



St. Paul Hospital Millennium Medical College
Post Graduate Study Program

**Patterns, outcomes, and associated factors of Penetrating
Abdominal Injury at Addis Ababa Burn Emergency
And Trauma Hospital Adult Emergency Department**

Name of Researcher: DR. TAMAGNSEW YIGZAW (EMCC R3)

**Advisors:-Dr. HAIMANOT (Assistant Professor of Emergency
Medicine and Critical care)**

**-Dr. ASHENAFI (Assistant Professor of Emergency
Medicine and Critical care)**

**A Research Thesis submitted to the Department of Emergency and Critical
Medicine for Partial fulfillment of the Requirements for specialty
Certificate in Emergency and Critical care Medicine at St. Paul Hospital
Millennium Medical College.**

**Addis Ababa, Ethiopia
[December 2023]**

Academic Research Proposal Submission Guide

Name of investigator	Dr. Tamagnsew Yigzaw (Emergency medicine and critical care year 3 resident)
Full title of the research project	Assessment of Pattern, outcomes and associated factors of penetrating Abdominal Injury among patient admitted at Addis Ababa Burn, Emergency and Trauma hospital.
Duration of the study	August 1,2023 – October 1,2023
Study Area	AaBET Hospital
Total Cost of the project	30,420 ETB
Source(s) of Funding	SPHMMC Finance
Address of investigator	Cell Phone: 0937592387/0922209472
	Fax:
	P.O.Box:
	Email: yigzawtamagnsew@gmail.com
Name and address of Advisor(s)	Haimanot (MD- Assistant professor of Emergency and Critical Care Medicine, SPHMMC). Mobile No: +251962268032 Ashenafi (MD- Assistant professor of Emergency and Critical Care Medicine, SPHMMC) Mobile No: +251911045806

Abstract

Background: The most common causes of PAI are gunshots and stabbings. Stab wounds (SW) occur three times as frequently as gunshot wounds (GSW), but have a lower mortality rate due to the lower energy transmitted. GSW is responsible for approximately 90% of deaths caused by penetrating abdominal injury (PAI).

Objectives: To assess the pattern, outcome and associated factors of PAI among patient admitted at AaBET Hospital.

Methods: An institution-based cross-sectional study was conducted from September 1, 2020 to October 1, 2023. A standard checklist was used to review the clinical charts of all patients admitted with PAI at AaBET Hospital ED. A total of 178 patients with penetrating abdominal injury who met the inclusion criteria were included. Patients' characteristics were described using descriptive statistics. Bivariate and multivariate logistic regression analyses were used to identify the factors associated with PAI treatment outcomes. Adjusted odds ratios (AORs) were calculated and statistical significance was determined at a P-value of 0.05.

Result: A total of 178 charts of patients with PAI were reviewed. The commonest mechanism of injury was stab injury occurring in 110 cases (61.8%) ,followed by bullet injuries in 63 cases (35.4%). The majority of the 95 (53.4%) study subjects were between the ages of 25 and 44. Males accounted for 89.9% of the study subjects, and rural residents made up 73.6%. The majority of our patients were managed conservatively (69.1%), however (30.9%) underwent exploratory laparotomy. Overall mortality was 5.6%. In this study, factors that determined mortality included age > 45 (AOR= 9.84 (95%CI: 1.69, 57.4), bullet injuries (AOR = 4.99 (95% CI: 1.13, 25.19), associated SCI (AOR = 12.20 (95% CI: 1.106, 134.44), and the presence of MODS (AOR = 373.86.20 (95% CI: 14.01, 942.92).

Conclusion: The most common mechanism of PAI among young adult males was stab injury. Mortality was associated with age above 45, bullet mechanism of injury, associated extra-abdominal injury, and presence of MODS. Ninety percent of penetrating abdominal injuries (PAI) deaths are due to bullet injuries, indicating the necessity of strictly enforcing the laws limiting the use of weapons in our nation.

KEY WORDS: Penetrating abdominal injuries, clinical patterns, associated factors, Outcomes, Ethiopia.

ACKNOWLEDGEMENTS

I would also like to thank my advisors, Dr. Haimanot (Assistant professor of Emergency Medicine and Critical Care) and Dr. Ashenafi (Assistant professor of Emergency Medicine and Critical Care) for guiding and advising me for the preparation of my research thesis development. I would like to say thanks to those who work in SPHMMC and AaBET hospital emergency department for helping me in availing medical records and documentation registration logbooks.

Finally, I would like to thank to those authors and researchers whom articles I have read and cited.

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ACRONYMS AND ABBRIVATIONS

AaBET- Addis Ababa Burn, Emergency and Trauma

ARDS-Acute respiratory distress syndrome

CM- Conservative management

CT scan- Computed tomographic scan

EFAST- Extended Focused Assessment with Sonography in Trauma

ED-Emergency Department

GI- Gastrointestinal

GSW- Gunshot wounds

HAI-Hospital acquired infection

Hr.-Heart rate

HIV/AIDS-Human immunodeficiency virus

HMIS-Health management information system

MODS-Multiorgan dysfunction

ICU- Intensive Care Unit

IAA- Intra abdominal abscess

NTP: Non-therapeutic procedure

NOM- Non operative management

OM- Operative management

PAI- Penetrating abdominal injury

SBP-Systolic Blood Pressure

SCI-Spinal cord injury

SPHMMC-St. Paul's Hospital Millennium Medical College

SNNP-Southern nations and nationality

SSI- Surgical site infection

SW-Stab wound

TB-Tuberculosis

1. INTRODUCTION

1.1. Background of the Study

Any injury caused by an object that penetrates the skin and enters the abdominal cavity is known as penetrating abdominal trauma(1). The boundaries of the abdominal cavity run from the pubic symphysis and inguinal ligaments to the nipples anteriorly and from the iliac crest to the inferior tips of the scapulae posteriorly(2).

PAI can result from a wide variety of mechanisms of injury, such as weapons, sharp objects, or other types of impalements that can cause penetrating abdominal trauma. The most common causes of abdominal trauma are gunshots and stabbings(3).

The third most often injured region in trauma is the abdomen. The most frequently injured organs are the small bowel (50%), the large bowel (40%), and the liver (30%)(3). Thirty-five percent of patients admitted to urban trauma centers and up to twelve percent of patients admitted to suburban or rural centers experience penetrating abdominal trauma(4).

Stab wounds (SW) occur three times as frequently as gunshot wounds (GSW), but have a lower mortality rate due to the lower energy transmitted. GSW is responsible for approximately 90% of deaths caused by penetrating abdominal injuries (PAI) (5).

