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# Prediction of Scoring System for Diagnosis of Intra-Abdominal Injury after Blunt Abdominal Trauma

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## Abstract

**Purpose:** The blunt abdominal trauma (BAT) is a common emergency and is significantly associated with morbidity and mortality. Our study was conducted to achieve the goal that a new scoring system could be used for the BAT patients.

**Methods:** The statistical population of this study was 100 patients with Blunt abdominal trauma (BAT) referred to emergency department of SMS Hospital, Jaipur, Rajasthan, India. Sampling was carried out in a convenience non-random manner and continued to reach the required sample size. BAT victims due to motor vehicle crash, fall, acceleration-deceleration, pedestrian trauma, motorcycle crash, direct trauma. Exclusion criteria were after 3 months of pregnancy, under the age of 18, warfarin taking, no reliable medical history providing and penetrating trauma. The study questionnaire was based on BAT scoring system. The receiver operating characteristic curve was used to analyse the effectiveness of the new scoring system in predicting the BAT patients' outcome.

**Results:** The mean age of the patients ($n$ = 100) was (~36) years. Based on this scoring system, the patients were divided into three categories. The first group was patients at low risk with score of less than 9, the second group was patients at moderate risk with score of 9–19 and the third group was patients at high risk with score of >20. The score of 50 (50%) patients were low, 44(44%) were moderate and 6 (6%) had a high score. The association between high score and patient been operated shows the reliability of this questionnaire to predict the future of patients.

**Conclusions:** The study tool has a sensitivity to predict the Blunt abdominal trauma patients' outcome, and has a proper specificity that can be used to reduce the use of harmful modalities such as computed tomography scan.

**Keywords**: Abdominal injuries, Blunt injury, Emergency department

## Introduction

Trauma is a major worldwide public health problem. Abdomen is the 3rd most common part to be injured. Abdominal injury is third most common cause of death from trauma.[1] Blunt trauma remains the commonest type of abdominal injury. Intra-abdominal injury diagnostic methods include physical examination,

laboratory tests, USG, CT scan, laparoscopy & laparotomy.[2] CT scan is gold standard for assessing blunt abdominal trauma (BAT) [3] but in addition to being expensive & not easily accessible, it entails irradiation to the patient. This research aims to the design a new scoring system that would help BAT patients in emergency care.

**Aims & Objectives**

To find out the prognostic effectivity of a scoring system & need of CT scan based on clinical manifestation & examination for diagnosis of Intra-abdominal injury (IAI) after blunt abdomen trauma.

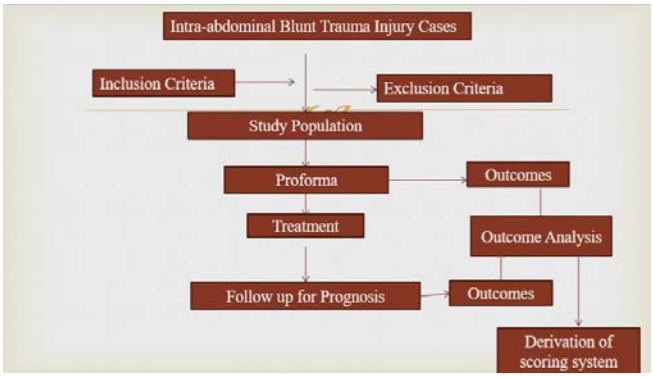
**Materials & Methods**

The present analytical study was performed to evaluate the reliability of the blunt abdominal trauma scoring system (BATSS). The statistical population of this study was 100 patients with BAT referred to emergency department of SMS Hospital, Jaipur, India. Follow up of the patients was done after a month.

**Inclusion criteria**: BAT victims due to motor vehicle crash, fall, acceleration-deceleration, pedestrian trauma, motorcycle crash, direct trauma.

**Exclusion criteria**

- pregnant women
- patients under 12 years of age
- patients on a warfarin
- Penetrating abdominal trauma.




**Variables Used**

1. Pulse rate
2. Blood pressure
3. Abdominal pain
4. Abdominal tenderness
5. Abdominal guarding
6. Abdominal wall sign- erythema, ecchymosis, abrasion
7. Low chest rib(6 lower ribs) tenderness
8. Chest wall sign- erythema, ecchymosis, abrasion
9. Pelvic fracture
10. Shifting dullness Obliteration of liver dullness

- ***Investigations***

FAST (Focused Assessment with Sonography in Trauma)

Abdominal pelvic CT scan with intravenous contrast.

