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Original Research Article

# ANALYSIS OF ABILITY OF PENETRATING ABDOMINAL TRAUMA INDEX (PATI) TO CORRECTLY PROGNOSTICATE THE PENETRATING ABDOMINAL TRAUMA PATIENTS

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**Abstract**

**Background:** To evaluate PATI by means of ROC curve analysis and establish its sensitivity and specificity for predicting the morbidity and mortality in penetrating abdominal trauma.

**Methods:** This was a prospective study over an 12-month period, patients with penetrating abdominal trauma who underwent laparotomy were enrolled. Initial assessment of the patients was done following the ATLS guidelines. Patients were stratified on the basis of those who developed complications, no complications and postoperative mortality. PATI was calculated based on operative findings and the outcomes were measured on the basis of complications or mortality in the postoperative period.

**Results:** Logistic regression analyses allow evaluations on how an instrument's performance can be graded with respect to the relative predictive power of a study variable on the effect of a specific characteristic outcome. ROC curve analysis evaluates an instrument's performance in a comprehensive manner; as results are summarized in a simple way, this methodology avoids data loss and simplification.

**Conclusion:** In this study it was observed that with increasing PATI score, rate of complications increased.

**Keywords:** Penetrating Abdominal Trauma Index, ROC curve, Death

## Introduction:

From time immortal, Injury has been man`s constant companion. In this age of speed, civil conflicts, crimes of passion and road traffic accidents; the incidence of cases of trauma keeps on increasing. Trauma is still one of the most frequent causes of death in first four decades of life.[1]

Out of several scoring systems available for predicting outcome in trauma, penetrating abdominal trauma index (PATI) is the sole one in its category of penetrating abdominal trauma. It was devised by Moore and colleagues in 1981. It is described as a method for quantifying the risk of complications following penetrating abdominal trauma. [2]

This study is being done to evaluate this Instrument`s behaviour, and study its ability to correctly prognosticate patients using the advantages of logistic regression analysis and ROC curve analysis over the traditional statistical techniques.

## Material and methods

**Study area**: The present study was conducted in the general surgery department of S.M.S Hospital & Attached Group of Hospitals, Jaipur.

**Study Design**: The present study was a hospital based analytical type of observational study.

**Study period**: This study was carried out from November 2011 to November excluding the period of data analysis and write up.

**Sample size**: Expecting difference in means of PATI scores in survived and died patients 10.23 with SD 15.98 and accepting alpha error 0.05 and 80% power using "primer software" sample size in each group with continuity correction was 27. Expecting the 10% sample loss the sample size had been increased to 30 in each group. A total of 60 patients were included in study.

**Sample technique:** Each and every eligible case till sample size completed.

**Study population:** Patients who attended emergency in SMS Hospital, Jaipur and that were underwent a laparotomy for penetrating abdominal trauma

**Selection Criteria:**

**Inclusion Criteria:**

- All the patients who arrived in the emergency with penetrating abdominal trauma by stab wound or gunshot wound, and underwent exploratory laparotomy after evaluation by the general surgeon

**Exclusion Criteria:**

- Patients who had no lesion at laparotomy or died during the first 24 hours of the postoperative period were excluded.

**Methodology:**

Each patient with penetrating abdominal trauma considered for laparotomy was assigned a PATI score after laparotomy abdominal evaluation in SMS Hospital. Patient received post surgical care in general surgery wards or in SICU when needed. Complications and/or the cause of death were recorded and tabulated against the PATI scores. After

laparotomy, PATI was assigned to each patient calculating the risk factor per organ injured and multiplying by the severity of injury estimate. Complications were recorded during the hospitalisation stay and this outcome was managed as a dichotomous variable,

1. Patients who had postoperative complications

2. Patients who did not have a complication until the time of discharge.

The severity of trauma outcome was also analyzed as a dichotomous variable;

- Survivors
- Deaths

**Data analysis:** Mean score results for the two subsets of populations were obtained by analysis of variance (ANOVA) of the difference of points obtained by each subset of patients i.e. complicated vs. Non complicated and survival vs. non-survival. For logistic regression and ROC analysis PATI was used as the independent variable; complications and trauma severity outcome (death) were used as binary dependent variables, i.e., binary response was set as complications present and no complications present until discharge and survival or no survival of patients. Logistic regression analysis was performed to determine the association of the relative predictive power of the independent variable with respect to the categorical dichotomous complication/no complication and survival/death dependent variables. ROC curve analysis was performed to summarize the instrument's performance with respect to discriminating patients who will or not complicate and those who will or will not survive. Thus, mean PATI scores for each subset of the population were plotted and sensitivity/specificity calculated by means of non-parametric estimates of the Area under the curve. Statistical analysis was done with **IBM SPSS 20**. Significance was attributed to P values <0.05.

