Apache II Scoring System Is Superior in the Prediction of the Outcome in Critically Ill Patients with Perforative Peritonitis

Samir Delibegovic¹, Dragana Markovic², Samir Hodzic²
Department of Surgery¹, Department of Anaesthesia, University Clinic Center Tuzla, University of Tuzla, Bosnia and Herzegovina²

Background. There are several scoring systems used in the prediction of outcome in critically ill patients. This study was undertaken to evaluate APACHE II, SAPS I, Sepsis score, MOF, TISS-28 and MPI scoring systems in prediction of the outcome in patients with perforative peritonitis.

Patients and methods. The prospective study of 145 patients of both sexes with perforative peritonitis was performed. The main outcome of study was peritonitis-related death. Variables necessary for calculation of the scoring systems were recorded at the initial admission to the hospital and the third and seventh day of hospitalization, except Mannheim Peritonitis Index, which was calculated during the first 24 hours after hospitalization. Cut-off points were specified and all values greater than cut-off points were taken to predict death. Sensitivity and specificity are graphically shown for the different values of cut-off points and represented with the receiver-operating characteristic curve. The difference in the area below the curve between scoring systems was statistically compared.

Results. The area under the curve for the first postoperative day was 0.87 for TISS-28 score, 0.86 for APACHE II score, 0.83 for MOF and SAPS I, 0.72 for MPI and 0.70 for Sepsis score. This demonstrated that TISS-28 and APACHE II are significantly better than other systems (p<0.01). In addition, this discriminatory ability remained on the third and seventh postoperative day as well. The highest rate of correlation between the observed and the expected mortality rate for the first (Kendall’s τ correlation 0.964) and the third day (Kendall’s τ correlation 0.810) was in APACHE II system. Conclusion APACHE II is superior in prediction of the outcome to other tested scoring systems.

Key words: peritonitis, APACHE II, Surgical Intensive Care Unit.

1. INTRODUCTION

Perforative peritonitis is the most frequent form of intra-abdominal infection. About 80% of cases of secondary peritonitis in large hospitals account for perforated peritonitis (1). These patients are among the most complex cases encountered in surgical practice (2). Early prognostic evaluation of these patients is desirable in order to make the correct therapeutic plan, selecting highly risky patients for more aggressive surgical procedures.

Several scoring systems, based on logistic regression, have been developed in the last two decades. Artificial neural network as an alternative method gave contradictory results (3, 4). Validity of APACHE II (Acute Physiology And the severity of Chronic illness) scoring system is confirmed in surgical patients with intra-abdominal infection (5) and peritonitis (6). However, APACHE III prognostic system is not confirmed for this (7). In literature we could not find any study about the use of SAPS I (Simplified Acute Physiology Score) in the group of patients with secondary peritonitis, although it is a simplified APACHE score which could be applicable for the use in this group of patients.

There are scoring systems specially developed to assess the impairment of organ function, such as MOF (Multiple Organ Failure) score (8) and the degree of sepsis, such as Sepsis score (SS) (9). In several studies MOF score was used in the group of peritonitis patients (10). In the last decade scoring systems based on intraoperative data have been developed. The validity of Mannheim Peritonitis Index (MPI) has been shown in literature (11).

Despite of the advancement in medicine of intensive care and introduction of aggressive surgical technique, prognosis of peritonitis remains poor, in some studies the mortality rate is around 60%6. Probably in some cases the incorrect prognosis can influence the decision not to start or even stop the treatment. We performed prospective evaluation of these five prognostic systems in order to assess their possibility of prediction of outcome in patients with perforative peritonitis.
2. PATIENTS AND METHODS

The prospective study involved 145 patients of both sexes with secondary peritonitis. The average age of all patients was 58 (ranges from 21 to 81); the ratio of men: women was 91: 54, with no significant differences in the average age between the two genders. The patients hospitalized in surgical intensive care unit (SICU) longer than 24 hours were included in the study. The inclusion criterion was secondary peritonitis, as determined by laparotomy. The exclusion criterion was posttraumatic peritonitis. Patients were tracked either to discharge or death. The main outcome of this study was peritonitis-related death. Scoring systems were calculated on the admission (during the first 24 hours), the third and the seventh day after hospitalization, because we wanted to check the value of serial determination of scoring systems, except MPI which was calculated only during the first 24 hours after hospitalization. Data were collected in computer database made in the commercial program of Microsoft Access. The statistical analysis was performed using the SPSS software 11.0.

Cut-off points were specified (26 points for APACHE II, 26 for MPI, 17 for SAPS I, 2 for MOF, 39 for TISS-28, 14 for Sepsis score) and all values greater than cut-off points were taken to predict death. Sensitivity and specificity are graphically shown for the different values of cut-off points. They are presented with ROC curve. The difference in the area below the curve between scoring systems was statistically compared. The test of the difference between areas under ROC curves was applied using trapezoidal rule to approximate areas, conservative estimation for the standard deviation, and Kendall’s τ as a measure of the correlation between the areas.

3. RESULTS

Discriminatory ability of prognostic systems

ROC curve used for the prognostic scoring systems (relationship between sensitivity and the false positive rates (1-specificity) for different cut-off points) was given for the first, third and seventh postoperative days (Figures 1, 2, 3). APACHE II and TISS-28 curve demonstrated that their discriminatory ability was better than SAPS I, MPI, SS and MOF curve. The area under the curve for the first postoperative day was 0.87 for TISS-28 score, 0.86 for APACHE II score, 0.83 for MOF score, 0.83 for SAPS I, 0.72 for MPI and 0.70 for Sepsis score. This illustrated that TISS-28 and APACHE II are significantly better than the other systems (Figure 1). In addition, this discriminatory ability remained on the third and seventh postoperative day as well (Fig. 2 and 3). In most cases, APACHE II (Table 1) gave the better prediction, after that TISS-28 scoring system.

