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Original Contribution

PROGNOSTIC PERFORMANCE OF WORLD SOCIETY OF EMERGENCY SURGERY SEPSIS SEVERITY SCORE IN BULGARIAN PATIENTS WITH COMPLICATED INTRA-ABDOMINAL INFECTIONS

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ABSTRACT

PURPOSE: To evaluate the ability of World Society of Emergency Surgery Sepsis Severity Score (WSES SSS) to prognosticate the fatal outcome in our local setting and compare the findings with global data.

METHODS: The retrospective study involved 110 patients with complicated intra-abdominal infections (cIAIs) admitted to Department of Surgical Diseases at a University hospital. All adult patients who required emergency surgery due to cIAIs from January 2017 to July 2019 were included. We assessed the prognostic performance of WSES SSS using area under receiver operating characteristics (AUROC) curves and analyzed the coordinates of the curves.

RESULTS: The observed in-hospital mortality was 22.7%. WSES SSS was significantly higher in non-survivors compared to survivors - 7(5-8) points vs. 3(0-5) points, $p < 0.0001$. The established AUROC value of WSES SSS for outcome prediction was 0.825 (0.749-0.902). We have identified sensitivity of 92% and specificity of 68.2% for cut-off value > 4 points.

CONCLUSION: The WSES SSS was shown as a practical and reliable mortality predictor in Bulgarian patients with cIAIs.

Key words: WSES SSS, intra-abdominal infections, outcome, mortality

INTRODUCTION

In the third decade of the twenty-first century, complicated intra-abdominal infections (cIAIs) still represent a challenge for surgeons and intensive care physicians. The cIAIs are infections that spread beyond the affected intra-abdominal organ, and result either in local or diffuse peritonitis [1]. They are responsible for about one fifth of sepsis in intensive care units (ICUs), and are associated with high morbidity and mortality [2].

Prognostic assessment at early stage of patients with cIAIs could help for the differentiation of those at a higher risk of death and provides an opportunity to change the management strategy, which might affect the adverse outcome. Over the years, various prognostic scores have been developed, however none of them is widely accepted in everyday practice. Many of these scores have proven to be reliable, but time consuming, difficult to calculate and complex; they require many laboratory and clinical data, and outside ICUs are rarely used.

The most recent and least investigated surgical score is the WSES Sepsis Severity Score (WSES SSS). It was designed by the World Society of Emergency Surgery (WSES) in 2014 as a prognostic scoring system specific for cIAIs [3]. Several studies validated this score globally [4-6] and found that it can be precise and practical for patients with cIAIs. A major advantage of WSES SSS is its simplicity and easy calculation. No study (to the best of our knowledge) has evaluated this score in Bulgarian patients yet.

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Therefore, the aim of our study was to analyze the ability of WSES SSS to predict mortality in patients with cIAIs in our local setting.

MATERIAL AND METHODS

We conducted a retrospective study at a University Hospital "Prof. Dr. Stoyan Kirkovich" Stara Zagora. The medical records of 110 adult patients admitted to the Department of Surgical Diseases (DSD) from the Emergency Department and operated on for cIAIs between January 2017 and July 2019 were reviewed. For the time period, 131 patients with a diagnosis cIAI were admitted to DSD. In 18 patients we found missing data on some clinical parameters, 2 patients died before surgery, and one was < 18 years old. Finally, demographic data, clinical information, and clinical outcomes were determined from 110 patients' medical records. The WSES SSS was calculated based on 6 risk factors postoperatively [4] (**Table 1**).

Table 1. *WSES Sepsis Severity Score (0−18 score)*

Risk factor	**Points**
Age > 70 years	2
Immunosuppression	3
Setting of acquisition	
Healthcare-associated infection	2
Clinical condition at admission	
Severe sepsis	3
Septic shock	5
Origin of cIAIs	
Colonic non-diverticular perforation peritonitis	2
Diverticular diffuse peritonitis	2
Postoperative diffuse peritonitis	2
Small bowel perforation peritonitis	3
Delay in source control	
Delayed initial intervention > 24 hours	3

The obtained data were analyzed using SPSS Statistics 19.0 (IBM, Chicago, Illinois, USA). The ability of WSES SSS to prognosticate the fatal outcome was evaluated using Receiver Operating Characteristic (ROC) Curve Analysis and direct logistic regression model. Continuous variables were presented as mean (±SD) for normally distributed data or median (IQR) for non-normally distributed data. Comparisons of group differences for continuous variables were performed by Student t Test or Mann-Whitney U test. Categorical variables were expressed as frequency (%) and compared by Chi-square test or Fisher exact test. P-value was considered significant at < 0.05.

