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ORIGINAL ARTICLE

EVALUATION OF PREDICTIVE EFFICACY OF APACHE IV SCORE IN ABDOMINAL TRAUMA PATIENTS

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ABSTRACT: OBJECTIVE: To evaluate predictive efficacy of APACHE IV score in abdominal trauma patients admitted in tertiary care centre and to calculate prognosis of patient. **MATERIAL AND METHODS:** We performed a prospective study of 107 patients who were admitted in surgical intensive care unit from July 2013 to august 2014. APACHE IV score and length of stay in SICU was calculated by APACHE IV calculator. Means of APACHE IV score and length of stay was calculated by SPSS 20 and p value calculated through single sample t test. APACHE SCORE OF 60 was kept as cut off. Patients with APACHE SCORE >60 were expected to have poor prognosis. **RESULTS:** In total 107 patients 17 patients died and 19 patients were expected to have poor prognosis. Mean age of patients who died was 38.88+/-16.186. MEAN APACHE IV SCORE of the 17 patients who died was 76.76 with SD +/-10.75 and the MEAN APACHE IV SCORE of the 90 patients who survived was 32.72 with SD+/-11.115. p value was 0.001. **CONCLUSION:** APACHE IV scoring system can reasonably predict the mortality risk in patients of Abdominal Trauma Patients which include blunt trauma and Penetrating abdominal injury. This scoring system can be used to assess the outcome of critically ill patients admitted in ICU and would help us in proper management of patients. It can help us in proper utilization of available resources& man power; better counselling.
KEYWORDS: APACHE IV score, abdomimal trauma, surgical ICU.

INTRODUCTION: As the name suggests APACHE means The Acute Physiology and Chronic Health Evaluation, this is one of the several intensive care unit (ICU) scoring system. It is applied in patients of age of equal to or more than 16 years of age and evaluation day is APACHE day 1 that is first 24 hours of admission of a patient to an intensive care unit. Diagnosis is made on day 1. Its score is from 0 to 286. Higher the score poor is the prognosis. As score increases up to 80 chances of mortality increases, after that decreases.[1] APACHE IV is better than APACHE III because APACHE III score is a component in the APACHE IV predictive equations that include the score, the patient's length of stay in the hospital prior to ICU admission, the patient's exact ICU admission disease classification (there are 116 specific diagnostic category classifications), the patient's chronic health conditions, the patient's origin immediately prior to ICU admission and a measure of practice patterns to provide probability estimates for various outcomes on a daily basis. In order to produce accurate risk estimates of hospital mortality or probabilities of length of stay (LOS) the APACHE III score must be combined with the other patient risk factors noted in the APACHE IV predictive equations.[2]

Anatomical scoring systems assess the extent of injury whereas physiological systems assess the impact of injury on function. Scores from anatomical scoring systems, once assessed, are fixed whereas physiological scores may change as the physiological response to the injury or disease varies9. Scoring systems used in Trauma can be classified into: 1) Physiologic such as the Trauma Score, and Glasgow Coma Scale. 2) Anatomical such as the Abbreviated Injury Scale and the Injury

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Severity Score. 3) Combined score such as the Trauma and Injury Severity Score (TRISS) method and A Severity Characterization of Trauma (ASCOT).[3,4]

Clinicians can use these benchmarks to assess their unit's through efficiency and monitor the impact of protocols aimed at reducing ICU stay for specific patient groups.

A. The Acute Physiology and Chronic Health Evaluation:

The death rate of patients admitted to intensive care units is much higher than that of other hospital patients.[5] ICU Patients are evaluated by physiologic scores and evaluation of chronic health status. Physiologic scores correlate with severity of illness. Results of the evaluation can be used to estimate the mortality rate for patients in the ICU and during the hospitalization.[6]

APACHE has two components: The chronic health evaluation, which incorporates the influence of co-morbid conditions (such as diabetes and cirrhosis) and Acute Physiology Score (APS).

Deviations from normal on 12 physiological variables like heart rate, blood oxygen level, or respiratory rate, Age of the patient, chronic illness include coma.

B. Physiologic classes of variables (total 8 classes with 34 variables):

1. Cardiovascular : 7 variables,
2. Respiratory : 3 variables,
3. Renal : 3 variables,
4. Gastrointestinal : 6 variables,
5. Hematologic : 4 variables,
6. Septic : 4 variables,
7. Metabolic : 6 variables,
8. Neurologic : 1 variable.