Due to violent crimes and war-related injuries; the burden of PAI is increasing in both developed and developing nations. Penetrating abdominal trauma affects 35% of those patients admitted to urban trauma centers and up to 12% of those admitted to suburban or rural centers. Approximately 90% of patients with penetrating trauma are male(6).

Prior to World War I, PAI was managed expectantly. During World War II, however, studies showed that early laparotomy improved survival. By the late 1950s, routine laparotomy was the standard treatment for PAI(3). Mandatory laparotomy in all patients presenting with PAI can, however, result in an unacceptably high rate of nontherapeutic surgery, exposing patients to morbidity of up to 20% associated with laparotomy(7).

Hemodynamically stable patients with gunshot wounds with no signs of peritonitis may be observed if a triple contrast CT scan illustrates no evidence of intra-abdominal injury. The following conditions are indications for laparotomy: (1) hemodynamically unstable patient; (2) peritonitis; and (3) evisceration, which is an indication for LAP regardless of region. Patients with a stab wound with clear signs of peritonitis similarly require a laparotomy. Stable patients with stab wounds may be locally explored or undergo a triple contrast CT scan (3,5,8).

1.2 STATEMENT OF THE PROBLEM

Globally, abdominal injuries make about 25% of all trauma cases, and deaths from injuries are roughly 1.7 times more common than deaths from HIV/AIDS, TB, and malaria combined(1).

PAI continues to be the leading cause of death in the first forty years of life and a major public health problem in all nations, irrespective of the degree of socioeconomic development(8). The third most often injured area is the abdomen, where surgery is necessary in roughly 25% of civilian cases. Because there is little bony protection for underlying organs, the abdomen is vulnerable to injury(9).

Penetrating abdominal injuries (PAIs) in Africa constituted 30% - 66% of the overall abdominal trauma burden. Majority of the patients were young adults (10–12).

It affects up to 12% of individuals admitted to suburban or rural facilities in the United States and 35% of those admitted to urban trauma centers. Because of the morbidity and mortality that it brings, trauma significantly reduces workforce productivity(11).

Available information indicates that 20% of penetrating abdominal injuries are due to gunshot wounds, and 80% are due to Stab wound(11). Compared to stab wounds, gunshot and shotgun blasts cause significantly more damage and have a higher rate of morbidity and mortality(13).

According to published studies, the mortality rate of patients with penetrating abdominal injuries ranges from 5% to 13.2%.The following factors were significantly associated with death: age >45 years, bullet injuries, duration of hospital stay, time since injury > 6 hours, delay in treatment, associated head injury, high injury severity score, and post-operative infectious complications(8,10,11,14).

Little attention has been given to interventions aimed at minimizing the occurrence of these injuries and the management of the victims, despite the fact that PAI is one of the main causes of morbidity and mortality in the developing world, including Ethiopia (15).

1.3. SIGNIFICANCE OF THE STUDY

Only few studies are conducted in our country and St. Paul's Hospital, Millennium Medical College, and AaBET Hospital to assess the pattern, outcomes and associated factors of PAI. The majority of prior studies have focused on patterns of both blunt and penetrating injuries requiring laparotomies.

Therefore, this study was conducted in our hospital to evaluate patterns, associated factors, and outcomes of PAI.

The study would provide additional data on the pattern of penetrating abdominal injuries and its outcomes, which affect individuals of all ages and genders in the country.

It can be used as reference data for a researchers interested to conduct further studies on penetrating abdominal injury.

2. Literature Review

Regardless of socioeconomic development, trauma is the main cause of death in the first 40 years of life and a significant public health problem worldwide (13). By 2020, it is predicted that 8.1 million individuals will lose their lives to injuries every year. Because of the morbidity and mortality that it brings, trauma significantly reduces workforce productivity (16).

The third most often injured body site is the abdomen, which requires surgery in about a quarter of civilian cases(16,17).

In the United States, penetration abdominal injuries continue to be a common reason for trauma admissions. Stab wounds (SW) are encountered three times more frequently than gunshot wounds (GSW), but have a lower mortality rate due to the reduced energy conveyed (18,19).

In a study conducted in Canada, 167 patients were identified as having penetrating abdominal trauma of these 72 patients were having peritoneal violation and identified as candidates for CM. Of this 29 were having anterior abdominal injuries, 18 flank injuries, 15 thoracoabdominal injuries, and 3 back injuries, and 7 were having injuries in more than one anatomic location. Ten of these patients were operated, while the other 62 were treated conservatively at first (3).

A study on PAI was conducted in France. The study included 100 people who had PAI among these 89 were males. The average age was 32; their age range was 18-69. Injuries were caused by stab wounds in 69 of the patients and gunshot wounds in the remaining 31(7).

A study conducted in Egypt revealed that abdominal trauma occurred in 248 cases. Stab injury was the most frequent cause of penetrating abdominal injuries in 119(47.4%) patients (13).

According to a study done in Gombe, North-east, Nigeria of 147 cases of abdominal trauma that presented to ED revealed that stabbing injuries were the most common type of injury, occurring in 76 cases (51.7%), followed by gunshot injuries in 60 cases, and blast pellet injuries in 11 patients (19). Every bullet wound required a laparotomy. 29 patients underwent laparotomies out of the 76 patients who suffered stab wounds, 59% of whom had no peritoneal break and were treated locally. The bowel was the most frequently injured organ, with small gut being affected in 22 cases and large bowel in 19, liver in 12, kidney in 5, stomach, and spleen in 3 cases each (8).

According to a prospective study from Calabar, Southern Nigeria, gunshot wounds are the most frequent. For management, the patients were divided into two groups: surgical (laparotomy) 25 (86.2%) and non-surgical 4 (13.8%). In the latter, the four male patients with stab wounds were treated successfully (12).

According to a study conducted in Khartoum, 89.4% of patients experienced penetrating abdominal injuries (PAIs) within the first four decades of life. 91.8% of the population was male. When they arrived at the ED, 27.1% were in a state of shock, and 20 (23.5%) exhibited peritonitis symptoms. 16.5 percent of the victims sustained GSW, while 83.5% were stabbed. The majority of patients (69.4%) experienced a smooth post-operative course and were sent home in good general health. 22 patients (25.9%) experienced complications, and four patients were died. Their deaths were due to pulmonary embolism, hemorrhagic shock, and sepsis (10).

A study was carried out in Hiwot Fana hospital, Eastern Ethiopia on the Pattern of PAI. The study included 352. The average age was 26 and there was a 5.6:1 male to female ratio. Machete injuries make up 65% of all injuries, and bullet injuries make up 22%. The anterior abdomen is the most frequently injured area, while the most frequently injured organs were the small intestine (55%), colon (25%), and liver (11.4%). Repair of hollow and solid organs is a commonly carried out surgery in 200 patients and end-to-end anastomosis in 123 (35%), and damage control surgery (DCS) in 25 (7.1%). The negative laparotomy rate was approximately 6.5%(14).