## Results

**Table 1: Injured organ distribution in 60 cases**

| Organ | Total no. Of cases | Total (%) |
|---|---|---|
| Liver | 4 | 5.7% |
| Small Intestine | | |
| Jejunum | 10 | 14.4% |
| Ileum | 14 | 20.2% |
| Duodenum | 1 | 1.4% |
| Large Intestine | 14 | 20.2% |
| Spleen | 2 | 2.8% |
| Mesentry | 10 | 14.4% |
| Pancreas | 0 | 0% |
| Kidney | 0 | 0% |
| Urinary Bladder | 0 | 0% |
| RPH | 5 | 7.2% |
| Omentum | 8 | 11.5% |
| Ureters | 1 | 1.4% |

The organs injury distribution is this series was topped small intestine (36%) followed by Colon (20.2%) and Mesentry (14.4%). Liver was injured in 4 cases while spleen injured only in 2 cases.

**Table 2: Associated extra abdominal injuries**

| Injury | Total no. Of cases | Operative management | Non operative management |
|---|---|---|---|
| Head Injury | 1 | 0 | 1 |
| Thoracic Injury | 5 | 0 | 5 |
| Fracture of long bones | 3 | 2 | 1 |
| None | 51 | 0 | 0 |
| Total | 60 | 2 | 7 |

In this series thoracic injury was commonest extra abdominal injury, being present in 5 cases. Fracture of long bones was present in 3 cases.

**Table 3: Post operative complications**

| Complications | No of Patients | % |
|---|---|---|
| Wound infection | 8 | 34.7 |
| Wound dehiscence | 1 | 4.34 |
| Respiratory complications | 4 | 17.3 |
| Septicaemia | 2 | 8.6 |
| Intra abdominal sepsis | 5 | 21.7 |
| Faecal fistula | 1 | 4.34 |
| ARF | 2 | 8.6 |

Commonest complication after laparotomy in penetrating abdominal trauma was wound infection (34.7%) followed by intra abdominal abscess(21.7%) and respiratory complication(17.3%). This can be attributed to the fact that most of these complications were present in patients who had contamination of peritoneum after perforation in gut. One patient developed faecal fistula after undergoing colon perforation repaired.

**Table 4: Indication for Laparotomy**

| Indication | Present study | Total (%) |
|---|---|---|
| Peritoneal penetration on LWE | **32** | **53.3** |
| Omental and/or bowel evisceration | **9** | **15** |
| General peritonitis | **7** | **11.7** |
| Hemodynamic instability | **12** | **20** |

Out of 60 patients 32 patients had peritoneal penetration on local wound exploration. Omental evisceration with or without bowel was present in 15% of cases. Hemodynamic instability was present in 20% cases.

**Table 5: PATI Score and complications**

| PATI Score | Complications No | Complications Yes |
|---|---|---|
| **0-5** | **22** | **0** |
| **6-10** | **13** | **4** |
| **11-15** | **2** | **2** |
| **16-20** | **0** | **6** |
| **20-25** | **0** | **5** |
| **25-30** | **0** | **6** |

In this study it was observed that with increasing PATI score, rate of complications increased.

**Table 6: PATI score**

| PATI Score | Survivors | Non Survivors |
|---|---|---|
| 0-5 | **22** | **0** |
| 6-10 | **17** | **0** |
| 11-15 | **4** | **0** |
| 16-20 | **6** | **0** |
| 20-25 | **3** | **2** |
| 26-30 | **0** | **6** |
| >30 | **0** | **0** |

The no of death increased with increasing PATI score on laparotomy, a fact which is already proved in many studies.

Logistic regression model when applied to the results of complication and no complication subset of population , it was found that the patients with PATI sore 18.86 are 1.79 times(95% Cl 1.2 to 2.5) more likely to present with complications than those with lesser score points, coefficient of PATI has a wald statistic of 11.81 which is significant at 0.001 level(99.9% confidence level). The ROC curve analysis for this model gives an Area under the curve of 0.980 (95% CI 0.954 to 1.00),which makes this a fair test to discriminate complicated from non-complicated patients. At the score level of 18.5, the coordinates of the ROC curve show a sensitivity of 47.1%, and specificity of 100%.

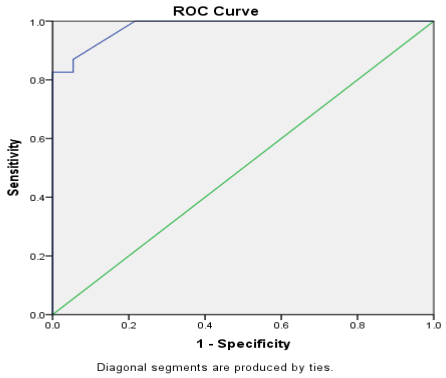
The overall model is significant according to the Model Chi-Square statistic (P = 0.0003). The model predicts 90.00 % of the responses correctly.