C. SCORING: The physiologic data is evaluated during the first 32 hours after admission to the ICU. Each variable is assigned a value of 0 to 4, based on significance of deviation from normal, with more severe deviations given higher values.[6]

APACHE I: The APACHE (Acute Physiology and Chronic Health Evaluation) prognostic scoring system was developed in 1981 at the George Washington University Medical Centre as a way to measure disease severity.[7]

The Intensive Care National Audit Research Centre (ICNARC) used APACHE score develop by Knauss to compare ICU mortality and total hospital mortality.[7]

APACHE II: APACHE II uses a point score based upon initial values of 12 routine physiologic measurements, age, and previous health status to provide a general measure of severity of disease. When APACHE II scores are combined with an accurate description of disease, they can prognostically stratify acutely ill patients and assist investigators comparing the success of new or differing forms of therapy. This scoring index can be used to evaluate the use of hospital resources and compare the efficacy of intensive care in different hospitals or over time.[8]

APACHE II scoring is still appropriate in the severity assessment and stratification of sepsis patients as an indication for determining the appropriateness of the use of Activated Protein C for patients with severe sepsis.

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APACHE II allows the probability of death before discharge from hospital to be estimated. The probability of death for each patient admitted to intensive care can be summed to give the expected hospital death rate for the whole group. The expected hospital death rate can then be compared with the actual hospital death rate.[9]

APACHE III: It is a refinement of APACHE II,[9] which was introduced in late 1990. Potential uses of APACHE III include the identification of factors in the ICU which contribute to outcome and assistance in individual patient decision-making.

APACHE III can provide initial risk stratification for severely ill hospitalized adult patients.[10]

APACHE IV: Scoring systems represent classification systems or point systems that have been designed for making quantitative statements regarding the severity of a disease, its course and its prognosis1. These systems are based on physiologic abnormalities and have been successful in measuring severity of illness among critically ill patients.[11] This score is for the Non-CABG patients only. Dr. William Knaus, APACHE's original developer, recommends that researchers discontinue the use of APACHE II and move to the more contemporary and accurate APACHE IV, now that both the score and two of the predictions are in the public domain. The APS consists of weighted variables representing the major physiologic systems, including Neurological, Cardiovascular, Respiratory, Renal, Gastrointestinal, Metabolic, Hematological variables, Co-morbidies, admissions, admitting diagnosis. APACHE IV predictions of hospital mortality have good discrimination and calibration and should provide useful benchmarks for evaluating efficiency in ICUs. Clinicians can use these benchmarks to assess their unit's throughout efficiency and monitor the impact of protocols aimed at reducing ICU stay for specific patient groups.[12] APACHE IV mortality has good Physiology and diagnosis of the model's predictive power.[13] The accuracy of predictive models is dynamic and should be periodically retested. When accuracy deteriorates they should be revised and updated.[14]

APACHE IV scores can be used as a clinical predictor for early tracheostomy in patients with respiratory failure in ICU. Patients with APACHE IV scores greater than eighty are less likely to be extubated successfully.[15]

Outcome has usually been measured as death before discharge from hospital after intensive care.[4] As the acute physiology score rise there was a linear increase in ICU stay until the score exceeded 80, at which point ICU stay decreased.[12]

APACHE IV is a successful scoring system assessing severity of illness and prognosis of ICU patients.[11] It has been evaluated and validated in patients for mortality outcome.

The APACHE IV system has already been validated at King Faisal Specialist Hospital[16], this study was conducted to evaluate the performance of this system in a subset of patients with acute renal failure.

Scoring systems represent classification systems or point systems that have been designed for making quantitative statements regarding the severity of a disease, its prognosis, and its course. These systems are based on physiologic abnormalities and have been successful in measuring severity of illness among critically ill patients. Furthermore, scores may serve the purposes of assessing therapies, of quality control and of quality assurance, and of an economic evaluation of intensive care. We validated the APACHE IV benchmark for a subset of patients with severe acute pancreatitis (SAP).[11]

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The critically ill obstetric population still search for a model that accurately predicts mortality. The study hypothesis was that APACHE IV predicts ICU mortality better than APACHE III[17] and APACHE II.[18]

As APACHE IV is a successful scoring system for assessing severity of illness and prognosis of ICU patients and no study has been conducted regarding APACHE IV in our setup. This study was conducted in our set up for the first time to see the applicability of APACHE IV in of MYH INDORE to evaluate the predictive accuracy of apache IV scoring system, and to evaluate the prognostic outcome of scoring system in SICU patients at MYH.

