EVALUATING THE PROGNOSTIC VALUE OF SELECTED PROGNOSTIC SCALES IN PATIENTS OPERATED ON DUE TO PERITONITIS

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The aim of the study was to assess the usefulness of prognostic scales: ASA (American Society of Anesthesiologist), MPI (Meinheim Peritonitis Index), MOFS (the Multiple Organ Failure Score) and SPI (the Simple Prognostic Index) in the prognosis of the course of disease in patients operated on for peritonitis.

Material and methods. The study was conducted in the Clinical Department of General and Oncological Surgery of the Medical University in Łódź between January 2009 to December 2010. During this period 263 patients were operated on for peritonitis. Before surgery all patients were classified into particular groups according to the above mentioned prognostic scales according to their criteria.

Results. There were 29 (11%) deaths. ASA ≥4 (p<0.0001), MPI >30 (p<0.0001) MOFS ≥2 (p<0.0001), SPI II, III, IV (p<0.0001) were important risk factors of death.

Conclusions. 1. ASA, MPI, MOFS and SPI scales are of high significance in predicting the outcome in patients operated on for peritonitis. 2. The ASA scale in spite and due to its simplicity is adequate enough to be used in everyday practice in patients operated on for peritonitis. 3. The MPI scale is most suitable in the scientific aims and in comparing the outcomes of patients operated on for peritonitis.

Key words: peritonitis, mortality, prognostic scales

Prognostic scales are a popular tool used to assess prognosis in patients, including those operated on due to peritonitis. Their application is based on the assumption that the total assessment of potential risk factors increases the predictive value and allows to change a multidimensional problem into an easy to use one-dimensional number.

A number of different prognostic scales, whose prognostic value is still the subject of research, is used to assess the condition and the risk of death in patients operated on due to peritonitis (1-4). Some of the prognostic scales were created and are also used in other clinical situations (e.g. ASA, APACHE II, APACHE III, APS, SAPS II, MPM II, MOFS, MODS). Other were developed for risk assessment of patients operated on solely because of peritonitis (e.g. MPI, PIA, PSS, Boey Score).

Number of employed and proposed scales indicates that none of them is perfect. Good prognostic scale should be simple, easy and fast to use. Possible to use in different centers, and being able to accurately predict the risk of death.

The aim of the study was to evaluate the prognostic scales: ASA (American Society of Anesthesiologist), MPI (Meinheim Peritonitis Index), MOFS (the Multiple Organ Failure Score) i SPI (the Simple Prognostic Index) patients with peritonitis.

MATERIAL AND METHODS

Prospective study was performed on 263 patients who underwent surgery because of peritonitis in the Department of General Sur-
Evaluating the prognostic value of selected prognostic scales in patients operated on due to peritonitis

All patients before surgery were classified into various groups in the following prognostic scales according to criteria adopted by them:

- ASA (American Society of Anesthesiologist) – tab. 1,
- MPI (Mannheim Peritonitis Index) – tab. 2,
- MOFS (the Multiple Organ Failure Score) – tab. 3,
- SPI (the Simple Prognostic Index) – tab. 4.

The mortality rates of patients in each group according to the scales. Logistic simple linear (univariate) regression model was used for the statistical analysis to identify potential risk factors for mortality in this population of patients (Hilbe, 2009; Hosmer and Lemeshow, 1989).

RESULTS

There were 144 (54.8%) men and 119 (45.2%) women. The age of patients ranged from 19 to 96 years—an average of 52.3 years, 58.3 years for women and 47.6 years for men, respectively.

ASA classification (tab. 5): Preoperatively 116 (44.1%) patients were classified to ASA I, 50 (19%) to ASA II, 59 (22.4%) to ASA III, 34 (12.9%) to ASA IV, 4 (1.5%) to ASA V.

MPI classification (tab. 6): 107 (40.7%) patients preoperatively received 4-15 points, 104 (39.4%) patients received 16-30 points and 52 (19.8%) patients received more than 30 points.

In MOFS classification (tab. 7) 200 (76%) patients received 0 points, 26 (9.9%) patients received 1 point and 37 (14.1%) patients received two or more points.

SPI classification (tab. 8) 190 (72.2%) patients were classified to SPI I, 18 (6.8%) patients to SPI II, 27 (10.3%) patients to SPI III and 28 (10.6%) patients to SPI IV.

