The Clinical Prognostic Indicators of Acute Pancreatitis by APACHE II Scoring

RITHIN SUVARNA, ARAVIND PALLIPADY, NITHISH BHANDARY, HANUMANTHAPPA

ABSTRACT

Background and Objectives: Acute pancreatitis is a catastrophic condition with many complications and poses a great challenge to the treating surgeon. 10-20% of the patients who develop complications will not recover with simple supportive therapy. Hence, an accurate prediction of severity and prognostic monitoring are necessary to anticipate the early and late complications so as to consider aggressive treatment. The present study aimed at predicting the prognosis in patients with acute pancreatitis by using the APACHE II scoring system and at determining the utility of these scores in further management.

Methods and Material: 51 patients who were admitted to the AJ Institute of Medical Sciences with the clinical and radiological

evidence of acute pancreatitis with an elevation in the serum amylase levels, were the subjects of this study.

Results And Interpretation: The mean APACHE II scores were 6.62 and 11 in 32 uncomplicated cases and 19 complicated cases respectively.4 complicated patients who died eventually had scores which were persistently above 14. Sequential variations in the APACHE II scores correlated with the patient outcome.

Conclusion: The APACHE II scores which are calculated on admission accurately predict the outcome of the patients with acute pancreatitis. This scoring system is superior to other systems like Ranson's criteria because it takes into account all the major risk factors that influence the patient outcome.

Key Words: Prognostic indicators, APACHE II, Acute Pancreatitis

INTRODUCTION

Acute pancreatitis has been recognized since time immemorial and has been described as the most terrible of all calamities that occur in connection with the abdominal viscera [1]. In 1889, Reginald Fitz gave the classic clinical and pathological description of acute pancreatitis and opined that an early operative intervention was usually ineffective and indeed could be hazardous [2]. Fortunately, in 80-90% of the patients, acute pancreatitis is a mild self limiting disease due to oedematous interstitial inflammation which resolves with conservative treatment. The remaining 10-20% of the patients will develop complications due to pancreatic necrosis and retroperitoneal inflammation which will not resolve with simple supportive therapy and may be fatal. These patients require intensive care, haemodynamic monitoring and frequent laboratory and radiological evaluation [3]. Many prognostic factors have been identified and many scoring systems have been proposed to predict the severity of the attack and the overall prognosis. Some of the scoring systems which are being used are Ranson's criteria and Imrie's Glasgrow system, the Simplified Acute Physiology Score (SAPS), the Acute Physiology And Chronic-Health Evaluation score (APACHE II) and the Medical Research Council Sepsis score (MRCS) [4, 5].

The reasons for grading acute pancreatitis clinically or by using multiple factor scoring systems or single prognostic factors are: [6]

1. For the early assessment and the accurate prediction of the severity of the disease to avoid costly and invasive monitoring and treatment in the largest group of patients who tend to run a more benign course.
2. To compare the outcome between the centers both for an effective clinical audit and for the comparison of differing therapeutic approaches.

3. To enable the selection of patients for clinical trials.

THE APACHE SYSTEM

The acute physiology score and the chronic health evaluation (APACHE) were used in the first major attempts to quantify the severity of the illness in ICU patients, by Knaus et al in 1981 and this was later modified in 1985 by the same author as APACHE II [5,6]. It contains 12 continuous variables from the original APACHE system and also takes into account the age of the patient, the pre-morbid conditions and the Glasgow coma scale (GCS). The major advantage of the APACHE II scoring system, as compared to the other systems, is that it can be used in monitoring the patient's response to therapy while the Ranson and the Glasgow scales are mainly meant for the assessment at presentation [7].

The APACHE II scoring system takes into account 12 variables which include, (1) Body temperature, (2) mean arterial pressure (mm Hg), (3) Heart rate(HR), (4) respiratory rate (R.R/mt), (5) Oxygenation (mm Hg), (6) P^H, (7) Na (mmol/l), (8) k (mmol/l), (9) Creatinine (mg/100ml), (10) Haematocrit, (11) total leucocyte count and the (12) Glasgow coma score. To eliminate the problem of the missing values and concerns about the assumption that an unmeasured variable was normal, the measurement of all the 12 variables was made mandatory for the usage of APACHE II. The recorded values of the variables are based on the most deranged values during the past 24 hours [7, 8].

Because age and severe chronic health problems reflect a diminished physiological reserve, they have been directly incorporated into APACHE II. Also, emergency surgery and non operative patients with severe, chronic organ system dysfunction were given

five additional points in comparison to the elective surgical patients who were given only two points because patients with severe chronic conditions are not considered to be candidates for elective surgery [8].