RESULTS

Patients' characteristics

Of the 110 patients, 25 (22.7%) had an adverse outcome. None of the patients was immunosuppressed, had septic shock or healthcare-associated cIAIs. Survivors were significantly younger than non-survivors (56.84±18.89 vs. 74.80±12.64, p < 0.0001). The most common cause of cIAIs was acute appendicitis (27%), followed by acute cholecystitis and peptic ulcer perforation. In patients with chronic renal failure (p = 0.004) and malignancy (p = 0.002) mortality rate was significantly higher. We found significant differences between survivors and non-survivors according to exudate (p = 0.007), spread (p = 0.016) and source of peritonitis (p = 0.041). Patients who had severe sepsis at admission (p < 0.0001) or underwent delayed initial intervention > 24 hours had higher risk of death (p = 0.004) (**Table 2**).

WSES SSS

Median WSES SSS of the sample was 3 (0-7) points. Non-survivors had a significantly higher median score than survivors – 7 (5-8) vs. 3 (0-5), p < 0.0001 (**Figure 1**). The highest calculated score was 10 points, and thirty-four patients had WSES SSS = 0 points. WSES SSS > 4 points was observed in 31.8 percent of survivors and 23 out of 25 of non-survivors **(Table 2).**

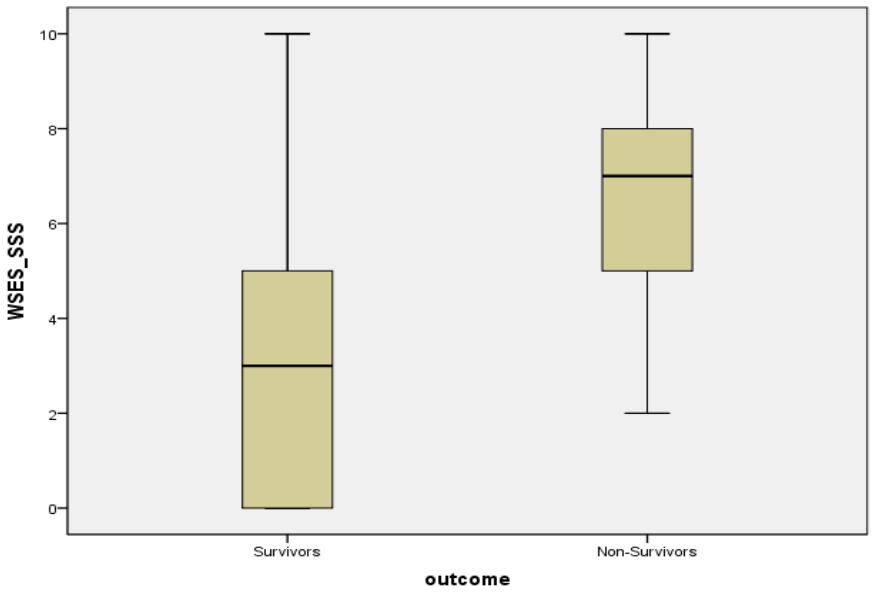

Figure 1. Boxplot of WSES SSS in survivors and non-survivors

Table 2. *Patients' characteristics*

Variable	**Total population**	**Survivors(n=85)**	**Non-Survivors(n=25)**	**p value**
Sex, n(%) ***male/female***	61(55.5)/49(45.5)	48(78.7)/37(75.5)	13(21.3)/12(24.5)	0.693
Age, years ±SD	60.92±19.17	56.84±18.89	74.80±12.64	< 0.0001
Age >70 years, n(%)	46 (41.8)	27 (31.8)	19 (76.0)	< 0.0001
Source, n(%)				0.041
Appendix	27 (24.5)	25 (29.4)	2 (8.0)	
Hepatobiliary system	26 (23.6)	20 (23.5)	6 (24.0)	
Stomach/duodenum	24 (21.8)	18 (21.2)	6 (24.0)	
Colon/Rectum	18 (16.4)	10 (11.8)	8 (32.0)	
Small intestine	2 (18.)	1 (1.2)	1 (4.0)	
Gynecological	7 (6.4)	7 (8.2)	0 (0)	
Other	6 (5.5)	4 (4.7)	2 (8.0)	
Peritonitis, n(%)				0.016
Local	40 (36.4)	36 (42.4)	4 (16.0)	
Diffuse	70 (63.6)	49 (57.6)	21 (84.0)	
Exudate, n(%)				0.007
Serous	21 (19.1)	19 (22.4)	2 (8.0)	
Purulent	84 (76.4)	65 (76.5)	19 (76.0)	