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Table 4. SPI scale (the Simple Prognostic Index)*

<table>
<thead>
<tr>
<th>SPI</th>
<th>Organ dysfunction</th>
<th>Comorbidities</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>none</td>
<td>none or minor additional illness</td>
</tr>
<tr>
<td>II</td>
<td>none</td>
<td>serious additional illness</td>
</tr>
<tr>
<td>III</td>
<td>failure of at least one organ</td>
<td>none or minor additional illness</td>
</tr>
<tr>
<td>IV</td>
<td>failure of at least one organ</td>
<td>serious additional illness</td>
</tr>
</tbody>
</table>

Table 5. ASA classification

<table>
<thead>
<tr>
<th>ASA</th>
<th>Number of patients</th>
<th>M (%)</th>
<th>F (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>116 (44,1%)</td>
<td>68 (47,2%)</td>
<td>48 (40,3%)</td>
</tr>
<tr>
<td>II</td>
<td>50 (19,1%)</td>
<td>35 (24,4%)</td>
<td>15 (12,7%)</td>
</tr>
<tr>
<td>III</td>
<td>59 (22,4%)</td>
<td>29 (20,1%)</td>
<td>30 (25,2%)</td>
</tr>
<tr>
<td>IV</td>
<td>34 (12,9%)</td>
<td>11 (7,6%)</td>
<td>23 (19,3%)</td>
</tr>
<tr>
<td>V</td>
<td>4 (1,5%)</td>
<td>1 (0,7%)</td>
<td>3 (2,5%)</td>
</tr>
</tbody>
</table>

Table 6. MPI classification

<table>
<thead>
<tr>
<th>MPI</th>
<th>Number of patients</th>
<th>M (%)</th>
<th>F (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤15</td>
<td>107 (40,7%)</td>
<td>61 (42,4%)</td>
<td>46 (30,3%)</td>
</tr>
<tr>
<td>16-30</td>
<td>104 (39,5%)</td>
<td>71 (49,3%)</td>
<td>33 (31,1%)</td>
</tr>
<tr>
<td>&gt;30</td>
<td>52 (19,8%)</td>
<td>12 (8,3%)</td>
<td>40 (33,6%)</td>
</tr>
</tbody>
</table>

Table 7. MOFS classification

<table>
<thead>
<tr>
<th>MOFS</th>
<th>Number of patients</th>
<th>M (%)</th>
<th>F (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>200 (72,4%)</td>
<td>118 (81,9%)</td>
<td>82 (70,2%)</td>
</tr>
<tr>
<td>1</td>
<td>26 (9,9%)</td>
<td>14 (9,7%)</td>
<td>12 (10,2%)</td>
</tr>
<tr>
<td>2</td>
<td>15 (5,6%)</td>
<td>6 (4,2%)</td>
<td>9 (7,7%)</td>
</tr>
<tr>
<td>3</td>
<td>10 (3,7%)</td>
<td>3 (2,1%)</td>
<td>7 (6,0%)</td>
</tr>
<tr>
<td>&gt;4</td>
<td>12 (4,4%)</td>
<td>3 (2,1%)</td>
<td>9 (7,5%)</td>
</tr>
</tbody>
</table>

Of the 263 patients 29 (11%) patients died, including 9 (6.25%) men and 20 (16.8%) women. In 15 patients the cause of death was cardiovascular or respiratory failure, in 14 patients its was sepsis or septic shock, 1 patient died because of cancer cachexia, in 1 patient the cause of death was a pulmonary embolism, which occurred despite the administration of typical anti-thrombotic prophylaxis.

Mortality increased with the degree of classification to the corresponding groups in the ASA. From 0 in the I group to 100% in the V group tab. 9. The assessment of the risk of death by ASA is shown in tab. 10. Classification for ASA ≥4 was a significant risk factor for mortality (p <0.0001).

Mortality depending on the amount of points awarded by the MPI scale in shown in tab. 11. Table 12 shows the risk of death depending on the number of points awarded on the MPI scale. Awarding 16-30 points in MPI classification increased the risk of death in relation to the patients who have been awarded up to 15 points but it was not a statistically significant increase, while awarding more than 30 points on this scale significantly increased risk of death (p <0.0001).

Mortality depending on MOFS classification is shown in tab. 13. The presence of a mediocre degree of failure of one organ (1 by MOFS) did not increase mortality. However, increasing the degree of failure to 2 significantly increased the risk of death (p <0.0001).
Evaluating the prognostic value of selected prognostic scales in patients operated on due to peritonitis

The usefulness of ASA scale to assess the risk of death is confirmed by the studies of many authors (3, 9, 10). Although the ASA scale, constructed in the original version in 1963, was created for the needs of anesthesia and not to assess the „surgical risk”, it is commonly used for this purpose, individually or in combination with other factors such as age, sex, mode and extent of surgery (8). Both in patients undergoing planned and ad-hoc surgeries a significant relationship was established between the classification on the scale and postoperative mortality, incidence of serious postoperative complications and hospital stay (11). In many reports, it was found that the preoperative assessment of the patient according to ASA is a good factor for assessing the risk of death in patients operated on due to peritonitis (4, 9, 12). Tan et al. analyzing a group of 129 patients operated on due to perforation of the colon, stated that ASA classification ≥ III is an important risk factor for mortality and severe complications (9). Lohsirivat et al. analyzing a group of 152 patients operated on due to perforation of peptic ulcer found that ASA classification is a better prognostic factor than the MPI classification MPI (12).