PATIENTS AND METHODS

Patients who were admitted to the AJ Medical College hospital, Mangalore from 10/08/2008 to 10/12/2010, with a clinical diagnosis of acute pancreatitis which was corroborated by any one of the below mentioned criteria, were included in the study.

1. Serum amylase exceeding 1000 IU/L.
2. Signs of pancreatitis seen on ultrasonography of the abdomen or on contrast enhanced CT scan.

The APACHE II Severity of The Disease Classification System which was proposed by Knaus et al was used and the scores were assigned to all patients. The end point of the patient outcomes were grouped as either uncomplicated or complicated. A complicated outcome was defined as

A) The development of local pancreatic complications

(a) Necrosis (demonstrated by CT scan or during surgery)

(b) Pseudocyst or abscess (demonstrated by ultrasound or CT scan)

B) The development of a systemic complication (major organ failure)

(a) Acute respiratory insufficiency (PO_2<60 mm Hg. Requiring ventilation or oxygen therapy by mask for greater than 5 days)

(b) Renal failure (Urine output <400ml/24 hrs with a rising blood urea and serum creatinine and with no response to 24 hrs fluid therapy)

(c) Left ventricular failure and pulmonary oedema which were diagnosed clinically and supported by characteristic changes on the chest X ray.

C) Death

The data was processed by using the dBase IV and the Excel programmes. The observations were recorded. Its sensitivity, specificity and predictive value have analyzed the diagnostic performance of the scoring system. Statistical analysis was conducted by using the Chi-square test and the Fisher's exact test.

Beginning : Date ------------- Time -------------- APACHI II patients study number Patients initial								
Acute Physiology and Chronic health evaluation								
A: Acute physiology score (12 variables)	High abnormal rage				Low abnormal range			
Physiological Variables	+4	+3	+2	+1	0	+1	+2	+3	+4
Temperature – rectal (°C)	≥41	39–40.9		38.5–38.9	36–38.4	34–35.9	32–33.9	30–31.9	≤29.0
Mean arterial pressure (mm Hg)	≥160	130–159	110–129		70–109		50–69		≤49
Heart rate-ventricular response	≥180	140–179	110–139		70–109		55–69	40–54	≤39
Respiratory rate non ventilated or ventilated	≥50	35–49		25–34	12–24	10–11	6–9		≤5
Oxygen: A – a DO or PaO_2 (mm Hg) $FiO^2 \geq 0.5$ record A – aDO2 $FiO_2 < 0.5$ record only PaO_2	≥500	350-499	200–349		<200 PO_2>70	$PO_2$61–70		$PO_2$55–60	PO_2<55
Arterial pH	≥7.7	7.6–7.69		7.5-7.59	7.33–7.49		7.25–7.32	7.15–7.24	<7.15
Serum HCO_3 – only if no ABGs	≥52	41.5–1.9		32–40.9	23–31.9		18–21.9	15–17.9	<15
Serum sodium (mmol/l)	180	160–179	155–159	50–154	130–149		120–129	111–119	≤110
Serum potassium (mmol/l)	≥7	6–6.9		5.5–5.9	3.5–5.4	3–3.4	2.5–2.9		<2.5
Serum creatinine (umol/l)	≥350	200–340	150–190		60–140		<60		
Haematocrit (%)	≥60		50–50.9	46–49.9	30–45.9		20–29.9		<20
White Blood cell court (x1000 /mm³)	≥40		20–39.9	15–19.9	30–14.9		1–2.9		<1
Glasgow Coma Score (GCS)	Score = 15 minus actual GCS								

[Table/Fig-1]: The APACHE II chart for scoring

B. Age points					
Age years	Points	History	Points for elective surgery	Points for emergency surgery and non-operative patients	Apache II score: sum of A + B + C
≥ 44	0	Liver: Biopsy proven cirrhosis and documented portal hypertension or prior episodes of hepatic failure	2	5	A: APS score
45–54	2	Cardiovascular NYHA class IV	2	5	B: Age Points score
55–64	3	Respiratory eg. Severe COPD, hypercapnia, home O2 pulmonary hypertension	2	5	C: Chronic health points score
65–74	5	Renal chronic dialysis	2	5	
≥ 75	6	Immunocompromised	2	5	Total apache II

[Table/Fig-2]: The APACHE II chart for scoring

RESULTS

A total of 51 patients were available for analysis during the course of the study of which a majority was males (46). The mean age of the cohort was 40.9 yrs and the peak incidence of the disease was in the 4th decade. Pain in the abdomen was the chief complaint in all the patients and it was associated either with vomiting, distention, ascites or ileus. A history of alcohol consumption as the aetiology of pancreatitis was accounted for in 72% of the patients while gall stones were the aetiology in 14% of the patients. In another 14% of the cases, a definite cause was not ascertained.

