgical Apgar score required ICU monitoring and followup , speedy investigations and immediate interventions .

10 point Apgar scoring system is superior in identifying the patients at risk of complications and 30 day mortality in Emergency surgeries.

This study there by concluded that the surgical apgar score which is a 10-point score based on the lowest heart rate, lowest mean arterial pressure and ESTIMATED BLOOD LOSSdiscriminated well between groups of patients at high risk and lower-than-average risk of major complications and death within 30 days of the surgery. The score also served as a simple aid in communication among surgeons, post anesthesia care providers, surgical residents and ICU OR surgical ward staff regarding patients' immediate postoperative status. It also helped to convey to the attenders about the condition and prognosis after surgery.

Thus surgical Apgar score holds promise as both a prognostic measure and a clinical decision support tool based on this study.

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BIBILOGRAPHY

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ANNEXURE

PROFORMA

NAME – AGE – SEX -

ADDRESS - TELEPHONE NO –

OCCUPATION-

FINAL PREOP DIAGNOSIS-

INTRA-OPERATIVE FINDINGS

COMORBIDITIES-

SURGICAL PROCEDURE EXECUTED-

PREOP HEMOGLOBIN AND HEMATOCRIT-

POST OP HEMOGLOBIN AND HEMATOCRIT-

SURGICAL APGAR SCORE-

POST OP COMPLICATIONS-

<24 HRS <1 WEEK UPTO 30 DAYS

MORTALITY-

<24 HRS <1 WEEK UPTO 30 DAYS

CAUSE OF DEATH -