A study on penetrating abdominal injury was carried out in three French hospitals. The study included 100 patients. Immediately, 72 patients were operated, and 22 had an NTP. 16 (32%) of the 50 therapeutic procedures had one or more postoperative complications. There were 7 major complications (hemoperitoneum, fistula, deep abscess, retroperitoneal cellulitis, ureteral injury, ARDS) and 9 minor complications (pneumonia, hematoma, pulmonary embolism, and ileus). The average hospital stay was 5.5 days (7).

A study conducted in Bangalore, India, on 80 patients with penetrating abdominal trauma. The mean age of patients was 29 years. There was a 25:1 male to female ratio. The majority of the patients (89.4%) were in their second to fourth decades of life. Shock was reported in 25 patients (31.25%). The most common type of injury seen was stab wound. All of patients underwent exploratory laparotomy. Hollow viscus injuries were reported in 81.25% of the patients, while solid organ injuries were found in 20%. This study's rate of negative laparotomy was 7.2 % (22).

A study in Tanzania, on the patterns and outcomes of patients with abdominal trauma.¹¹⁵ (84.6%) of the 136 patients were male, with a male-to-female ratio of 5.5:1. Majority of patients were between the ages of 21 and 40, accounting for 67 (49.3%), with a median age (IQR) of 31.5 (21.3-44.8) years. Complications and mortality occurred in 31.25% and 13.2% of cases, respectively. The average hospital stay was nine days. The majority of patients (89; 65.4%) had extra-abdominal injuries. Post-operative complications were observed in 57 patients (41.9%) (9).

In a research conducted at the Hiwot Fana hospital, surgical site infection accounted for 23.9% of all complications. The rate of admission to the intensive care unit (ICU) was 3.7%, and the mortality rate was 3.4%. In multivariate binary logistic analysis, hypotension, age more than 45, post-operative infectious complications (Pneumonia & Organ Spaced Surgical Site Infection), and ICU hospitalization were all related to death (23).

Conceptual framework

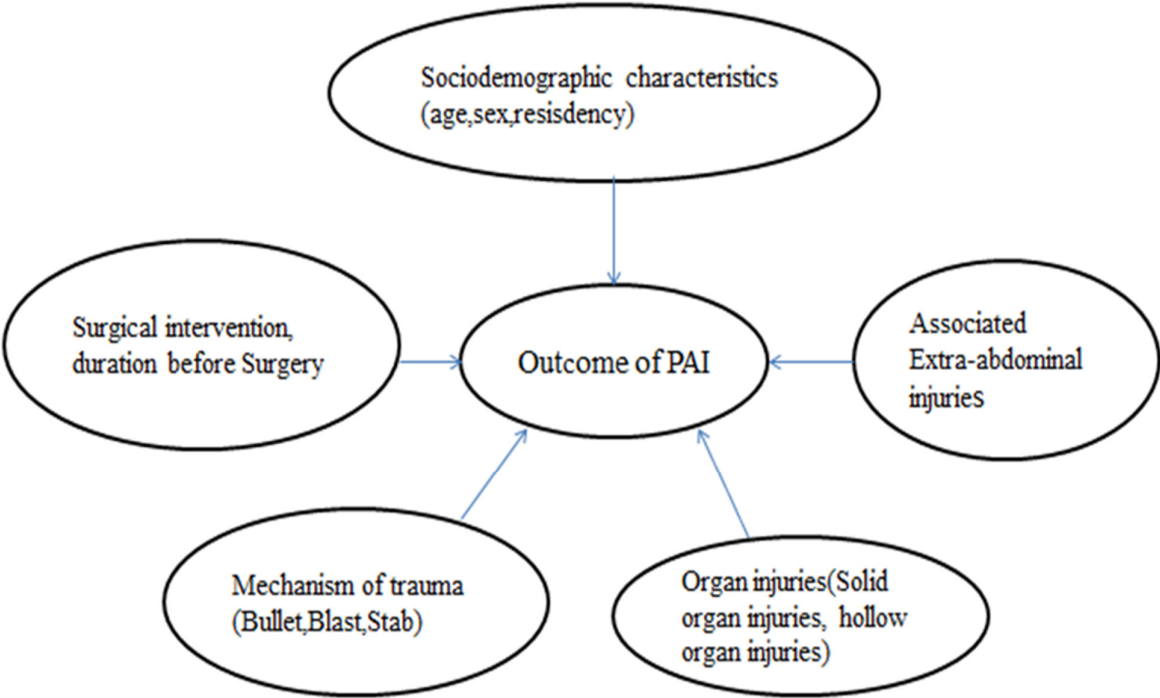


Figure 1 Conceptual framework

3 .OBJECTIVES OF STUDY

3.1. GENERAL OBJECTIVE

To assess the pattern, outcome and associated factors of penetrating abdominal injury among patients admitted at Addis Ababa Burn Emergency and Trauma Hospital ED from September 1, 2020 to October 1, 2023, Addis Ababa, Ethiopia.

3.2. SPECIFIC OBJECTIVES

- ❖ To determine the patterns of penetrating abdominal injury among patients admitted at Addis Ababa Burn Emergency and Trauma Hospital ED from September 1, 2020 to October 1, 2023. Addis Ababa, Ethiopia.
- ❖ To determine outcome of penetrating abdominal injury among patients admitted at Addis Ababa Burn Emergency and Trauma Hospital ED from September 1, 2020 to October 1, 2023. Addis Ababa, Ethiopia.
- ❖ To determine the associated factors of penetrating abdominal injury among patients admitted at Addis Ababa Burn Emergency and Trauma Hospital ED from September 1, 2020 to October 1, 2023, Addis Ababa, Ethiopia.

4. Methods & materials

4.1 Study design

Institutional based cross-sectional study was conducted.

4.2 STUDY AREA AND PERIOD

This study was conducted at AaBET Hospital from August 1, 2023 to October 1, 2023. As of November 2021, Ethiopia has a population of more than 115 million. Addis Ababa as the capital city of Ethiopia has a population of more than 5 million. AaBET Hospital is an affiliation of St Paul's Hospital Millennium Medical College (SPHMMC) which is the second top referral hospital in Addis Ababa, Ethiopia. It comprises an Emergency Medicine and Critical Care Department, Orthopedics and Traumatology Department, Neurosurgery Department, Plastic Surgery Unit, and General Surgery Unit since 2014 G.C. The hospital emergency department has 60 beds, 13 Intensive Care Unit (ICU) beds, and 300 inpatient beds. The hospital serves more than 150000 people from Addis Ababa and out of Addis Ababa. The hospital accepts referral patients from 55 health centers and 11 hospitals catchments through liaison communication. The referral is decided by the clinician, availability of further care, and resource in accepting facility. Currently, there is no organized poison center in Ethiopia. Therefore, every health facility provides care for poisoned patients based on their level of service and resources available. The annual emergency room patient visit of the hospital ranges from 15,000 to 20,000. The emergency room and ICU accept all types of cases, while inpatient wards are only for the respective departments and units.