**Table 7:**

**Classification Table**

| Observed | | Predicted | | |
|---|---|---|---|---|
| | | Complications | | Percentage Correct |
| | | No | Yes | |
| Complications | No | 35 | 2 | 94.6 |
| | Yes | 4 | 19 | 82.6 |
| Overall Percentage | | | | 90.0 |

| | | B | S.E. | Wald | Sig. | Exp(B) | 95% C.I.for EXP(B) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Lower | Upper |
| | Patiscore | .584 | .170 | 11.815 | .001 | 1.794 | 1.286 | 2.503 |
| | | | | | | | | |




| Area Under the Curve | | | | |
|---|---|---|---|---|
| Test Result Variable(s): PATI Score | | | | |
| Area | Std. Error[a] | Asymptotic Sig.[b] | Asymptotic 95% Confidence Interval | |
| | | | Lower Bound | Upper Bound |
| .980 | .013 | .000 | .954 | 1.000 |
| The test result variable(s): PATI Score has at least one tie between the positive actual state group and the negative actual state group. | | | | |

| Coordinates of the Curve | | |
|---|---|---|
| Test Result Variable(s): PATI Score | | |
| Positive if Greater Than or Equal To[a] | Sensitivity | 1 - Specificity |
| 1.0000 | 1.000 | 1.000 |
| 2.5000 | 1.000 | .892 |
| 3.5000 | 1.000 | .595 |
| 4.5000 | 1.000 | .514 |
| 5.5000 | 1.000 | .405 |
| 6.5000 | 1.000 | .243 |
| 7.5000 | 1.000 | .216 |
| 8.5000 | .913 | .108 |
| 9.5000 | .870 | .054 |
| 11.0000 | .826 | .054 |
| 12.5000 | .826 | .027 |
| 13.5000 | .826 | .000 |
| 14.5000 | .783 | .000 |
| 15.5000 | .696 | .000 |
| 16.5000 | .652 | .000 |
| 17.5000 | .609 | .000 |
| 18.5000 | .478 | .000 |
| 20.5000 | .435 | .000 |
| 22.5000 | .391 | .000 |
| 23.5000 | .304 | .000 |
| 24.5000 | .217 | .000 |
| 25.5000 | .174 | .000 |
| 26.5000 | .087 | .000 |
| 28.0000 | .043 | .000 |
| 30.0000 | .000 | .000 |
| The test result variable(s): PATI Score has at least one tie between the positive actual state group and the negative actual state group. | | |
| a. The smallest cutoff value is the minimum observed test value minus 1, and the largest cutoff value is the maximum observed test value plus 1. All the other cutoff values are the averages of two consecutive ordered observed test values. | | |

Logistic regression model when applied to the results of survival and death subset of population , it was found that the patients with PATI sore 24.50 are .63 times (95% Cl .45 to .88) more likely die than those with lesser score points, coefficient of PATI has a wald statistic of 7.29 which is significant at 0.001 level(99.9% confidence level). The ROC curve analysis for this model gives an Area under the curve of 0.977 (95% CI 0.932 to 1.00),which makes this a fair test to discriminate complicated from non-complicated patients. At the score level of 24.5, the coordinates of the ROC curve show a sensitivity of 62%, and specificity of 100%.

The overall model is significant according to the Model Chi-Square statistic (P = 0.0003). The model predicts 95.00 % of the responses correctly.

## Discussion

Penetrating abdominal trauma still presents as a challenge to the most surgeons.

Trauma related deaths tends to occur at three traditionally recognized times after injury; about half of all deaths occur within minutes of trauma, the next peak of mortality occurs in first hour of trauma. Because any of these deaths can be averted by early treatment, important reductions in this second peak have resulted from the rapid transport and trauma treatments.[3]

The third mortality peak include deaths occur from one day after injury to weeks later. This late mortality can be attributed to infection and multiple organ failures. Morbidity developed in these patients caused extensive hospitalization, higher health costs, prolonged antibiotics coverage, length of utilization of intensive care, negative impact on patient`s life and higher mortality.[4]

The risk factors influencing mortality and morbidity have been studied and they include various scoring system which are remarkable approach to the problem of classifying and characterizing different patients problems.[5]

Although score systems are an excellent tool for objective risk assessments, results can still be influenced by different type of bias which have to be regarded. The choice of a simple to assess score with high reliability and low variability is a further prerequisite for receiving valid results.[6]

Penetrating abdominal trauma index is widely used in assessing the outcome of penetrating abdominal trauma patients. Performance of this instrument was not studied previously.[7]

PATI has been used to measure injury severity in abdominal trauma in order to assist the surgeon in categorizing the patients at risk of developing complications, and even in decision-making techniques for repairing intra-abdominal organs according to its severity score.[8-12]

Several methods to asses abdominal trauma have been evaluated with adequate statistical techniques that quantify sensitivity and specificity, but they include invasive approaches as laparoscopy or image studies.[13-14] Among the trauma indices that have used this methodology of evaluation are the injury severity score and the new injury severity score.

**Conclusion**

In this study it was observed that with increasing PATI score , rate of complications increased.

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