Feculent	5 (4.5)	1 (1.2)	4 (16.0)	
Comorbidity,n(%)				
High Blood Pressure	44 (40.0)	32 (37.6)	12 (48.0)	0.353
Malignancy	16 (14.5)	7 (8.2)	9 (36.0)	0.002
Diabetes	13 (11.8)	10 (11.8)	3 (12.0)	1.000
Chronic Renal Failure	9 (8.2)	3 (3.5)	6 (24.0)	0.004
Delayed intervention >24h	56 (50.9)	37 (43.5)	19 (76.0)	0.004
Severe sepsis	37 (33.6)	21 (24.7)	16 (64.0)	< 0.0001
WSES SSS, points(IQR)	3 (0-7)	3 (0-5)	7 (5-8)	< 0.0001
WSES SSS >4, n(%)	50 (45.5)	27 (31.8)	23 (92.0)	< 0.0001

Sensitivity, Specificity and AUROC

WSES SSS showed a good ability to prognosticate the fatal outcome (AUROC = 0.825, 95% CI = 0.749-0.902, p < 0.0001). The optimal cut-off value that we determined was WSES SSS > 4 points and it permitted prediction of mortality with a sensitivity of 92% and a specificity of 68.2% (**Table 3**) (**Figure 2.**)

Table 3. *Sensitivity, Specificity and AUROCs*

Variable	Sensitivity,%	Specificity,%	AUROC (95% CI)	Significance
WSES SSS > 4	92.0	68.2	0.825(0.749-0.902)	p < 0.0001
WSES SSS > 5	68.0	80.0		
WSES SSS > 6	56.0	82.4		
WSES SSS > 7	44.0	84.7		

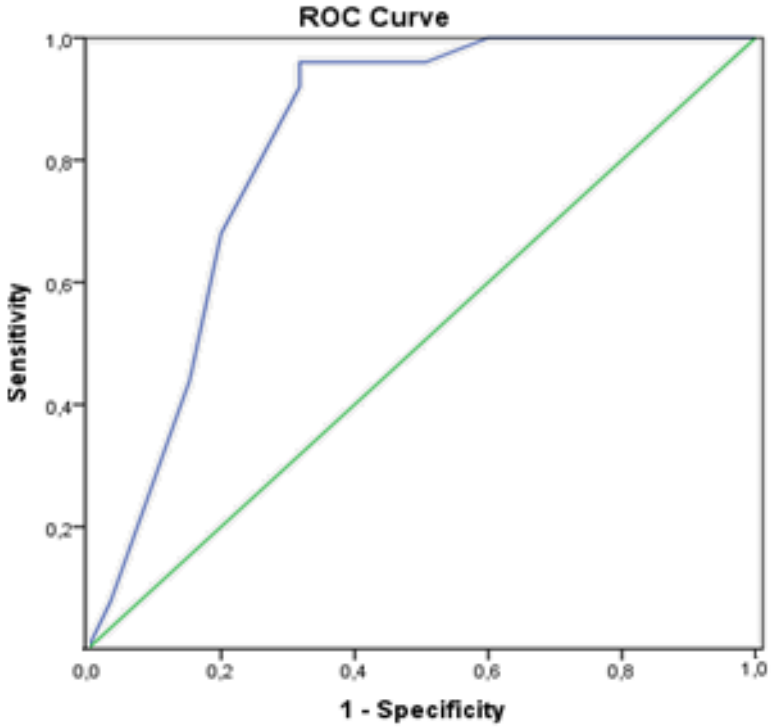

Figure 2. ROC Curve

Logistic regression

The ability of WSES SSS to prognosticate death was tested by direct logistic regression (**Table 4**). This model using only the WSES SSS was highly significant (p < 0.0001). The odds of unfavorable outcome increased by 0.535 by an increase on 1 point of the score, which is notable.

Table 4. *Direct logistic regression model for mortality prediction*

Variable	B	S.E.	Wald test	p-value	Odd Ratio (95% CI)
WSES SSS	0.428	0.097	19.332	< 0.0001	1.535 (1.268-1.858)

DISCUSSION

Complicated intra-abdominal infections are still associated with unacceptably high morbidity, mortality, and healthcare costs globally [3, 4, 9]. Prognostic evaluation of cIAIs at early stage of the disease and timely treatment can improve the poor outcome, which indicates the necessity of reliable tools for easier identification of patients at a higher risk of death. A number of researchers are trying to deal with these problems by developing novel prognostic scoring systems or validating already existing ones [4-10].