MATERIALS AND METHODS: The study was carried out in the Department of General Surgery, MGM Medical College & MY Hospital Indore. Study has included patients those were admitted in the department of Surgery as an emergency admission in surgical intensive care unit of penetrating injury and blunt trauma abdomen.

Patients Selection Criteria: All patients who were admitted in Department of General Surgery, M Y Hospital, Indore as an emergency admission in S. I. C. U. of penetrating injury and blunt trauma abdomen. And were of more than or equal to 16 year of age and remained in S. I. C. U. for more than 24 hour.

Protocol for Workup: A working Proforma sheet, containing patient's demography, variables from history, clinical examination, investigations, and outcome, was designed. Physiological data and Biochemical data were collected at the time of admission or within 24 hours of admission.

APACHE IV of the patients was calculated by APACHE IV calculator. Variables used are given in Table 1. SPSS 2.0 is used to calculate mean of values and single sample t test is used to calculate p value.

APACHE SCORE OF 60 was kept as cut off. Patients with APACHE SCORE >60 were expected to have poor prognosis.

RESULTS: In our study we took 2 major groups having blunt trauma injury abdomen patients in group one and second group was of patients with penetrating injury abdomen. Total 83 patients were diagnosed to have blunt trauma injury and 24 patients were having penetrating injury.

Out of total 107patients studied, 77 patients were below 40 years of age, and 30 were above 40 years of age. In this, 25 cases of Blunt trauma abdomen were above 40 years of age, 5 cases of penetrating injury were above 40years of age.

Out of total 107 patients who underwent study, 90survived and 17 died. In death group 16 cases were of blunt trauma abdomen and only 1 case was of penetrating abdominal injury.

In our study out of total 107patients, 93 were male and 14 were female. Out of which blunt trauma cases group had 12 female patients, presenting 14.5% of the same population, penetrating trauma group had 2female patients representing 9% of cases.

Out of 107 patients 90 patients survived with a mean age of 31.62+/-11.995 and 17 died with a mean age of 38.88+/-16.186.

The MEAN APACHE IV SCORE of the 17 patients who died was 76.76 with SD +/-10.75 and the MEAN APACHE IV SCORE of the 90 patients who survived was 32.72 with SD+/-11.115.

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Out of 107 patients with mean APACHE IV SCORE of 39.72 +/-19566 there were 83 patients of blunt trauma abdomen with mean APACHE IV SCORE of 41.17+/-20.819 and 24 patients were of penetrating injury abdomen with mean APACHE IV SCORE of 34.71+/-13.617.

In total of 107 there were 17 patients who died were having mean expected LOS 8.87+/-1.31 and mean observed LOS 4.59+/-3. 39.90 patients who survived were having mean expected LOS 3.06+/-1. 42 mean observed LOS 3.81+/-2.01.

DISCUSSION: In our study we took patients with abdominal trauma in which blunt trauma and penetrating injury were included.

Total of 107 patients were studied out of which 83 patients were having blunt trauma and 24 patients were having penetrating injury.

All patients went under exploratory laparotomy and were managed accordingly.

Out of 107 patients 93 were males contributing 86.92% and 14 were females contributing 13.08%.

Out of 107 patients 77 patients were of <40 years of age contributing 71. 96% and 30 patients were of >40 years of age contributing 28.04%.

In total of 107 patients 17 patients died out of which 16 were of blunt trauma abdomen and only 1 was of penetrating injury. Both contributing 15.89%.

In total of 107 patients 90 patients survived out of which 67 were of blunt trauma and 23 were of penetrating injury.

Mean age of the patients who dies was 38.88 with standard deviation (SD) of +/-16.186 and mean age of the patients who survived was 31.62 with standard deviation of +/-11.995. In study it has been found that higher the age more is APACHE IV SCORE and more is mortality risk.

Mean APACHE IV SCORE of total 107 patients was 39.72 with SD of 19.566 with minimum score of 16 and highest score of 102. Mean APACHE IV SCORE of 83 patients of blunt trauma abdomen was 41. 17 with SD of +/-20.819 and Mean APACHE IV SCORE of 24 patients of penetrating injury abdomen was 34.71 with SD of +/-13.617.

Mean APACHE IV SCORE of 17 patients who died was 76.76 with SD +/- 10.75 and Mean APACHE IV SCORE of the 90 patients who survived was 32.72 with SD +/-11.115. APACHE IV SCORE of the patients who died was significantly high. On applying one sample t test p <0.0001 which is significant. (Table 2).