The study period was from August 1, 2023 to October 1, 2023.

4.3 Source population

All trauma patients admitted to AaBET hospital ED from September 1, 2020 to October 1, 2023.

4.4 Study Population

All penetrating abdominal injury patients admitted to Addis Ababa Burn, Emergency, and Trauma (AaBET) hospital emergency department from September 1, 2020 to October 1, 2023, who meet the inclusion criteria, were included in this study.

4.5 SAMPLE SIZE

The sample size was calculated by using single population proportion formula by taking

Using assumption of 95% confidence level, 5% margin of error

$$n = [Z_{\alpha/2}]^2 p (1 - p) / w^2$$

Where; - n= the sample size

$$Z_{\alpha/2} = 1.96 \text{ (for 95\% of CI)}$$

p = Penetrating abdominal injury mortality rate was (P = 12 %) from study done(15).

$$w = \text{marginal error} = 0.05 \text{ (5\%)}$$

$$q = 1 - p = 0.49$$

$$n = (1.96)^2 \times 0.12 (0.88) / (0.05)^2 = 162$$

Considering incomplete charts of 10%, $= 162 \times 10\% = 16$, $162 + 16 = 178$

Hence, the required sample size is, 178

4.6 SAMPLING TECHNIQUE AND DATA COLLECTION PROCEDURES

A structured data extraction checklist was prepared by the principal investigator in English version after reviewing different literature to explore the objectives of the study. The sources of data were secondary data from medical records of penetrating abdominal injury. Data was collected using structured checklists, which were developed after different literature was reviewed based on research objectives.

The checklist contains socio-demographic characteristics, clinical profiles of participants, type of injury, operative findings, operations performed, and surgery outcomes.

The target study populations were first identified from the HMIS record and the sample card number was taken from the HMIS record then card number was sorted.

A total of 192 patients with PAI were admitted to the AaBET hospital between September 1, 2020, and October 1, 2023. Of those patients, 178 had complete charts and fulfilled the inclusion criteria, and data was collected from those 178 charts. Of the 14 charts that were eliminated, 8 charts were lost, 3 had incomplete documentation, and 3 patients had left against medical advice. Then the patients' medical records were retrieved and data was collected using a structured standard checklist from the chart. All eligible medical records were included and convenience sampling method was used.

4.6 Data Quality Control and Management

Structured data extraction checklist was prepared in English version. To assure the quality of data training was given for data collectors and supervisor on the data collection tool and the data collection. Then the questionnaire was pretested on 5% of the sample size out of the study area to ensure its validity. Data extractions were made by 4 General practitioners. Completeness of each questionnaire was checked by the principal investigator and the supervisors on daily basis.

4.7 Data Analysis Plan and Procedures

Data will be entered in Epi data and exported to SPSS version 23 for analysis. Descriptive statistics like frequency tables, graphs and charts will be used to describe the variables.

Bivariate and multivariate logistic regression analyses were used to identify the factors associated with PAI treatment outcomes. Those independent variables with P-values less than 0.25 in the bivariate analysis were included in the multivariate analysis. Adjusted odds ratios (AORs) with corresponding 95% confidence intervals were calculated using multivariate logistic regression analysis. The statistical significance was determined at a P-value of 0.05.

4.8 STUDY VARIABLES

4.8.1 Dependent variable

Outcomes of penetrating abdominal injury (Improved/Died)

4.8.2 Independent Variables

Injury patterns (stab vs. bullet)

Associated extra abdominal organ injuries

Socio demographic characteristics (Age, Sex, Residency)

Complications (SSI, wound dehiscence, HAI)

Treatment option (conservative or surgical interventions)

Duration of presentation

Operative time

Type of organ injured

Post-operative complications

Preoperative Hemoglobin

Length of hospital stay

4.9 INCLUSION AND EXCLUSION CRITERIA

4.9.1 Inclusion criteria

All patients with penetrating abdominal injuries who were discharged or died during the study period and had complete medical records.

4.9.2 Exclusion criteria includes

Patient who decided against medical advice to discontinue therapy

Patients who are referred to other facilities after admission

Patients with incomplete data and lost their charts.

Patients with no evidence of peritoneal penetration on either physical exam or CT

4.10 Operational definitions

PAI: Any injury caused by an object that penetrates the skin and enters the abdominal cavity is known as penetrating abdominal trauma

Improvement: When a patient is discharged from the hospital after receiving either surgical management or conservative treatment along with supportive management, as indicated by a clinical diagnosis of stable vital signs.

Outcome: Patient either treated and discharged or Died after admission.

Exploratory laparotomy: An urgent surgical procedure in which the abdominal cavity is opened via a midline incision and the four quadrants are evaluated for pathologies (e.g., bleeding, perforation).

Conservative management: Consider the following in consultation with the trauma team for select stable patients without indications for exploratory laparotomy: 24-hour observation, Vital signs monitoring, Serial abdominal examinations, Serial hemoglobin and hematocrit measurements, Repeat imaging if clinical status changes.

4.11 Ethical consideration

Ethical clearance was obtained from Institutional Review Board (IRB) of St. Paul's Hospital Millennium Medical College. The data found in the patient chart were kept confidential.

4.12 Dissemination and utilization of the result

The final report of this thesis will be presented to department of EMCC. The findings will be published in a relevant scientific journal and disseminated online so that they can be of use for other academic researchers and clinical practitioners. The data can also serve as a base line for future studies. At last, the final report will also be disseminated to federal ministry of health.

6. Result

6.1 Socio-demographic characteristics

In this study, 178 records of patients with complete data were reviewed and included. Their mean age was 30.18 years (SD $\pm$ 11.75), ranging from 5 to 75 years. The majority of the study subjects 95(53.4%) were between the ages of 25 and 44. Males accounted for 89.9% of the study subjects, and rural residents account 73.4%.

The majority of 106 (52.8%) of the study subjects were from Oromia region, 50(28.1%) of subjects were from Addis Ababa, 12(6.7%) from Amhara region, 9(5.1%) from SNNP and 1 (0.6%) were from Afar region.

