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The effectiveness of the APACHE II, SAPS II and SOFA prognostic scoring systems in patients with haematological malignancies in the intensive care unit

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Abstract

Background: Cancer-related mortality remains the second most common cause of death in Poland. In many cases, the occurrence of treatment-related complications requires admission to the intensive care unit (ICU). The aim of this study was to assess the clinical application of the APACHE II, SAPS II and SOFA scales to evaluate the risk of death in patients with haematological malignancies treated in the ICU.

Methods: This study's analysis included 99 patients, who were each assigned to one of the following two groups: surviving patients who were discharged from the ICU (n = 24); and patients who died in the ICU (n = 75). Analysis was performed using demographic, clinical and laboratory data obtained during the patient's admission to the ICU and also during the first 24 hours of intensive therapy. Patient assessment was performed using the APACHE II, SAPS II and SOFA scoring systems as well as other clinical variables.

Results: Univariate logistic regression identified the following risk factors of death in patients with haematological malignancies: systolic (P = 0.006), diastolic (P = 0.01) and mean arterial pressure values (P = 0.009); occurrence of acute kidney injury; neutrophil (P = 0.009) and platelet count in the peripheral blood (P = 0.001); and the SAPS II (P = 0.00005), SOFA (P = 0.00009) and APACHE II (P = 0.0007) scores. SAPS II score was the only independent risk factor of patient death in multivariate analysis (P = 0.0004; unitary OR 1.052 [95% CI: 1.022–1.082]).

Conclusion: Of all the applied patient assessment scales, only the SAPS II score was found to be useful in subjects with haematological malignancies hospitalised in the ICU.

Key words: intensive care, mortality; intensive care, prognosis; haematological malignancies; lymphatic neoplasms

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Haematological malignancies account for over 2% of newly diagnosed neoplastic diseases in our country. They predominantly affect young, previously healthy individuals, but their incidence in the elderly has been rising in recent years. Early diagnosis and the application of appropriate therapy are essential for positive treatment outcomes. Unfortunately, targeted intensive chemotherapy and advanced stages of an underlying disease can lead to dysfunction of the immune system and multiple system organ failure. The development of severe treatment-related complications can be the primary reason for admission to the intensive care unit (ICU). For many years patients with haematological malignancies have been considered for ICU treatment with reluctance due to poor treatment outcomes. At present, the number of those admitted is increasing, although the mortality in this group is still high, ranging from 40% to 90%, according to the literature [1, 2].

The aim of the present study was to evaluate the usefulness of the APACHE II, SAPS II and SOFA scoring systems in predicting the risk of death in patients with haematological malignancies treated in the ICU. Also, an attempt was made to identify demographic, clinical and laboratory risk factors for death.

METHODS

Medical records of 114 patients with haematological malignancies admitted to the ICU due to severe dysfunction of vital organs and systems were initially retrospectively analysed. The observation period covered the years of 1994 to 2010. All of the patients had been previously treated in the department of haematology and transplantology. The inclusion criteria were the duration of the ICU treatment above 15 hours and the complete medical data necessary for the analysis. Ultimately, the analysis involved medical records of 99 patients divided into two groups: group I (n = 24), who were the survivors discharged from the ICU; and group II (n = 75), who were the non-survivors who died in the ICU.

The following prognostic scales were used to assess the patients' conditions: APACHE II, SAPS II and SOFA. Calculations were performed based on forms available on the Internet (www.sfar.org). In addition, the demographic, clinical and laboratory parameters obtained at the ICU admission of the patient and during the first 24 hours of ICU treatment were analysed. During the first 24 hours of treatment, demographic data (i.e., age, gender), the type of malignancy and the selected haemodynamic parameters (i.e., heart rate, systolic, diastolic and mean arterial pressure), and the supply of catecholamines including their types and doses were analysed in detail. Moreover, the incidences of acute renal failure and the institution of renal replacement therapy were determined in the study groups. Also, the groups were compared according to haematopoietic stem cell transplantation and graft-versus-host disease. Acute renal failure was diagnosed based on the Knaus criteria for multiple system organ failure [3]. The following blood parameters were analysed: white blood cell count, red blood cell count, platelet count, haematocrit and haemoglobin. Additionally, the length of each patient's stay in the ICU was analysed.