Outcome of the patients

Out of the 51 patients with acute pancreatitis, 32 (63%) had an uncomplicated outcome, as shown in [Table/Fig-3].

Complications were seen in 19 (37%) patients, out of which 8(16%) developed pseudo cysts. Pancreatic necrosis was observed in 2(4%) cases and 1 patient developed an abscess which was tracked down to the lumbar region. Renal failure and respiratory failure were encountered in 5 patients (10%) and in 3(6%) patients respectively. 4 patients had a fatal outcome as the sequelae to pancreatic necrosis and multi organ dysfunction syndrome (MODS).

Summary of the outcomes in patients who were group based on a range of APACHE II scores on admission.

The average APACHE II score in patients who had an uncomplicated outcome was 6.62, the score in patients with a complicated outcome was 11 and that in patients with a fatal outcome was 18.6.

Of the 15 (29%) patients who had an admission with the APACHE II score in the range of 0-5, 14 (93%) had an uncomplicated outcome and 1(7%) developed a pseudocyst.

Eighteen (35%) patients had on admission, the APACHE II score in the range of 6-10 and 15 (83%) of them had an uncomplicated outcome. 2 (11%) developed pseudocysts and 1 (6%) developed major organ failure.

Of the 9(18%) patients with an admission APACHE II score in the range of 11-15, 3(33%) had an uncomplicated outcome and 2 (22%) developed pseudocysts, 2 (22%) had necrosis/abscess and 2 (22%) developed major organ failure. Of the total 9 (18%)

patients with an APACHE II score of more than 15, 4 (44%) had a fatal outcome. Of the 4 patients with a fatal outcome, 1 had severe pancreatic necrosis and 3 died of multiple organ failure.

The APACHE II score (≥ 10) which was calculated at the time of admission, predicted 72% of the severe attacks and 76% of the mild attacks with a positive predictive value of 68% and a negative predictive value of 78%. An on-admission APACHE II score of more than 9 predicted more number of severe attacks (75%) but less number of mild attacks (60%), with a positive predictive value of 55.5% and a negative value of 78%.

On admission APACHE II scores of more than 12 predicted less number of severe attacks (52%) and branded the more severe attacks as mild (specificity 89%).

An APACHE II score of more than 10 had the best sensitivity, specificity and predictive value (P value <0.001). Refer [Table/Fig-4] for details.

When the 14 individual components of the APACHE II score were examined, serum sodium, serum creatinine, pH, pO_2, heart rate and the Glasgow coma scale were found to be significantly different in the uncomplicated group and in the complicated group. The Glasgow coma scale had the best correlation with a P value of <0.001.

The sequential APACHE II score

The APACHE II scores were repeated in 18 patients for a variable duration (a maximum of 5 days). Patients with an increase in the APACHE II score on subsequent days had a complicated outcome in the form of pseudo cysts, necrosis, organ failure or death. In patients with decreasing scores on the subsequent days, the outcome was proportionally better. All patients who had scores persistently above 14, died.

DISCUSSION

The prospective assessment of the APACHE II Severity of Disease Classification System has been shown to provide an objective discrimination between uncomplicated, complicated and fatal attacks of acute pancreatitis within a few hours of admission to the hospital [9]. The laboratory tests which are required are simple, routine and readily available. APACHE II may prove to be a useful addition to the management and the study of these patients, providing an objective indication of the severity and the possible

Outcome APACHE II score	Uncomplicated outcome	Complicated outcome			Total
		Preudocyst	Necrosis/ Abscess	Major organ failure	
0–5	14	1	0	0	15
6–10	15	2	0	1	18
11–15	3	2	2	2	9
>15	0	3	1	5	9

[Table/Fig-3]: Major out come of patients with acute pancreatitis

On admission	Sensitivity	Specificity	Predictive value of positive test	Predictive value of negative test	P value
APACHE II≥9	75%	60%	55.5%	78.3%	<0.02
APACHE II≥10	71.4%	75.8%	68.2%	78.6%	<0.001
APACHE II≥12	52%	89%	78%	72%	<0.01

[Table/Fig-4]:

	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Prediction of severe outcome				
Present study	75%	60%	55%	78%
Larvin et al study	63%	81%	46%	89%
Wilson et al study	68%	67%	40%	87%
Prediction of major organ failure				
Present study	92%	76%	63%	95%
Larvin et al study	76%	84%	38%	96%
Prediction of pancreatic collections				
Present study	54%	76%	46%	81%
Larvin et al study	73%	84%	31%	97%

[Table/Fig-5]: Comparison of diagnostic performance of on admission APACHE II score with Larvin et al and Wilson et al study

outcome of an attack soon after admission to the hospital [10]. Thus, it may permit an early, non – invasive selection of patients for intensive therapy of inclusion in the clinical trials.

In this study, acute pancreatitis was found nine times more commonly in males than in females and the mean age was 40.9 years. These results do not match with the results from the study of Larvin et al where the male; female ratio was 47:53 and the mean age was 62 years. In the present study, alcohol was the aetiological factor in 60% of the patients and gallstones were the aetiological factor in 14%, contrary to alcohol being the factor in 22% and gallstones in 43% of the patients in Larvin et al's study [9].

The mean APACHE II score on admission for uncomplicated, complicated and fatal outcomes were 6.62, 11 and 18.6 respectively. The scores were comparable with those from Wilson et al's study where the scores were 6.29, 9.35 and 14.2 for the respective groups [10]. The wide difference in the mean APACHE II scores in the patients who had a fatal outcome could be explained by the fact that all the 4 patients who died had an APACHE II score of above 18, which had contributed to the higher mean.

In the present study, pancreatic necrosis was documented only in 4% of the patients, the reason being that necrosis could only be diagnosed by contract enhanced CT scan and confirmed by laparotomy/necropsy [11]. Due to financial constraints, CT scan was done only in 6 patients in this study. Therefore, the incidence of pancreatic necrosis was probably underestimated.

By comparing the outcomes in patient groups which were based on a range of APACHE II scores, it was observed that complications like pseudo cysts, necrosis, major organ failure and death were more common when the APACHE II scores exceeded 10. In contrast to the expectations, pseudo cysts were observed in 1 patient who's APACHE II scores on admission were less than 5. These patients presented to the hospital later than 48 hours after the onset of the symptoms, by which time the severity of the attack had subsided and the recorded scores were spuriously low [12].

It can therefore be concluded that patients with an admission APACHE II score of more than 10 are high risk patients. These patients benefit from treatment in an ICU and it is worthwhile repeating the scores everyday to monitor the clinical state in these patients, in order to detect complications and to institute therapeutic modifications and also to monitor the efficacy of the treatment which is being instituted [13].

The sensitivity, specificity, positive predictive value and negative predictive value were comparable with those of other studies

[Table/Fig-5] in the prediction of the severity [4, 7]. On admission, the APACHE II scores were very sensitive for the prediction of major organ failure (92%) but they were less sensitive for the prediction of the pancreatic collection (54%). In contrast to the expectations, the APACHE II scores failed to predict the period of the hospital stay [14]. As the policies with respect to discharge in the individual surgical units differed, the period of hospital stay did not reflect the severity of the disease.

Of the 14 parameters which constituted the APACHE II score, serum sodium, serum creatine, pO_2, pH, heart rate and GCS were more often deranged in patients who had a complicated outcome. The Glasgow coma scale had the maximum significance (p value <0.001). [15,16]

In patients in whom the APACHE II scores were repeated on subsequent days, it was observed that an increasing score predicted a complicated or a fatal outcome and that a decreasing score predicted an uncomplicated outcome. Therefore, the daily recording of the APACHE II score may be particularly useful to monitor the progress of the patients and also in taking a decision about the timing of the surgery for pancreatic necrosis [17].

The APACHE II system is superior to other systems like Ranson's, because it is the only system which takes into account all the major risk factors that influence the outcome from the disease including the acute physiological derangements, as well as the patient ability to recover which may be diminished by advancing age or chronic disease [18]. Another advantage is that it can be calculated immediately after admission and can be repeated everyday, unlike other scoring systems for acute pancreatitis. The range of the APACHE II score is wide, providing a better spread between the mild and severe attacks because varying weights are assigned to increasingly abnormal values, rather than all or no judgements [19].

In the present study, the mortality rose steeply to 44% when the APACHE II score range was raised to greater than 16 when compared to the scores between 11 and 15. Moreover, patients with very high scores in the range of 20 to 35 died within 6 hours of admission to the hospital [20].