Rix and Bates collected data from seven works evaluating the prognostic value of ASA in elderly patients operated on because of acute abdominal diseases (≥65 or ≥70) years, and found significant differences in mortality in different groups in different centers. Mortality in ASA I-II ranged from 0 to 17%, ASA III from 9 to 25%, ASA IV from 29 to 75%, and ASA V from 75 to 100% (13). These differences may result from various factors such as size and population differences, different types of surgeries and different time of observation. However, they may also depend on the subjective assessment of the anesthetist qualifying for particular ASA groups. In the examined population, we found that mortality increased progressively with increasing ASA classification, however, a significant increase in mortality was observed only in patients with ASA IV, among which Mortality depending on SPI classification is shown in tab. 15 and 16. The risk of death significantly increased with each value on the SPI scale greater than I (tab. 16).

**DISCUSSION**

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there was 68.8% mortality rate (tab. 9). ASA IV classification was a significant risk factor for mortality (OR = 70, p <0.0001) (tab. 10).

Mannheim Peritonitis Index (MPI) is based on data obtained from the treatment of 1253 patients with peritonitis, in case of whom 17 possible risk factors were analyzed. Eight of these factors had a prognostic value and were included on the scale. Patients were divided into groups ≤21 MPI MPI MPI ≤22-29 and >29 mortality rate of 2%, 22%, 59% (10). MPI prognostic value was confirmed in a study of 2003 patients of 7 centers in Europe, found for the of value (threshold) 26 points with a sensitivity of 86%, specificity 74% and accuracy of 83% (14). The increasing risk of death with increasing number of points on the MPI scale was confirmed by many foreign and native authors (3, 7, 15, 16). Mulari and Leppäniemi, examining a group of patients with severe peritonitis, found significantly higher number of points awarded on the MPI scale in patients who died compared with those who survived (27 ± 8 vs 20 ± 8, p <0.0001) (17). Similarly Notash et al., in a group of 90 patients operated on due to secondary peritonitis, found a significantly higher number of points awarded on the MPI in patients who died (33.07 vs 19.39, p<0.001) (7).

Many studies confirm a significant relationship between the number of points awarded on the MPI scale and the risk of death (3, 7, 9, 15, 16, 17). Toren et al. analyzing the results of treatment of 56 patients operated on because of postoperative secondary peritonitis concluded that the risk of death increased significantly with MPI>30 (18). In the work of Bielecki at al. it was found that in the group of 59 patients operated on due to perforation of the colon MPI classification >25 was a significant risk factor for mortality. None of the patients, who were awarded less than 25, died while the mortality of patients with MPI 26-36 was 36.8% (19).

According to the results obtained in my research awarding 30 or more points on the MPI scale was an important factor for death (OR = 85, p <0.0001) (tab. 12). 44.6% of the patients who were awarded at least 30 points on the MPI scale died (tab. 11).

There are a number of prognostic scales to assess the current condition of the patient in terms of multiple organ failure (20, 21, 22). MOFS scale proposed in 1985 by Goris stands out among them with a relative simplicity of the application (22). In 2001 Lefering and Goris evaluated the risk assessment on the MOFS scale 147 patients treated in the Intensive Care Unit at two centers. The study found a significant relationship between the number of points awarded and mortality. In patients whose number of awarded points on the MOFS scale was up to 2 points mortality was 0%. When the number of awarded points was 3, the mortality was 4% when 4 points were awarded 38%, when 8 points 57% and when 10 points were awarded 100% (14). The usefulness of the MOFS scale in assessing the risk of death in patients operated on due to peritonitis was also confirmed by other authors (7, 23). Koperna and Schultz assessing the results of treatment of 92 patients with secondary peritonitis found that in those who survived the average number of points awarded on the MOFS scale was 1.1, while in those who died it was 4.9, and it was statistically a significant difference (p <0.0001) (23). Similarly, a significant difference in average points awarded on the MOFS scale in patients operated on due to peritonitis was found by Notash et al. in their material, the average number of points in the group of patients who survived was 0.48, whereas in those who died it was 4.8 (p <0.0001) (7).

In our own material symptoms of organ failure had a significant effect on the risk of death. The degree of risk was dependent on the severity and the number of failing organs. Awarding of at least 2 points on the MOFS scale was an important risk factor for mortality (p <0.0001) and mortality increased in proportion to the number of point awarded on this scale (tab. 13 and 14) The presence of a mediocre degree of failure of one organ did not increase the risk of death. In contrast, symptoms of advanced failure of one organ or a mediocre degree of failure of two organs increased the risk of death 26 times. In patients with 4 or more points awarded on the MOFS scale the risk of death was 156 times higher than in patients without symptoms of organ failure. In our material, varying degrees of organ dysfunction were found in 24% of patients, whereas in 14% of patients the severity significantly affected the risk of death (≥2 points on the MOFS scale). Awarding of 2 or more points on the MOFS scale outside prognostic factor may have a significant impact in selecting patients requiring treatment in the Intensive Care Units.