Table 1 Socio demographic character of Penetrating abdominal injury patients admitted at AaBET hospital Adult emergency, Addis Ababa, Ethiopia 2023

Variable	Category	Frequency	Percent (%)
Age	5-24	64	36
	25-44	95	53.4
	45-64	16	9
	65-75	3	1.7
Sex	Male	160	89.9
	Female	18	10.1
Residence	Rural	131	73.4
	Urban	47	26.4
Region	Oromia	108	60.7
	Addis Ababa	50	20.1
	Amhara	12	6.7
	SNNP	7	3.9
	Afar	1	0.6

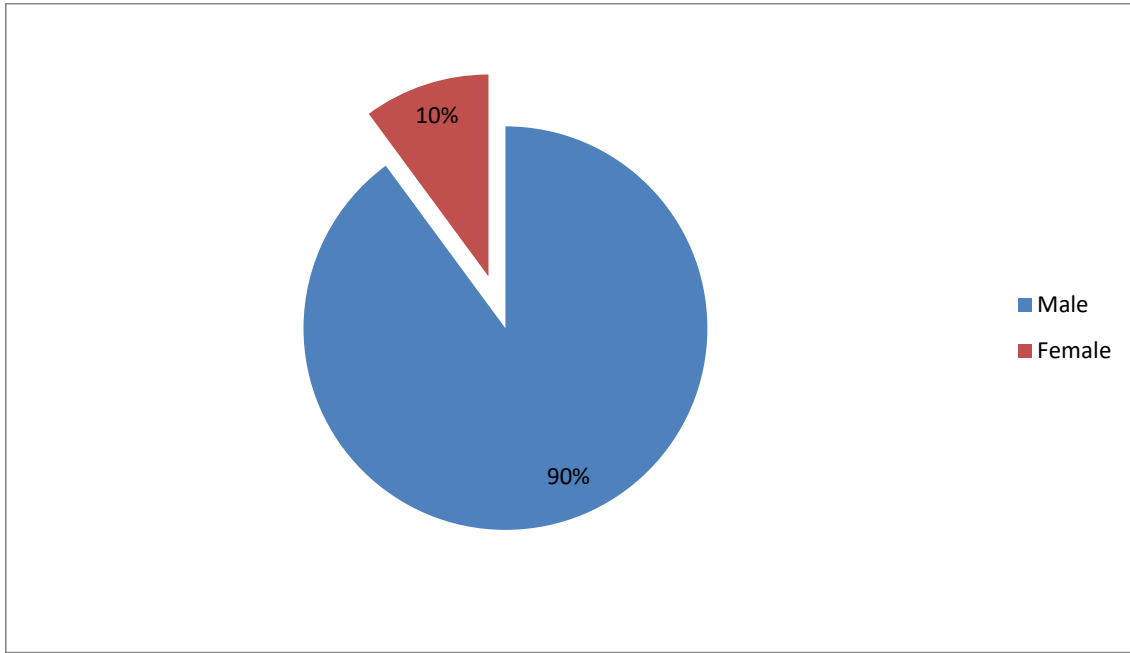


Figure 2 PAI patients sex distribution at AaBET Hospital adult emergency department, Addis Ababa, Ethiopia, 2023

6.2 Clinical profiles of penetrating abdominal injury

The commonest mechanism of injury was stab occurring in 111 cases (62.3%), followed by bullet injuries in 63 cases (35.4%), 3(1.7%) sustained blast injuries.

Anterior abdominal injury was the most common site of injury 72(42.1%), followed by thoracoabdominal injury 69(38.8%), flank and back 33(18.5%), pelvic/gluteal 1(0.6%). From 178 injured patients 26(14.6%) were having solid organ injury from those liver was the most commonly injured solid organ in 13(7.3%), followed by spleen 7(3.9%) and kidney 6(3.4%).

About 94(52.8%) of injured patients presented within 6-24 hour of injury, 64 (36%) presented <6 hours of injury, whereas 20(11.2%) presented >24 hours of injury.

About vital signs at presentation systolic blood pressure (SBP) was >90 mmHg in 152(85.4%) and in 26(14.6%) it was less than 90 mmHg. Regarding baseline Hgb level of patients at presentation 158(88.8%) had baseline Hgb level greater than 13, 20(11.2%) had Hgb level less than 10.

Anterior abdominal injury was the most common site of injury 72(42.1%), followed by thoracoabdominal injury 69(38.8%), flank and back 33(18.5%), pelvic/gluteal 1(0.6%). From 178 injured patients 26(14.6%) were having solid organ injury from those liver was the most commonly injured solid organ in 13(7.3%), followed by spleen 7(3.9%) and kidney 6(3.4%).

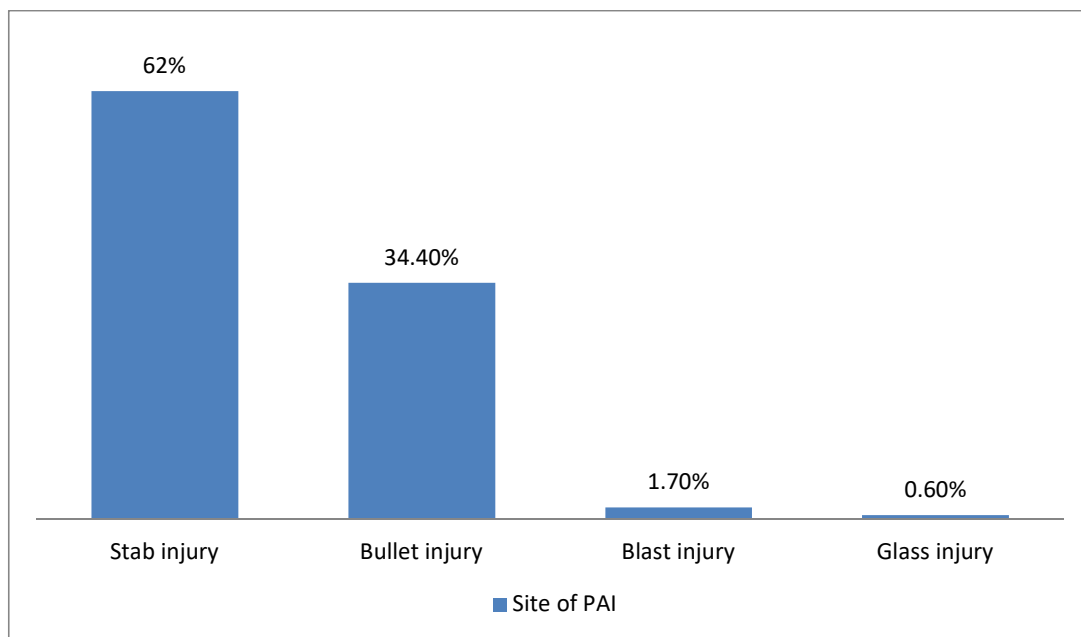


Figure 1 mechanism of PAI at AaBET Hospital adult emergency department, Addis Ababa, Ethiopia, 2023