The aim of each novel predictive score is to improve the evaluation of a disease and eventually to replace the existing scoring systems. In this regard, WSES developed in 2014 a new clinical scoring system – a WSES Sepsis Severity Score (WSES SSS), which shows a very good ability to predict mortality and can be used worldwide [3]. In 2015 the WISS study [4] confirmed these findings and

indicated that the best threshold for predicting death was WSES SSS >5 with a sensitivity and a specificity of 89.2% and 83.5%, respectively. Raimondo et al. [7] observed in sixty-five patients with cIAIs an identical cut-off value with sensitivity and a specificity of 85.7% and 75.9%, respectively. We identified a cut-off value of WSES SSS >4 points with a sensitivity of 92% and a specificity of 68.2%. The same cut-off value was established by Godinez-Vidal et al. [6] in 185 patients with cIAIs and Sazhin et al. [8] in 153 patients with diffuse peritonitis. For a threshold >4 points Godinez-Vidal et al. [6] reported a sensitivity and a specificity of 76.47% and 90.48%, respectively and Sazhin et al. [8] reported a sensitivity and a specificity of 78.6% and a 84.7%, respectively. Mwenda et al. [5] observed in 173 patients with cIAIs a cut-off value >6 with a sensitivity of 80% and a specificity of 20.9%. The highest threshold - WSES SSS ≥8 with a sensitivity of 73% and a specificity of 76% was established by Tolonen et al. [9] in 93 patients with severe cIAIs.

In the present study we used ROC curve analysis to determine the threshold values, and the AUROC was tested for significance. The established AUROC was 0.825, which was statistically significant for prediction of unfavorable outcome ($p < 0.0001$). With the exception of Tolonen et al. [9] (AUROC = 0.809), all other researchers found a higher AUROC of WSES SSS than our study: Godinez-Vidal et al. [6] - AUROC = 0.931, Raimondo et al. [7] - AUROC = 0.887, Mwenda et al. [5] - AUROC = 0.874 and Sazhin et al. [8] - AUROC = 0.851.

Non-survivors in our study have significantly higher score than survivors, whereat a threshold > 4 points is associated with an increased risk of death. We observed that advanced age and delayed intervention are significant prognostic factors – 76% of patients who died were >70 years old and had preoperative duration of peritonitis >24 hours. In our study patients with severe sepsis ($p < 0.0001$), malignancy ($p = 0.002$) or chronic renal failure ($p = 0.004$) had a less chance of survival. Using direct logistic regression model we demonstrated that WSES SSS is highly significant prognostic score ($p < 0.0001$) with odds ratio of 1.53.

Sartelli et al. [3] reported a mortality rate of 10.5% in CIAWO study, and 9.2% in the WISS study [4]. We observed a much higher mortality rate - 22.7%. This could be due to the fact that in our study most of the patients were presented with diffuse peritonitis – 63.4% unlike CIAWO (43.6%) and WISS (35.9%) studies. Furthermore, only 24.5% of the surveyed patients had acute appendicitis as a source of infection, whereby the observed mortality rate was low. In CIAWO and WISS studies patients with acute appendicitis represented 33.3% and 34.2% of the population, respectively. In patients with severe cIAIs, Tolonen et al. [9] found a similar mortality rate - 22%. The lower rate was established by Mohan et al. [10] – 16% in patients with perforation peritonitis, Sazhin et al. [8] – 13.7% in patients with diffuse peritonitis, Mwenda et al. [5] – 12.8% and Raimondo et al. [7] – 10.8% in patients with cIAIs. Godínez-Vidal et al. [6] reported the lowest mortality rate of 9.2% in patients with cIAIs.

This is the first study, (to the best of our knowledge) that analyzes the prognostic performance of WSES SSS in Bulgarian patients with cIAIs.

As limitations of our study we can highlight the single-center experience, the retrospective design, and the small sample size.

CONCLUSION

In Bulgarian patients with cIAIs WSES SSS was observed as a reliable and independent predictor of mortality. It allows the surgeon to evaluate the risk of unfavorable outcome even intraoperatively and maybe after more large-scale validation studies WSES SSS should be applied routinely in clinical practice.

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