- ***Outcome***

Discharge

Admission for IAI

Operating room

**Results**

**Distribution of cases with CT finding with PR**

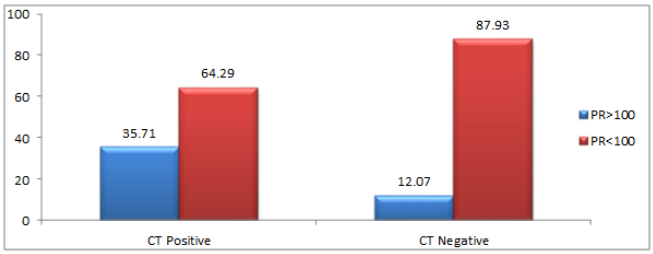



Fig.1: Distribution of cases with CT finding with SBP

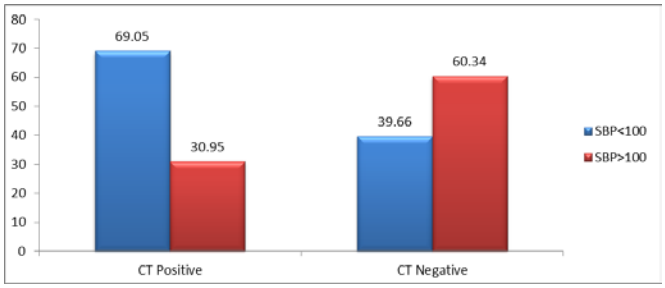



Fig.2: Distribution of cases with CT finding with DBP

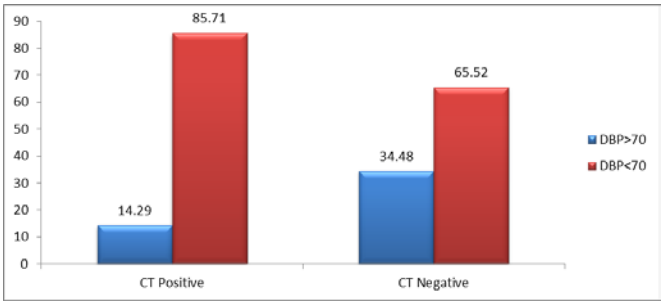



Fig. 3: Distribution of the cases with CT finding with Abdominal Pain

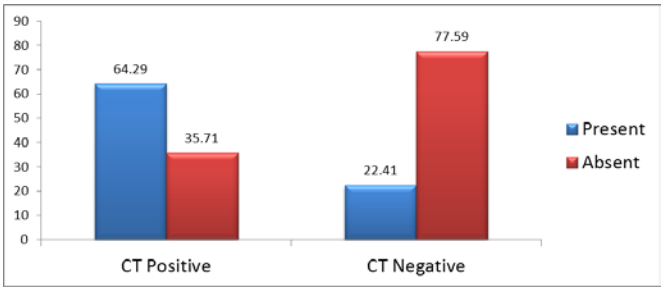



Fig.4: Distribution of cases with CT finding with Abdominal Tenderness

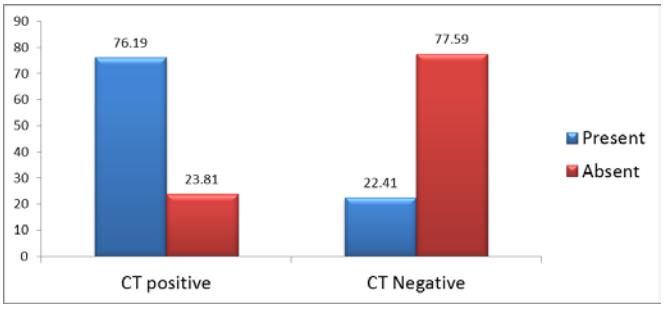



Fig.5: Distribution of cases with CT finding with Abdominal Guarding

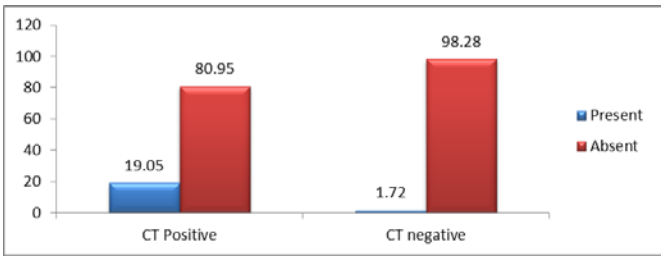



Fig.6: Distribution of cases with CT finding with Chest Wall Sign

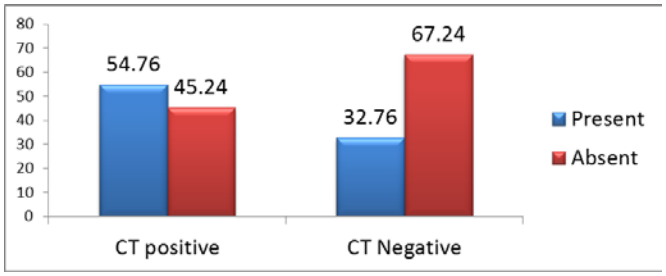



Fig.7: Distribution of cases with CT finding with Rib Tenderness

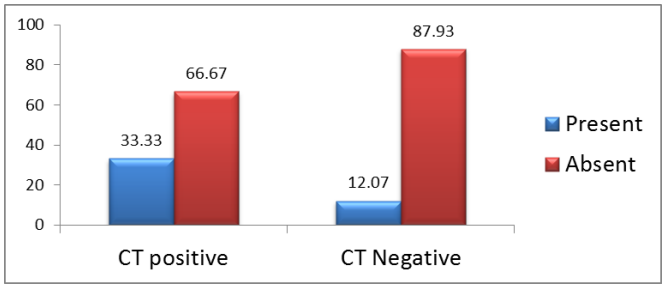



Fig.8: Distribution of cases with CT finding with Pelvic Fracture