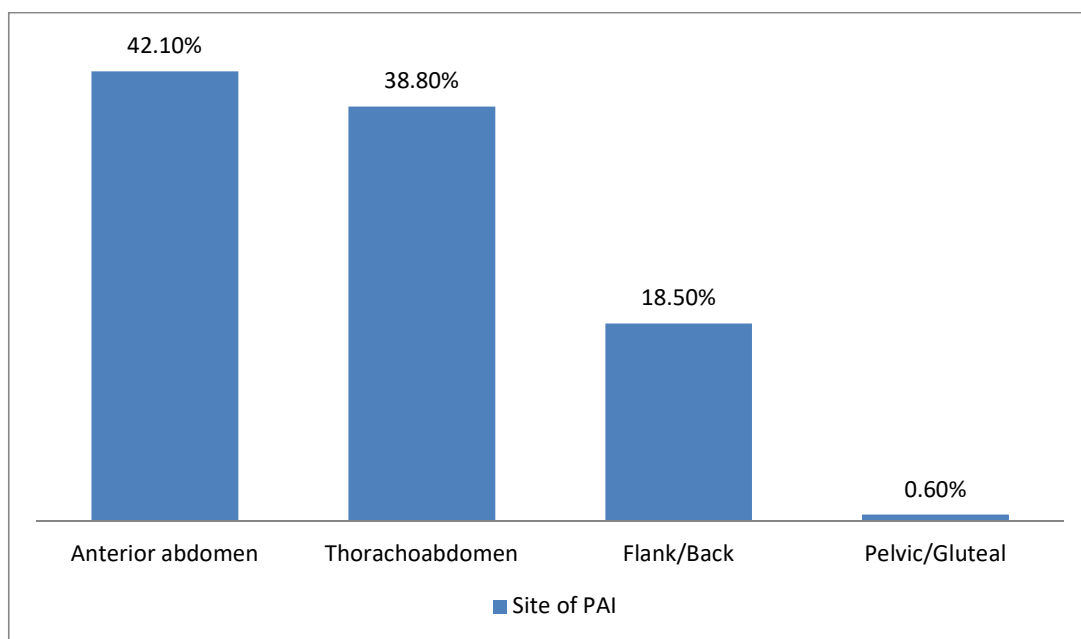


Figure 2 Sites of PAI at AaBET Hospital adult emergency department, Addis Ababa, Ethiopia, 2023

Table 2 -Distribution of PAI patients according to their clinical profile, management, complications, and final Outcomes at AaBET Hospital, 2023

Clinical characteristics	Categories	Frequency	Percent (%)
Mechanism of injury	Stab	111	62.3
	Bullet	63	35.4
	Blast	3	1.7
	Glass	1	0.6
SBP at ED on arrival (mmHg)	<90	26	14.6
	>90	152	85.4
HR at ED on arrival (b/m)	<100	84	47.2
	>100	94	52.8
GCS at ED on arrival	9-12	1	0.6
	13-15	177	99.4
Triage site	Red	50	28.1
	Orange	108	60.7
	Yellow/green	20	11.2
Site of penetration	Anterior abdominal	75	42.1
	Flank and back	33	18.5
	Thoracoabdominal	69	38.8
	Pelvic/gluteal	1	0.6
E-FAST	Positive	167	93.8
	Negative	11	6.2
Base line Hg (mg/dl)	<10	20	11.2
	>13	158	88.8
Blood transfusion	Yes	30	16.9
	No	148	83.1

Viscus injury	Yes	45	25.3
	No	133	74.7
Type of viscus Injured	Small bowel	20	11.2
	Large bowel	16	9
	Stomach	9	5.1
Solid organ injury	Liver	13	7.3
	Spleen	7	3.9
	Kidney	6	3.4
Type of procedure for solid organ injury	Laceration repair	3	1.7
	Splenectomy	2	1.1
	Nephrectomy	1	0.6
	Conservative	20	11.2
Associated extra-abdominal injuries	Spinal cord injury	10	5.6
	Chest injury	55	30.9
	Pelvic fracture	3	1.7
	Upper extremity injury	4	2.2
	Lower extremity injury	4	2.2
	None	102	57.3
Post-operative complication	Yes	17	9.6
	No	161	90.4
Duration of injury	< 6 Hrs.	64	36
	6-24 Hrs.	94	52.8
	>24 Hrs.	20	11.2

Post op Complications	Surgical site infection	2	1.1
	Intra-abdominal Collection abscess	1	0.6
	Wound dehiscence	1	0.6
	Anastomotic leak	3	1.7
	Necrotizing fasciitis	1	0.6
	HAP	4	2.2
	MODS	6	3.4
Length of hospital stay(day)	1-7	132	74.2
	8-14	34	19.1
	15-21	8	4.5
	22-28	1	0.6
	>29	3	1.7
Interval between arrival and surgery (Hrs.)	1-4	41	23
	3-8	12	6.7
	9-12	1	0.6
	>13	1	0.6
Type of procedure done for viscus injury	Primary repair	25	14.0
	Resection and anastomosis	16	9.0
	Repair and colostomy	5	2.8
	Hemicolectomy and anastomosis	1	0.6
	Bleeding ligation	1	0.6
	Negative laparatomy	4	2.2
Final outcome of patient	Improved	168	94.4
	Dead	10	5.6

6.3 Treatment modalities

Of the 178 patients, 45(25.3%) had viscus injuries, of those 20 (11.2%) had small bowel injury, followed by large bowel injury in 16(9.0%), and stomach injury 9(5.1%).

Exploratory laparotomy was done in 55 (30.9%) of patients and generalized peritonitis was major indication in 30(16.9%), followed by hemodynamic instability in 17 (9.6%), Evisceration in 5(2.8%), diaphragmatic injury in 3(1.7%) and peritoneal violation after local wound exploration in 2(1.1%), were the major indications for damage control surgery respectively. The rate of negative laparotomy was 4(2.25%).

Of all 178 PAI patients 26(14.6%) were having solid organ injury among this 21 (11.8%) were managed conservatively, 6(3.4%) of patients were managed operatively, laceration repair was done in 3(1.7%), splenectomy 2(1.1%), nephrectomy 1(0.6%).