CONCLUSION

APACHE II scores which are calculated on admission accurately predict the outcome of the patients with acute pancreatitis. A score of ≥10 on admission significantly (p value < 0.0001) predicts a complicated outcome with a sensitivity of 72% and a specificity of 76%.

REFERENCES

[1] Senn H: The surgery of the pancreas. Philadelphia, *WJ Dormon*; 1886: p 71.

[2] Fitz RH: Acute pancreatitis. *Boston Med Surg J* 1889; 120:181.

[3] Paredes – Cotore et al: Prognosis of acute pancreatitis: Ranson or APACHE II. *Rev Esp Enferm Dig* 1995 Feb; 87(2):121-6.

[4] Wilson C et al : Prediction of the outcome in acute pancreatitis: a comparative study of APACHE II. Clinical assessment and multiple factor scoring systems. *Br. J Surg* 1990 Nov; 77(11):1260-4.

[5] Knaus et al: APACHE, a physiologically based classification system. *Crit Care Med* 1981; 9:591.

[6] Knaus et al : APACHE II. A severity of disease classification system. *Crit Cared Med* 1985;13: 818.

[7] Wahab Shagufta, Ahmed Khan Rizwan, Ahmed Ibne,Wahab Arif; Imaging and clinical diagnostic indicators of acute pancreatitis: a comparative insight. *Acta Gastroenterologica Latinoamericano* 2010 September; 40/ 3: 283-28.

[8] Theodoros E Pavlidis, Efstathios T Pavlidis and Athanasios K Sakantamis; Advances in prognostic factors in acute pancreatitis: a mini-review. *Hepatobiliary Pancreat Dis Int* October 15, 2010;9/ 5:889.

[9] Larvin et al: APACHE II score for assessment and monitoring of acute pancreatitis. *Lancet* 1989 Jul; (8656):201-5.

[10] Robert Quinlan, Shackelford's surgery of the alimentary tract.2009; 4th edition, vol-3, page 19 and 20, table 2-1 and 2-2.

[11] Lerich et al: Pancreatic duct obstruction triggers acute necrotizing pancreatitis in the opossum. *Gastroenterology* 1993;104:853.

[12] Kloppel et al: Human acute pancreatitis: Its pathogenesis in the light of immunocytochemical and ultrastructural findings in the acinar cells. *Virchows Arch Pathol Anat* 1986; 409:791.

[13] Agrawal et al: Evaluating tests for acute pancreatitis. *Am K Gastroenterol* 1990; 95:356.

[14] Robert et al: Serum and peritoneal amylase and lipase in the determination of early prognosis in acute pancreatitis. *Ann Surg* 1986; 203:163.

[15] Rabeneck et al : A new clinical prognostic staging system for acute pancreatitis. *Am J Med* 1993; 95:61-70

[16] Toh et al: APACHE – II. A new predictor of severity in acute pancreatitis. *Gut* 1996; 38 (Suppl 1):A35.

[17] Dominguez et al : Monitoring of the serum proteinase – antiproteinase balance and systemic inflammatory response in the prognostic evaluation of acute pancreatitis. *Dig Dis Sci* 1993; 38:507-13.

[18] Clavien et al: Value of CECT in the early diagnosis and prognosis of acute pancreatitis. *Am J Surg* 1988; 155:457.

[19] Balthazar et al : CT diagnosis and staging of acute pancreatitis. *Radiol Clin North Am* 1989; 27:19-37.

[20] De Sanctis et al : Prognostic indicators in acute pancreatitis. CT Vs APACHE II. *Clin Radiol* 1997 Nov; 52 (2):842-8.

AUTHOR(S):

1. Dr Rithin Suvarna
2. Dr Aravind Pallipady
3. Dr Nithish Bhandary
4. Dr Hanumanthappa

PARTICULARS OF CONTRIBUTORS:

1. Associate professor, Dept of General surgery, AJ Institute of medical sciences Mangalore, India
2. Corresponding Author.
3. Assistant professor, Dept of General Medicine, AJ Institute of medical sciences Mangalore, India
4. Assistant professor, Dept of General Surgery, AJ Institute of medical sciences Mangalore, India

NAME, ADDRESS, TELEPHONE, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr Aravind P

Door No: 3-90(11) Behind Kannur Telephone Exchange

P.O Kannur, Manglore - 575007, India.

Moblile No: 9448127559

E-mail address: aravindpath@ yahoo.co.in

DECLARATION ON COMPETING INTERESTS:

No competing Interests.