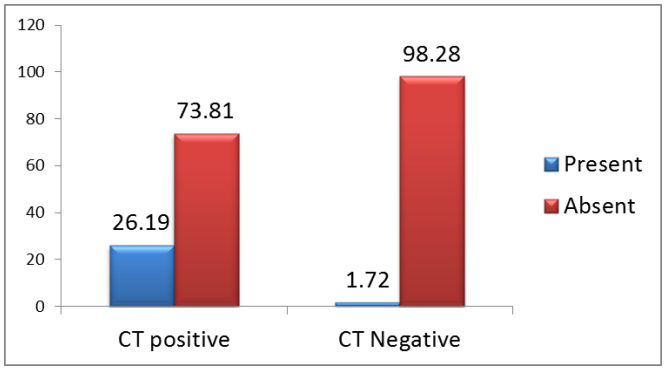



Fig.9: Distribution of cases with CT finding with FAST

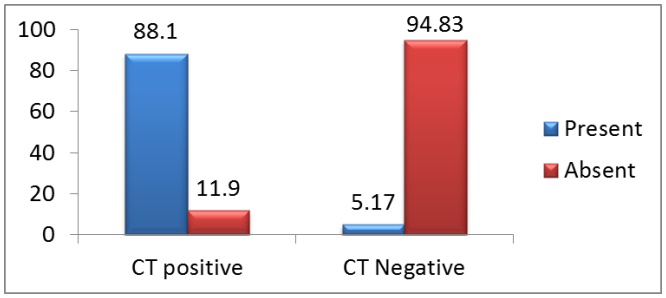



Fig.10

- No Significant difference was observed in relation with abdominal wall sign, shifting dullness, obliteration of liver dullness.

**Predictors for CT positive by using multiple logistic regressions (Multivariate analysis)**

| Variables in Equation | β score |
|---|---|
| SBP | 3.615 |
| DBP | 4.876 |
| Pulse Rate | 4.774 |
| Abdominal pain | 0.209 |
| Abdominal guarding | 1.577 |
| Abdominal tenderness | 1.810 |
| Chest wall sign | 0.141 |
| Rib tenderness | 2.521 |
| Pelvic fracture | 0.831 |
| FAST | 6.517 |
| Constant | 8.289 |

Table.1

**Receiver operating characteristic (ROC) curve**

The ROC curve is constructed by plotting the sensitivity on the y-axis and (1 - specificity) on the x-axis at different cut off points. As accuracy and discrimination improve, the ROC curve moves toward and to the left.