6.3 Treatment outcome and complications

Multiorgan dysfunction syndromes (MODS) was the most common postoperative complication seen in 6(3.4%) of patients, followed by hospital acquired pneumonia (HAP) in

4 (2.2%), anastomotic leak in 3(1.7%), surgical site infection (SSI) in 2(1.1%), wound dehiscence in 1(0.6%), and intra- abdominal collection abscess in 1(0.6%).

The overall mortality rate was 5.6% and 168(94.4%) of patients were improved and discharged home.

6.4 Factors associated with outcome of penetrating abdominal injury

Initially, cross tabulation were done for all variables to see existence of association between dependent and independent variables. Then, bi-variate and multivariate analysis were done to determine factors associated with outcome of penetrating abdominal injury.

In bi-variate binary logistic regression age, sex, place of residence, mechanism of injury, duration of time from injury to arrival, viscus injury, transfusion, Solid organ injury, baseline Hgb level ,Exploratory laparotomy, solid organ injury, baseline SBP, duration of surgery , spinal cord injury, baseline Hr., and MODS were statistically associated factors with death due to PAI. In multivariate analysis age, presence spinal cord injury, Bullet injury and MODS were statistically associated with death due to PAI.

At bivariate analysis such age, sex, place of residence, mechanism of injury, duration of time from injury to arrival, viscus injury, transfusion, Solid organ injury, baseline Hgb level ,damage control surgery, solid organ injury, baseline SBP, duration of surgery , spinal cord injury, baseline Hr., and MODS had p-value of 0.25 and included to multivariate analysis.

In multivariate analysis variables age >45 years had 9.84 times higher odds of death as compared to those <= 45 years of age, (AOR= 9.84(95%CI: 1.69, 57.4). Patients with bullet injuries had 4.96 times greater odds of dying than patients without such injuries (AOR = 4.99 (95% CI: 1.13, 25.19). The odds of death for patients with associated SCI were 12.2 greater than those without associated SCI (AOR = 12.20 (95% CI: 1.106, 134.44). Patients with PAI who had MODS had 373.86 times higher odds of death when compared with their counterparts, (AOR = 373.86.20 (95% CI: 14.01, 942.92).

Table 3 Bi-variable and multivariate binary logistic regression analysis for Patterns, outcomes, and associated factors of PAI at AaBET Hospital Emergency Department, Ethiopia, 2023 (n=178)

Variables	Categories	Death	COR (95% CI)	p-value	AOR (95% CI)

		Yes	No			
Sex	Male	8	152	0.42(0.082-2.12)		
	Female	2	16	1		
Viscus injury	Yes	9	36	33(4.05-269.11)		
	No	1	132	1		
Transfusion	Yes	7	23	14.71(3.55-60.99)		
	No	3	145	1		
Baseline Hgb level	<10	3	7	9.86(2.13-46.43)		
	>10	7	161	1		
Solid organ injury	Yes	2	24	1.50(0.30-7.45)*		
	No	8	144	1		
Duration of surgery	<= 4hrs	1	33	1		
	>4 hrs	9	8	18.56(2.15-165.29)		

Table 4 Bi-variable and multivariate binary logistic regression analysis for Patterns, outcomes, and associated factors of PAI at AaBET Hospital ED, Ethiopia, 2023 (n=178)

Variables	Categories	Death	COR (95% CI)	p- value	AOR (95% CI)

		Yes	No			
Duration of injury	<=24 hrs	7	151	1		
	>24 hrs	3	17	3.81(0.90-16.12)*		
Age	<=45	5	153	1		
	>45	5	15	10.20(2.65-39.27	0.001	9.84(1.69-57.4)
Residence	Rural	8	123	1.46(0.299-7.152)*		
	Urban	2	45	1		
Exploratory laparatomy	Yes	9	46	23.87(2.94-19368)		
	No	1	122	1		
BP	BP<90	6	20	11.1(2.88-42.76)		
	BP>90	4	152	1		
Spinal cord injury	Yes	3	8	8.52(1.85-39.24)	0.041	12.195(1.106-134.439)
	No	7	159	1		
Bullet injury	Yes	8	61	7.02(1.44-34.10)	0.001	4.96(1.13-25.19)
	No	2	107	1		
MODS	Yes	5	1	167(16.35-1706.14)	0.000	373.86(14.01-942.92)
	No	5	167	1		

7 .Discussion

Penetrating abdominal injuries (PAIs) in Africa constituted 30% - 66% of the overall abdominal trauma burden (10,20,21). Majority of the patients in this study were young adults, roughly similar to previous studies, in the 25–44 age range (22,23). This might be attributed to their involvement in sports, occupational hazards, and interpersonal violence (23).

This study has also shown that the residents in rural area were more injured 73.6% than residents in urban area 26.4%. This is in agreement with the study done in our setup and Bangladesh where the rural residents were 62%, followed by urban residents 38% and 58% and 42% respectively (17,24).

There was higher male preponderance, ratio of 7.4 men to 1 woman; penetrating abdominal injuries were far more common in men than in women. The results obtained from other centers are comparable to this one (14,23). This might be due to male's engagement in high-risk activities; and male are bread winner of most households and are probably more involved in activities that predispose them to get injured in the process of trying to earn a living. and the young age group being the mobile population more involved in recreational activities like other studies and males are highly prone for fighting (25).

According to this study, stab injury accounts for 61.8% of all PAI cases, followed by bullet, blast, and glass injuries, which account for 35.4%, 1.7%, 0.6% and 0.6% of cases, respectively. This result was also shown in a study done in France, Egypt, Nigeria and India (7,13,14,21,26). According to study done in Iraq gunshot injury was the commonest cause in 89.4%, followed by stab injury in 9.1%, and sharp instrument in 1.5%(27). The variation could be due to cultural variation between population.

Solid organ injury occurred in 14.6% of our patients (liver 8.7%, spleen 3.9%, kidneys 3.4%). After reviewing additional literatures, it was discovered that, while our rate of liver injuries was clearly different from 14.6%(25) , 26.7% (28), and 33.3%,(23), it was comparable to 7%(29) , 8.7% (12), and 10% (23).The rate of splenic injury was found to be comparable to 3.2% (17) and 5.3%(30).

In our study, the most frequently injured abdominal organs were the bowel in 25.3%, small bowel in 11.2 %, large bowel in 9% and stomach in 5.1%. In the literatures, large bowel injuries were reported in 10.2 % - 39.9% of cases, whereas small bowel injuries accounted for 23% - 55.1%(10,16,18,23). Different studies generated different results; most of them agreed that small bowel injuries are frequently injured organ in PAI. Its anatomy may be the cause of this, as it occupies a significant portion of the abdomen and is freely mobile. Stomach injuries in the literatures ranged from 3.2% to 14.5%, which is nearly similar to our study (10,14,18,28).