Statistical analysis was performed using the Statistica 9.0 PL software created by StatSoft of Tulsa, USA. The distribution of the interval scale data was checked with the Shapiro-Wilk W test. The data with the distribution near normal were compared using the Student's t test for unrelated variables, following the Levene`s test for homogeneity variance. The interval scale data with the distribution far from normal and the data on the ordinal scale were compared with the Mann-Whitney U test. The data on the nominal scale were compared with the x^2 Fisher test or the Fisher-Snedecor test, if applicable. To identify the risk factors for death in the study population, analysis of the logistic regression was applied using the quasi-Newton method. Firstly, univariate analysis was performed; once statistically significant variables were identified, they were entered into a multivariate analysis using the stepwise regression method. $P < 0.05$ was considered significant.

Table 1. Types of haematological malignancies in the study population (%)

Type	Group I n = 24	Group II n = 75	*P* value
Acute lymphoblastic leukaemia	13%	12%	0.597
Acute myeloid leukaemia	25%	41%	0.15
Chronic myeloid leukaemia	17%	8%	0.249
Hodgkin lymphoma	8%	9%	1.0
Myelodysplastic syndrome	0%	11%	0.193
Non-Hodgkin lymphoma	29%	19%	0.389
Bone marrow aplasia	8%	0%	0.33

Table 2. Reasons for ICU admissions (%)

Reasons for ICU admission	Group I n = 24	Group II n = 75	*P* value
Respiratory failure	75%	64%	0.319
Circulatory-respiratory failure	38%	45%	0.5
Sudden cardiac arrest	21%	31%	0.352
Septic shock	8%	20%	0.23
Multiple organ failure	17%	20%	1.0

RESULTS

Group I consisted of 13 women (54%) and 11 men (46%), while group II included 26 women (35%) and 49 men (65%) ($P = 0.089$). The mean age in group I was 45.1 ± 13.8 years, and in group II, 46.8 ± 14.9 years ($P = 0.611$). The median number of months from diagnosis to ICU admission in group I was 12 months and ranged from 0 to 108, and in group II was 6 months and ranged from 0 to 120 ($P = 0.719$). There were no significant intergroup differences in the percentages of haematological malignancy types diagnosed (Table 1) or in reasons for ICU admission (Table 2).

Analysis of the selected haemodynamic parameters upon ICU admission did not demonstrate significant intergroup differences in the heart rate ($P = 0.361$). The mean systolic ($P = 0.006$), diastolic ($P = 0.01$) and mean arterial pressures ($P = 0.009$) were significantly higher in group I; however, in the multivariate analysis, those parameters were not found to be independent risk factors of death. Upon ICU admission, 54% of group I patients and 71% of group II patients received catecholamines ($P = 0.136$). No significant intergroup difference was observed in the percentage supply of individual catecholamines, such as noradrenaline ($P = 0.051$), dopamine ($P = 0.261$) and dobutamine ($P = 0.921$) (Table 3).

Analysis of the peripheral blood parameters did not reveal significant intergroup differences in the values of

Table 3. Types and doses of catecholamines used in the study groups (μg kg^{-1} min^{-1})

	Group I			
	n	Mean dose	Minimum dose	Maximum dose
Noradrenaline	7	0.14	0.05	0.3
Dopamine	9	17.7	3.33	40.0
Dobutamine	6	13.8	3.33	20.0
	Group II			
Noradrenaline	39	0.2	0.05	1.0
Dopamine	38	17.7	3.33	50.0
Dobutamine	18	16.7	5.0	50.0

haematocrit (P = 0.318), haemoglobin (P = 0.993) and RBC (P = 0.352); however, there were significant differences in the median WBC (P = 0.011), neutrophil (P = 0.009) and platelet counts (P = 0.001), which were significantly higher in group I compared to group II.

The median ICU length of stay was 234 hours (range 20–984) in group I, while only 73 hours (range 16–2604) in group II. This difference was statistically significant (P = 0.017). Based on the Knaus system organ failure criteria, acute kidney failure was diagnosed in 29% of group I patients and in 56% of group II patients (P = 0.022); statistical analysis of the percentage of patients with renal replacement therapy after admission to ICU did not show a significant difference between the groups (P = 0.331). Moreover, there was no significant difference between the groups in the percentages of patients after hematopoietic stem cell transplantation (HSCT) (P = 0.596) and of those with graft-versus-host disease (GvHD) (P = 0.756).