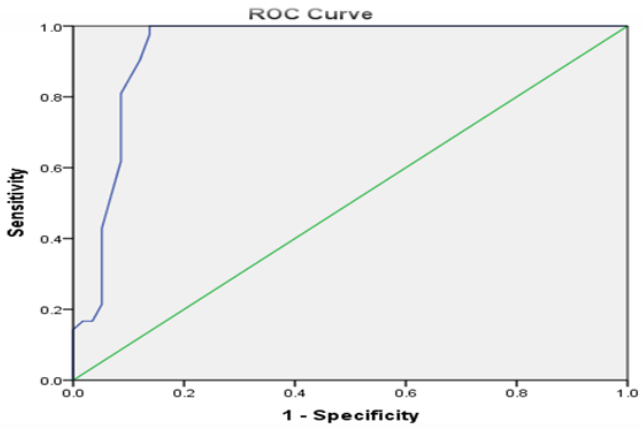



Fig.11

**Scoring**

| Variable | Score |
|---|---|
| Pulse Rate | 5 |
| SBP | 4 |
| DBP | 5 |
| Abdominal Pain | 1 |
| Abdominal Tenderness | 2 |
| Abdominal Guarding | 2 |
| Chest Wall sign | 1 |
| Lower chest rib tenderness | 2 |
| Pelvic fracture | 1 |
| FAST | 7 |
| **Total** | **30** |

Table.2

**Distribution of patients for risk of IAI according to score**

| GROUP | SCORE |
|---|---|
| Low Risk | <9 |
| Moderate Risk | 9 to 19 |
| High Risk | ≥20 |

Table.3

**Distribution of patients based on outcome and presence of IAI**

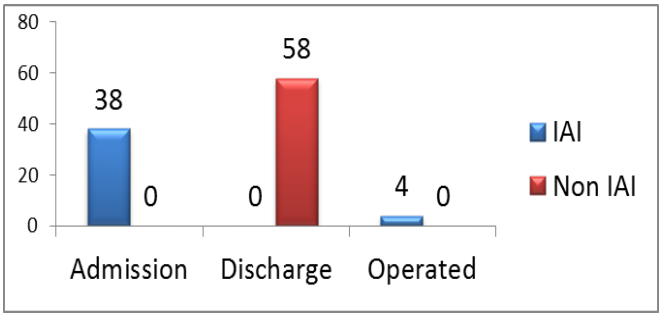



Fig.12

**Distribution of the Score based on CT scan result and outcome.**

| | Low Risk (Score <9) | Moderate risk (score 9-19) | High risk (score >19) |
|---|---|---|---|
| CT | No. | No. | No. |
| Negative | 50 | 8 | 0 |
| Positive | 0 | 36 | 6 |
| | | | |
| Outcome | | | |
| Admission | 0 | 36 | 2 |
| Discharge | 50 | 8 | 0 |
| Operating room | 0 | 0 | 4 |
| | 50 | 44 | 6 |
| | | | |

Table.4

**Distribution of patients in different risk group based on CT Scan result**

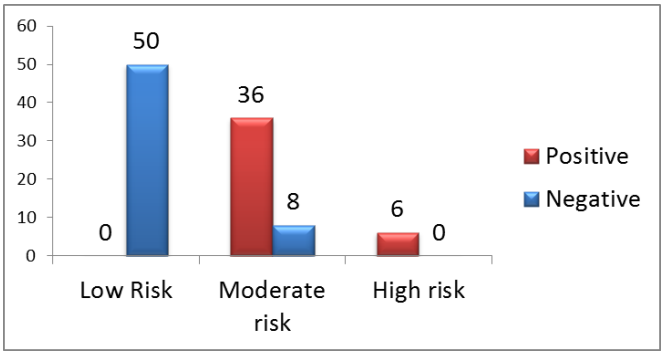



Fig.13

**Distribution of patients according to score**

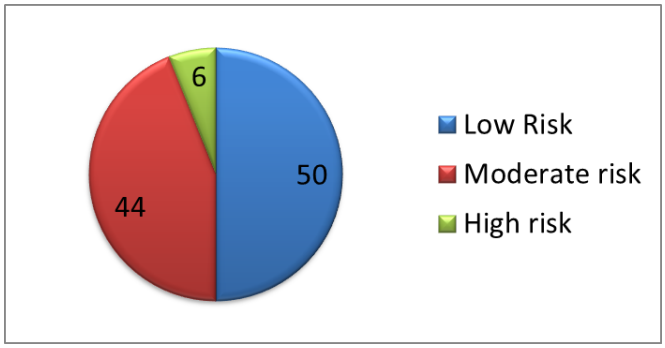



Fig.14

**Discussion**

Parreira et. al.[11] found that injuries sustained in a traumatic event without abdominal pain or without changes in the clinical examination of the abdomen; these injuries may be severe and require special surgical treatment. The study also emphasized that clinical scoring has not yet been validated to better identify the victims of traumatic risk with intra-abdominal injury.[1]