In this study 30.9% of patients presented with PAI underwent exploratory laparotomy, and generalized peritonitis was the most common indication 30(16.9%), followed by hemodynamic instability in 17(9.6%). Many authors now support a selective approach to the management of penetrating injuries. This is especially important to prevent a high rate of negative laparotomy in cases of stab injuries to the abdomen. This study's rate of 30.9% was similar to one conducted in Pakistan, which found a rate of 34%. Operative management rates vary from 69 to 90% in other studies(10,18).

In addition, the current study found that chest injury was the most frequently observed associated extra-abdominal injuries, followed by injuries to the spinal cord and extremities. According to studies conducted in Tanzania and Saudi Arabia, among polytrauma patients, chest and head injuries were most commonly associated extra abdominal injuries(25,29).

In this study the most commonly injured site was the anterior abdomen 75 (42.1%), followed by the thoracoabdominal region 69(38.8%), flank and back 33(18.5%), and pelvic and gluteal region 1(0.6%). Which is similar to other studies (10,14).

The overall mortality of 5.6% in our center falls within the range of 4.4-10.3% reported by other authors (10,23,30,31). A research study done Kenya and Tanzania showed that the mortality rate of 12.5% and 13.2% respectively(20,29). Risk factors that predictors mortality include age>45, post op development of MODS, associated spinal cord injury and bullet mechanism of injury.

7. Limitations of the study

7.1 Limitation of the study

The study was conducted at a single tertiary care hospital, with a small sample size which may limit the generalizability of the findings to the general population.

The study did not collect data on all potential confounders, which could have resulted in residual confounding.

In addition poor documentation of patient charts and incomplete patient data were the major challenges.

8. Conclusion and Recommendation

8.1 Conclusion

The most common mechanism of PAI among young adult males was stab injury. Mortality was associated with age above 45, bullet mechanism of injury, associated extra-abdominal injury, and presence of MODS. Ninety percent of penetrating abdominal injuries (PAI) deaths

are due to bullet injuries, indicating the necessity of strictly enforcing the laws limiting the use of weapons in our nation.

8.2 Recommendation

For policy makers

The incidence of abdominal penetrating trauma due to stab wound is much higher than bullet injury in our set up but the mortality rate due to bullet injury is higher, which indicates the need for full enforcement of the legislation on restriction of weapons use in our country.

For health institutions

The hospital should improve chart keeping and need to digitalize patient information.
The hospital needs to write feedbacks to the referring health institutions for timely referral of severely injured patients.

Early detection and treatment, close monitoring of vital signs, resuscitation, and hemodynamic monitoring should also be prioritized.

To health professionals working at the hospital provide

I recommend early and timely recognition of complications to minimize preventable caused morbidity and mortality following abdominal injury.

I also recommend health professionals to improve their chart keeping and completeness.

To researchers

Future similar studies should be carried on a large sample size in different trauma center hospitals to reveal patterns of penetrating abdominal injury.

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10. Annex

Assurance of Principal Investigator

I the undersigned agree to accept all responsibilities for the scientific and ethical conduct of the research project. I will provide timely progress report to my advisor and seek the necessary advice and approval from my primary advisors in the course of the research. I will

communicate timely to my advisors all stakeholders involved in the study including any source of funding for this research.

Name of the student: _____

Signature: _____

Date: _____

Approval of Advisor

Name of the primary advisor: _____

Signature: _____

Date: _____

Approval of Advisor

Name of the primary advisor: _____

Signature: _____

Date: _____

11. Questionnaire

Data collection check list for patients with penetrating abdominal injury

1 Age of the patient years

2. Sex of the patient

A. Male

B. Female

3 Residences

A. Rural

B. Urban

4. Triage site

A. Red

B. Orange

C. Yellow-green

5. Region

A. Oromia

B. Addis Ababa

C. Amhara

D. Afar

E. Debub

F. Benishangul

G. Tigray F. Others.....

6. Mechanism of penetrating abdominal injury

A. Stab

B. Gunshot

C. Blast injuries

D. Horn F. Others.....

7. Duration from time of accident/in jury in hours.....

8. Vital signs at ED

- 8.1. Systolic blood pressure at EOPD at arrival
- 8.2. Pulse rate (bpm)
9. Glasgow Coma Scale.....
10. Sites of penetrating entry wound
- A. Anterior Abdomen
 - B. Flank and Back
 - C. Thoracoabdominal
 - D. Pelvic/gluteal
11. Baseline Hemoglobin -----g/dl
12. Damage control surgery
- A. Yes
 - B. No
13. EFAST
- A. Positive
 - B. Negative
14. Management
- A. Conservative
 - B. Surgical
15. Transfusion
- A. Yes
 - B. No
16. If no.15 is yes, how many should unit
17. Indication for exploratory Laparotomy

- A. Hemodynamic instability**
- B. Generalized Peritonitis**
- C. Evisceration**
- D. Peritoneal violation after local wound exploration**
- E. Others.....**

18. Does patient has viscus injury

- A. Yes**
- B. No**

19. If yes for 18, type of viscus injury identified

- A. Stomach**
- B. Small bowel**
- C. Large bowel**
- D. Genitourinary (bladder ureter, urethra)**
- E.OTHERS.....**

20. If yes for no. 19, Type of procedure done for viscus injuries

- A. Primary repair**
- B. Resection and Anastomosis**
- C. Ileostomy**
- D. Colostomy**
- E. Ileostomy and repair**
- F. Resection and anastomosis and colostomy**
- G. Repair and colostomy**

21. Does patient has solid organ injury

A. Yes

B. No

22. If yes for 21, type of Solid organ injury identified

A. Liver

B. Spleen

C. Kidneys

D. Pancreas

23. If yes for question 22, type of procedure done for solid organ injury

A. Laceration repaired

B. Splenectomy

C. Nephrectomy

D. Splenorrhaphy

F. Renorrhaphy

24. Duration of surgery Hrs

25. Associated extra-abdominal injuries

A. Head injury

B. Spinal cord injury

C. Chest injury

D. Pelvic fracture

E. Upper extremity injury

F. Lower extremity injury

G. None

Part 3:Post-Operative conditions

26. Does the patient has any post-operative complications

A. Yes

B. No

27. If yes for question no. 26, which of the following complication the patient develops

A. Surgical site infection

B. Intra-abdominal collection abscess

C. Wound dehiscence

D. Stoma complication (Necrosis or retraction)

E. Anastomotic leak

F. Enter cutaneous Fistula

G. Necrotizing fasciitis H. OTHERS.....

28. Length of hospital stay.....

29. Interval between arrival and surgery.....

30. Final Outcome of the patient

A. Improved

B. Died