Statistical analysis demonstrated significant intergroup differences in the APACHE II scores, predicted death rate (PDR) and predicted death rate adjusted (PDRA), which all consider the reason for ICU admission. The APACHE II scores were found to be significantly higher in group II. Likewise, the statistical analysis of SAPS II, extended SAPS II, SAPS II — PDR and SOFA scores showed significant differences between the groups (Table 4).

Univariate logistic regression used to assess the parameters on admission and during the first 24 hours of ICU treatment showed statistical significance for systolic, diastolic, and mean arterial pressures; percentage neutrophil and platelet counts in the peripheral blood; acute kidney failure; and the SAPS II, SOFA and APACHE II scores. Multivariate analysis demonstrated only one independent risk factor for death, which was the SAPS II score (P = 0.0004; OR 1.052 [95% CI: 1.022–1.082]).

Table 4. Prognostic scales evaluated during ICU stay. Abbreviations explained in the test. Means ± SD or medians (range)

Prognostic scale	Group I n = 24	Group II n = 75	*P* value
APACHE II	24.20 ± 6.38	32.22 ± 10.57	0.0007
APACHE II — PDR	49.7 (18.6–81.0)	78.6 (12.9–99.4)	0.0006
APACHE II — PDRA	47.85 (18.6–100.0)	73.3 (9.9–100)	0.013
SAPS II	52.45 ± 11.55	74.77 ± 24.65	0.00005
SAPS II — PDR (%)	54.25 (0–86.8)	87 (11.2–97.6)	0.00002
SOFA	9.83 ± 3.71	13.8 ± 4.24	0.00009

All abbreviations are explained in the text

DISCUSSION

Prognosis for patients with haematological malignancies requiring treatment in the ICU is unfavourable [3], which was also confirmed by our findings that indicated a mortality rate of 75.7%. Such a high mortality amongst ICU patients with haematological malignancies was reported in publications from the 1980s [4]. Currently, the literature is more optimistic [2]. However, the relatively high mortality rate observed among 99 patients in our study confirms the older reports, which is likely to result from the fact that almost all patients, except two in each group, already required mechanical ventilation during the first day of their ICU admission. According to the results presented by Lecuyer and co-workers (5) in 2007, the survival rate of patients with haematological disease and solid tumours requiring mechanical ventilation in the ICU was 21.8%. A comparable survival rate (i.e., 24.3%) was found in our study. Thus, it seems that despite substantial advances in ventilation techniques and widespread use of lung-sparing ventilation, the survival of patients with haematological malignancies accompanied by respiratory failure has not markedly improved.

None of our patients were older than 65 years, and the groups did not significantly differ in this parameter. However, many authors consider age, particularly advanced age, an unfavourable prognostic factor in individuals with haematological malignancies. The studies mentioned above were carried out in the previous century, but more current reports have also identified age as a prognostic factor for death [6]. According to Azoulay [7], older patients with haematological malignancies, especially in the early stages, should not have limited access to the ICU as ICU treatment can increase their chances of survival.

Moreover, gender was demonstrated to be an unfavourable prognostic factor, although the data reported are conflicting. According to Verplancke and colleagues [8], the female gender is an unfavourable factor; however, Santos and co-workers [9], who studied patients with haematologi-

cal malignancies and acute kidney failure requiring renal replacement therapy, identified the male gender as an unfavourable prognostic factor. The findings in our study did not reveal significant gender-related differences between the groups. There were also no significant intergroup differences according to the diagnoses of haematological malignancies. In a British study conducted in 178 ICUs amongst patients with haematological malignancies, Hodgkin's lymphoma was found to be an unfavourable prognostic factor [6]. Poor prognosis for a 6-month survival was demonstrated in another study involving patients with acute myeloid leukaemia and non-Hodgkin lymphoma [10]. A high degree of malignancy of the underlying haematological disease also appears to be an unfavourable prognostic factor [8]. However, the other studies did not confirm a relationship between the diagnosis of haematological disease and the risk of death [11].