On study it was found that patients with APACHE IV SCORE >60 were having very high chances of mortality. On this basis 19 patients were having chances of death. But on observation 17 died and 2 patients who were having high APACHE IV SCORE but did not died and were discharged.
Predicted Mortality rate was found to be 17.75% and Observed Mortality rate was 15. 89% with SMR (Standard Mortality Ratio) of 0.89.

Mean Expected Length of stay (LOS) in ICU of total 107 patients as calculated by APACHE IV SCORE was 3.98 with SD+/-2.55 Mean Observed Length of stay (LOS) in ICU of total 107 patients was 3.93 with SD+/-2.297.

Mean Expected Length of stay (LOS) in ICU of 17 patients who died was 8.87+/-1.31 and Mean Observed Length of stay (LOS) in ICU was 4.59 with SD+/-3.39. On applying one sample test p<0.0001 which is significant. (Table 3).

Mean Expected Length of stay (LOS) in ICU of 90 patients who survived was 3.06 with SD+/- 1.42 and Mean Observed Length of stay (LOS) in ICU was 3.81 with SD+/-2.01. On applying one sample test p<0.0001 which is significant.

In observation we found that patients who were having pre ICU length of stay in hospital were having higher APACHE IV SCORE and they were at risk of mortality.

Robbert Crusio, MD; Kavan Ramachandran, et al[19] conducted a study in 2010 for predicting APACHE IV Score Accurately in Renal Failure in 107 Critically Ill Patients in which they showed patients with an APACHE IV score of 75 or greater developed renal failure as compared to patients with APACHE IV scores of less than 75 (P=0.024) while no patients with an APACHE IV score less than 75 developed renal failure (P=0.026). A high APACHE IV score of greater than 75 is associated with a higher rate of renal failure requiring renal replacement therapy.

T Dahhan, M Jamil et al[20] conducted a study in 2009 for Validation of the APACHE IV scoring system in patients with severe sepsis and comparison with the APACHE II system in which they showed that APACHE IV is a successful scoring system assessing severity of illness and prognosis of ICU patients. It has been evaluated and validated in our patients for mortality outcome. The objective of this study was to validate the APACHE IV benchmark for patients admitted with severe sepsis and septic shock to the ICU and to compare the performance of the APACHE IV system with APACHE II.

M Bhattacharyya and S Todiet al[21] conducted a study in 2009. During the study period the total ICU admission was 3, 647 patients. Patients with limitation of life support and discharge against medical advice were excluded. Cases where data were incomplete were also excluded, and 2, 919 patients were finally analyzed. The median APACHE II and APACHE IV scores of the study cohort were 12 (8 to 18) and 44 (30 to 62). The median predicted mortality over the study period was significantly higher with APACHE II scoring in comparison with APACHE IV (15 (8 to 25) vs. 4. 6 (1.66 to 12. 67)) (P = 0.00001). The standardized mortality ratio was likewise significantly lower with APACHE II in comparison with APACHE IV (median = -0.87 vs. 2.85, mean = -1.13 vs. 8.18) (P = 0. 00001). Currently, APACHE II benchmarking overestimates ICU Performance and APACHE IV might be more relevant tool to estimate ICU Performance.

Jack E. Zimmerman et al[22] conducted a study in 2006 in which they developed APACHE IV using day 1 information and a multivariate logistic regression procedure to estimate the probability of hospital death for randomly selected patients who comprised 60%of the database. Predictor variables were similar to those in APACHE III, but new variables were added and different statistical modelling used. They assessed the accuracy of APACHE IV prediction by comparing observed and predicted hospital mortality for the excluded patients (validation set). We tested discrimination and used multiple tests of calibration in aggregate and for patient's subgroups. APACHE IV had good discrimination and calibration (p=. 08). For 90% of ICU patients the ratio of observed to predicted mortality was not significantly different from1.0.