Although discriminatory ability of APACHE II is 0.86 and for TISS-28 0.87, it is far from perfect. Even with selection of optimal cut-off points it is not possible to get false-positive rate less than 20% and false-negative rate lesser than 20%.

Sharpness

The distribution of scoring systems, a measure for sharpness of prediction, is shown in Table 1. APACHE II and TISS-28 predictions were sharper than those of other scoring systems.

Reliability of prognostic scoring systems

Reliability of probabilities was tested comparing the observed and expected mortality on the first, third and seventh postoperative day for the tested scoring systems (Table 2). Testing Kendall’s τ as a measure of correlation, we have found that the highest rate of correlation between the observed and the expected mortality rate was in APACHE II system, for the first (Kendall’s τ correlation 0.964) and the third (Kendall’s τ correlation 0.810) day. There was a decrease in the rate of correlation on the seventh day for all scoring systems except for MOF score.

![Figure 1. ROC curve (receiver-operating characteristic curve) for the first postoperative day for tested scoring systems. TISS-28 and APACHE II are significantly more accurate than the other systems. There is no other significant difference.](image-url)
4. DISCUSSION

There are several scoring systems available for the estimation of severity of the disease and prognosis in ICU, especially in peritonitis patients. Most studies have shown that among scoring systems based on physiological parameters, the most reliable system is APACHE II score (10, 12). APACHE II is extremely flexible, with good prediction and without significant difference between elective and urgent surgery, in benign and malignant diseases, or in prediction of complications (13). APACHE II reliably assesses mortality in the group of surgical patients with systemic disarrangement, such as peritonitis (14).

APACHE score in our study was from 0 to 38, with the average of 25 points. No patients with a score higher than 28 survived. In other studies, different values of scores were reported for the dead patients. Chen et al. in their study cited that patients with a score higher then 40 did not survive (15), and Edwards et al. cited the score value of 22, so that value can be used as an additional criterion for clinical decision not to operate (16). However, there are opposite opinions that this scoring system can be used in retrospective studies, but that it should not be used in a triage process nor as a predictor of the outcome in individual patients. The triage decision should be based on clinical estimation (17).

Mannheim peritonitis index (MPI) is based on intraoperative data and it has been developed specifically for abdominal infection (11). Although there are opinions that combination of APACHE II and MPI should be a standard classification system for grading severity of peritonitis and intra-abdominal sepsis (18), in our study we show that MPI has no predictive power, while APACHE II does.

MOF score can be used in the prognosis of postoperative complications and deaths (10), but predictive power of APACHE II and TISS-28 score is far better. However, there is a characteristic good correlation between observed and expected mortality rate on the seventh day for MOF score, and a drop in the correlation rate for other tested scoring systems. MOF syndrome represents the process in surgical patients which cannot be manifested during the first 24 hours. Organ failure is associated with prolonged stay and higher costs (19).

In literature we could not find any papers about the use of SAPS I scoring system, in peritonitis patients. A significant correlation between SAPS I score, morbidity and hospital stay has been reported, in biliary tract surgery patients (20). However, in our study sensitivity and significance of this scoring system was lower than APACHE II, so that characteristics of this score cited in literature could not be reproduced.

Even though Elebute and Stoner graded local and systemic effect of infection and predicted correctly outcome in large number of patients, APACHE II in relation to Sepsis score is more objective and prospectively better validates large number of patients with different diagnosis (21), which was confirmed in our study.

TISS-28 correlates well with length of stay in ICU (22) and can provide useful information about severity of disease and prognosis (23). Usefulness of economic analysis supports its clinical application as well. So TISS-28 can be used as a valuable tool for the control of quality and the analysis of costs in ICU (24). In our study, high sensitivity and specificity of this scoring system has been proven.

We show that the ROC curve for TISS-28 and APACHE II is significantly more accurate than for the other tested scoring systems. Comparing observed and expected mortality we do not find significant difference in the first and third postoperative day for APACHE II and TISS-28 score, and the seventh day for MOF score. Overall, in the aspect of observed and expected mortality APACHE II had the best predictive power.

Mortality in this study was 36.5%. Mortality associated with severe peritonitis has not changed dramatically in the last 50 years (~24%) despite the availability of antibiotics of a broad spectrum, ICU and a radical attitude in elimination of bacterial contamination in the abdominal cavity. The anatomical origin of infection and degree of local infection do not affect prognosis, but severity of disease measured by APACHE II scoring system (25). Severity of the disease and organ failure, not recurrent peritoneal infection, is the main reason for negative outcome in patients with peritonitis (26).

APACHE II is made for assessment of severity of patients in ICU and assesses general consequences of disease, respecting the age and previous medical conditions. Its practical use is pretty demanding, as it contains a large
number of parameters that can be obtained only by invasive monitoring. On the other side, it can be expected, even in ICU in developing countries, to take over management of these patents, because all parameters of APACHE II scoring system are a part of routine monitoring (27).

Quantification of the severity of the disease in critically ill patients is further controversial. However, scoring systems are a useful tool for controlling the quality of management and assessment of management itself. The value of APACHE II can alert a doctor to a possible negative outcome and help him/her design a strategy for the patient’s treatment.

REFERENCES