Lower values of systolic, diastolic and mean arterial pressures in group II were most likely the cause of the increased supply of catecholamines in this group (71% of patients compared to 54% in group I). It can be assumed that despite the lack of significant intergroup differences in the supply of catecholamines, the supply to many group II patients could have affected the mortality in this group. In a study conducted by the researches from Honolulu, the mean arterial pressure assessed in 33 patients with haematological malignancies was found to be a prognostic factor of death [12]. The mortality rate observed in this group of patients (i.e., 74%) was similar to that in our study. Likewise, Hampshire and co-workers (6) analysed 7689 patients with haematological malignancies in their study and demonstrated that haemodynamic parameters such as heart rate and systolic arterial pressure affected the mortality of patients.

Neutropaenia, a significant prognostic parameter, is considered to be a controversial factor of low prognostic value in the population of patients with neoplastic diseases. The authors stress the lack of data regarding the duration of neutropaenia, the baseline conditions of patients, and the stages of the underlying disease. Moreover, they emphasise that the assessment of neutropaenia is extremely difficult in such a diverse group of patients with haematological malignancies undergoing curative or palliative chemotherapy, after haematopoietic stem cell transplantation or otherwise [13].

A study based on the analysis of 714 patients hospitalised in 26 ICUs in Scotland confirmed not only the necessity for substitutive ventilation, cardio-pulmonary resuscitation 24 hours before admission and the supply of catecholamines during the first 24 hours of the patient's stay but also the importance of the APACHE II score as an independent prognostic factor of death [14]. In our study, the APACHE score was not found to be an independent risk factor for death.

The SAPS II score was identified as the only independent risk factor for death. The usefulness of SAPS II for predicting mortality in patients with haematological malignancies treated in ICUs has been confirmed in other studies [11, 15]. Moreover, it is known that the survival of patients with haematological malignancies requiring ICU hospitalisation is not generally dependent on the individual clinical and laboratory parameters related to the underlying disease but rather on the severity of the patient's general condition [1, 5, 10, 16].

In the groups of patients analysed, respiratory failure and septic shock were the most common reasons for ICU admission, which apparently affected the SOFA scores. Statistical analysis showed significant differences between the groups' SOFA scores, whereas multivariate analysis did not demonstrate that the SOFA score was an independent risk factor for death. In contrast, the findings reported by Silfvast and co-workers (3) disclosed that the SOFA score could be an independent risk factor for death in patients with haematological malignancies.

The length of ICU stay could be one of the parameters assessing treatment outcomes, although it is not always explicit [17]. ICU stays of critically ill patients can be shorter as they die due to severe health conditions, despite the therapy instituted; for patients whose condition is no longer life threatening, the stay may be longer [17]. Also, the duration of ICU treatment in the European countries as well as the USA and Canada varies. The data show that the mean ICU stay in the USA is 3.7 to 4.74 days, while in Canada, it is 5.2 days. The varied lengths of stays in ICUs are caused by the availability of beds, by admission and discharge policies and mostly significantly by the diversity and severity of the conditions treated. The group II patients in our study were characterised by lower values of systolic, diastolic and mean arterial pressures, neutropaenia, thrombocytopaenia; 56% of them had acute renal failure diagnosed during the first 24_hours of their ICU stay. It seems that the above factors could have markedly affected organ function and the survival of patients, which was statistically shorter.

According to the literature, 11–40% of patients after haematopoietic stem cell transplantation require ICU admission. The mortality among this group reaches 54–92%; 80% in almost all cases when mechanical ventilation is required [18, 19]. Because the mortality is so high, some authors have suggested considering the purposefulness of expensive therapy that may lead to many complications. Nevertheless, the survival of patients after haematopoietic stem cell transplantations has improved over the years; some authors have reported that ICU mortality has decreased to 53%, in-hospital mortality to 64% and 6-month mortality to 81% [20].

CONCLUSION

Of all the prognostic scales applied to patients with haematological malignancies treated in ICUs, including clinical and laboratory parameters, only the SAPS II score was found to be an independent risk factor for death.