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Age (yrs)	Creatinine (mg/dL)
Temperature (°C)	Urea (mEq/L)
MAP (mmHg)	BSL (mg/dL)
HR (/min)	Albumin (g/L)
RR (/min)	Bilirubin (mg/dL)
Mechanical Ventilation – yes/no	Ht (%)
FiO2 (%)	WBC (x1000/mm3)
pO2 (mmHg)	Glasgow coma scale
pCO2 (mmHg)	Chronic Health Condition- CRF / HD, Lymphoma, Cirrhosis, Leukemia / Myeloma, Hepatic Failure, immunosuppression, Metastatic Carcinoma, AIDS
Arterial Ph	Admission Information- Pre-ICU LOS (days) Origin Readmission- No / Yes Emergency Surgery- No / Yes
Na+ (mEq/L)	Admission Diagnosis- Non operative / Postoperative
Urine Output (mL/24h)	Thrombolysis- No/ Yes
APACHE IV Score	/286
APS Score	/239
Estimated Mortality Rate	%
Estimated Length of Stay	Days

Table 1: Variables Used In Apache IV Calculator (For Non CABG Patients)

DIAGNOSIS	MEAN APACHE IV SCORE
DIED	76.76
SURVIVER	32.72

Table 2: Mean apache score of died and surviver

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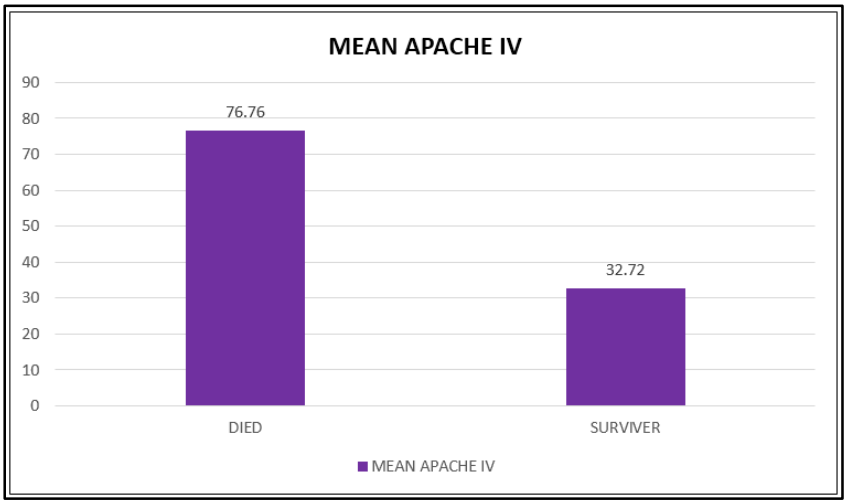
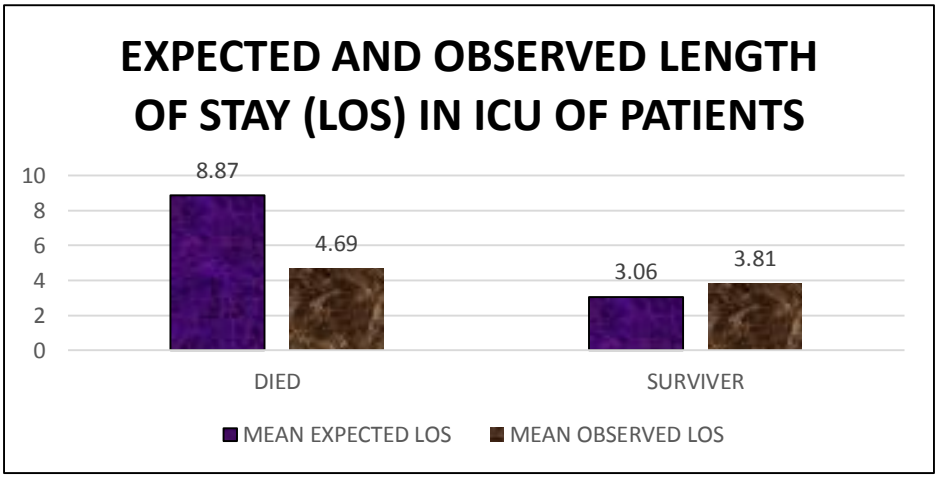


The MEAN APACHE IV SCORE of the 17 patients who died was 76.76 with SD +/-10.75 and the MEAN APACHE IV SCORE of the 90 patients who survived was 32.72 with SD+/-11.115.

Diagnosis	Mean expected los	Mean observed los
Died	8.87+/-1.31	4.59+/-3.39
Surviver	3.06+/-1.42	3.81+/-2.01

Table 3: Expected and observed length of stay (LOS) in ICU of patients



In total of 107 there were 17 patients who died were having mean expected LOS 8.87+/-1.31 and mean observed LOS 4.59+/-3.39.90 patients who survived were having mean expected LOS 3.06+/-1.42 mean observed LOS 3.81+/-2.01.

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