Shojaei et al.[10] divided the patients into two groups- high and low risk based on the presence or absence of abdominal injury, based on medical history, examination and primary ultrasound as part of the examination and the results of urinalysis and the related cases. Low-risk patients were discharged after re-ultrasound, other necessary measures, explanation of the warning signs and justification for recurrence in case of any complications. Risky patients were those who had pelvic free fluid in primary or secondary ultrasound, had clear clinical hematuria in test, or had a serious pelvic fracture that caused suspicion of intra-abdominal injury. A score was determined to express the relationship between clinical signs and abdominal organ damage. These symptoms included abdominal tenderness, distension, and intraperitoneal stimulation,

seat belt sign on the side and abdomen, hematuria and Glasgow coma scale.

In 2015, Parreira et. al.[11] evaluated the severity and treatment of occult intra-abdominal trauma in patients with blunt trauma. Their exclusion criteria were patients with retroperitoneal hemorrhage, patients with no specific injury and those who had only lumbar spine fractures. The abdominal imaging protocol was routinely performed on the basis of FAST, sonography and CT, and laboratory tests such as white blood cell, amidase, to evaluate the possibility of abdominal injuries. Leukocytosis, elevated amidase level and metabolic acidosis were suggested for injuries that may not be detected by imaging examinations and in future evaluations. The severity of traumatic injury indexes was categorized using: reduced trauma scale, GCS, injury severity scale, organ injury scale and abbreviated injury scale. The mechanisms of the injuries to pedestrians were cars, motorcycles, level falls, and 76% of patients had GCS >13 and injuries following were identified: spleen, liver, kidneys, intestines, diaphragm, and bladder. Surgical procedures were splenectomy, diaphragmatic suture, intestine and bladder. In this study, there were no deaths directly related to abdominal injuries, and they showed that the clinical score that should help to better identify the victims with high-risk intra-abdominal trauma has not yet been validated.[11]

The study has a sensitivity and specificity- that can be used to reduce the use of harmful modalities such as CT scan.

| Mean age (years) | | | |
|---|---|---|---|
| Our study | Goan et al 1998[4] | Kundson et al 1999[5] | Soffer et al 2006[6] |
| 36 | 38 | 30 | 36 |

| Male to Female ratio | | | |
|---|---|---|---|
| Our study | Goan et al 1998[4] | Kundson et al 1999[5] | Soffer et al 2006[6] |
| 15.67:1 | 2:1 | 2:1 | 3:1 |

| Cause of Abdominal Injury | | | |
|---|---|---|---|
| | Our study | Gary S et al 1998[7] | Neugebauer et al 1999[8] |
| Automobile accident | 58% | 78.4% | 58.6% |
| Free Fall From Height | 23% | 5.8% | 11.4% |

Afifi et. al.[9] proposed a 15- point scoring system. It is based on five parameters including ED admission time post trauma, PR, SBP, GCS and three clinical signs of abdominal trauma consisting abdominal pain, tenderness and guarding. Group I (score≥12) immediate laparotomy should be done. Group II (score between 11-9) needs further assessments. Group III (score≤8) should be kept under observation.

**Conclusion**

A 30-point Jaipur blunt trauma scoring system (JBTSS) was developed based on the obtained β score of each independent predictor for positive CT status using

multivariate logistic regression and were divided into three groups including low (<9), moderate (9≤19) and high (≥20). Patients with score ≥20 should be highly suspected of having intra-abdominal injury. Scores between 9 to19 were considered as moderate risk patients & needed additional observations & test. The ROC curve indicated a close relationship between the results of CT scan and JBTSS (AUC =0.935). The study tool has a sensitivity to predict the Blunt abdominal trauma patients' outcome, and has a proper specificity that can be used to reduce the use of harmful modalities such as computed tomography scan.

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