The Simple Prognostic Index (SPI) is a scale proposed by Abbasa et al. in 2009 to evaluate
Evaluating the prognostic value of selected prognostic scales in patients operated on due to peritonitis

prognosis in patients operated for acute abdominal diseases (8). The scale assesses the general condition of the patient and the risk of death based on the assessment of organ failure occurring in the course of the underlying disease and the incidence of serious additional diseases. The authors retrospectively analyzed a group of 1712 patients who underwent surgery for acute abdominal diseases, and found that the presence of a small degree of dysfunction in the form of moderately severe inflammatory reaction of the body (e.g. increased leukocytosis, tachycardia, electrolyte disturbances) does not affect the risk of death, and symptoms of organ failure significantly increased the risk of death (p <0.0001). They also found that the presence of minor, additional controlled disease did not increase the risk of death. In contrast, the occurrence of additional serious disease significantly affects the probability of death.

Based on these data, patients were divided into four groups (tab. 4). The authors found a significant relationship between the incidence of major complications and mortality between the groups (p <0.0001). Mortality in patients with SPI I was 2%, SPI II 12%, SPI III 49% and SPI IV 70%. The gradual increase in mortality in relation to the SPI scale in patients operated on due to peritonitis is confirmed by my results. In patients with SPI I mortality was 1.1%, SPI II 27.7%, SPI III 33.3% and SPI IV 46.4% (tab. 15). SPI scale is a simple scale, with the ease of use similar to ASA, based on preoperative factors. It only requires knowledge of the current additional serious disease and confirming any symptoms of organ failure on the basis of routinely used laboratory tests and clinical examination. We found that SPI II, SPI III and SPI IV classification was a significant risk factor for mortality (p <0.0001) (tab. 16).

However, in contrast to the results of Abbas et al. we found relatively small differences in mortality between SPI II, SPI III and SPI IV groups. The authors developed the SPI scale based on retrospective data, before any broad application of this scale further prospective studies on a larger group of patients would be required.

The most important feature of the prognostic scale that allows its routine use, beyond good predictive value, is the simplicity of application. All of the analyzed scales can significantly predict the risk of death in patients with peritonitis. The simplest to use is the ASA scale. Although it was developed nearly 50 years ago, the alleged disadvantage related to the subjectivity of evaluation and development of many new prognostic scales, is still the most widely used prognostic scale in the operated patients. This is due to the good prognostic value, confirmed by many studies and simplicity of application. It is confirmed by the results of our studies. Factor facilitating routine use of ASA, is the possibility of its application in all the operated patients. However, based on the classification to higher groups in the ASA scale it is hard to evaluate whether a serious condition of the patient is caused by the presence of an additional serious illness or the severity of local and systemic lesions caused by the primary disease.

Although the use of the MPS scale requires knowledge of a larger number of factors and assigned values, the number of awarded points better describes the severity of peritonitis. This is possible by including among the evaluated factors the factors that demonstrate the extent of the local inflammatory process (ascertained intraoperatively) and systemic changes (organ failure) which follow this process. By determining constant evaluated components it is also more objective. In addition to the confirmed prognostic value of this scale, through the evaluation of the severity of peritonitis, it allow to compare the treatment results of patients treated in different centers.

MOFS scale also has a high predictive value, however, it is more complex in application. It is much more useful in the Intensive Care Units where in virtually all patients the symptoms of failure of at least one or more organs were observed. In our material in 76% of patients no symptoms of organ failure were observed, in further 10% mild failure of one organ not affecting the increase of mortality was observed. A significant proportion of the remaining 14% of patients who have been awarded two or more points, were treated in the ICU.

SPI scale is a relatively recently proposed scale, developed for patients with acute diseases of the abdominal organs. It seems interesting due to the ease of use, good prognostic value, described by its authors and the ability to assess a serious condition of the patient based on it. However, my results show very small differences in the percentages of deaths between groups of patients qualified to SPI II, III, and IV. The disadvantage, in my opinion, is the inability of its application in all the operated patients.
CONCLUSIONS

1. Prognostic scales: ASA, MPI, MOFS and SPI have important prognostic significance in patients with peritonitis.
2. ASA scale, despite and because of its simplicity, is sufficient for use in daily practice in patients operated on due to peritonitis.
3. For the purposes of scientific research and comparing the results of treatment of patients with peritonitis between the various centers, most useful is the MPI scale.

REFERENCES