References:

1. *Azoulay E, Alberti C, Bornstain C et al.*: Improved survival in cancer patients requiring mechanical ventilatory support: impact of noninvasive mechanical ventilatory support. Crit Care Med 2001; 29: 519–525.
2. *Bird GT, Farguhar-Smith P, Wigmore T, Potter M, Gruber PC*: Outcomes and prognostic factors in patients with haematological malignancy admitted to a specialist cancer intensive care unit: a 5 yr study. Br J Anaesth 2012; 108: 452–459.
3. *Knaus WA, Draper EA, Wagner DP, Zimmerman JE*: Prognosis in acute organ-system failure. Ann Surg 1985; 202: 685–693.
4. *Silfvast T, Pettila V, Ihalainen A, Elonen E*: Multiple organ failure and outcome of critically ill patients with haematological malignancy. Acta Anaesthesiol Scand 2003; 47: 301–306.
5. *Lecuyer L, Chevret S, Thiery G, Darmon M, Schlemmer B, Azoulay E*: The ICU trial: a new admission policy for cancer patients requiring mechanical ventilation. Crit Care Med 2007; 35: 808–814.
6. *Hampshire PA, Welch CA, Mccrossan LA, Francis K, Harrison DA*: Admission factors associated with hospital mortality in patients with haematological malignancy admitted to UK adult, general critical care units: a secondary analysis of the ICNARC Case Mix Programme Database. Crit Care 2009; 13: 137.
7. *Azoulay E, Soares M, Darmon M, Benoit D, Pastores S, Afessa B*: Intensive care of the cancer patient: recent achievements and remaining challenges. Ann Intensive Care 2011; 1: 5.
8. *Verplancke T, Van Looy S, Benoit D et al.*: Support vector machine versus logistic regression modeling for prediction of hospital mortality in critically ill patients with haematological malignancies. BMC Med Inform Decis Mak 2008; 8: 56.
9. *Santos P. Maximino J, Paiva A, Baldaia AJ*: Outcome of critically ill patients with haematological malignancies treated with renal replacement therapy. Port J Nephrol Hypert 2011; 25: 145–150.
10. *Massion PB, Dive AM, Doyen C et al.*: Prognosis of hematologic malignancies does not predict intensive care unit mortality. Crit Care Med 2002; 30: 2260–2270.
11. *Owczuk R, Wujtewicz MA, Sawicka W, Wadrzyk A, Wujtewicz M*: Patients with haematological malignancies requiring invasive mechanical ventilation: differences between survivors and non-survivors in intensive care unit. Support Care Cancer 2005; 13: 332–338.
12. *Nishida K, Palalay MP*: Prognostic factors and utility of scoring systems in patients with hematological malignancies admitted to the intensive care unit and required a mechanical ventilator. Hawaii Med J 2008; 67: 264–269.
13. *Azoulay E*: Editorial Pulmonary infiltrates in patients with malignancies; why and how neutropenia influences clinical reasoning. Eur Respir J 2009; 33: 6–8.
14. *Cuthbertson BH, Rajalingam Y, Harrison S, McKirdy F*: The outcome of haematological malignancy in Scottish intensive care units. JICS 2008; 9: 136–140.
15. *Schellongowski P, Staudinger T, Kundi M et al.*: Prognostic factors for intensive care unit admission, intensive care outcome, and post-intensive care survival in patients with de novo acute myeloid leukemia: a single center experience. Haematologica 2011; 96: 231–237.
16. *Pène F, Aubron C, Azoulay E et al.*: Outcome of critically ill allogeneic hematopoietic stem-cell transplantation recipients: a reappraisal of indications for organ failure supports. J Clin Oncol 2006; 24: 643–649.
17. *Knaus WA, Wagner DP, Zimmerman JE, Draper EA*: Variations in mortality and length of stay in intensive care units. Ann Intern Med 1993; 118: 753–761.
18. *Soubani AO, Kseibi E, Bander JJ et al.*: Outcome and prognostic factors of hematopoietic stem cell transplantation recipients admitted to a medical ICU. Chest 2004; 126: 1604–1611.
19. *Afessa B, Azoulay E*: Critical care of the hematopoietic stem cell transplant recipient. Crit Care Clin 2010; 26: 133–150.
20. *Huynh TN, Weigt SS, Belperio JA, Territo M, Keane MP*: Outcome and prognostic indicators of patients with hematopoietic stem cell transplants admitted to the intensive care unit. J Transplant 2009; 2009: 917294.

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