Comparison of APACHE II, P-POSSUM and SAPS II scoring systems in patients underwent planned laparotomies due to secondary peritonitis

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BACKGROUND: *The first aim of this study was to discuss the factors affecting mortality rate in patients with severe intra-abdominal sepsis treated with planned relaparotomy. The second aim was to compare APACHEE II, P-POSSUM and SAPS II scoring systems to allow identification of high-risk patients.*
MATERIAL AND METHODS: *A series of 34 patients who had intra-abdominal sepsis and treated with planned relaparotomy between January 2009 and January 2012 were included the study. The source of the peritonitis, type and number of surgical procedures, number of planned relaparatomies, microbiology surveillance, total intensive care unit (ICU) and hospital stay duration, number of intubated days, morbidity and mortality were analyzed. APACHEE II, SAPS II, P-POSSUM scores and estimated mortality ranges at admission were compared.*
RESULTS: *The mean age was 46 (16-76 years) and 73.5 % (n=25) were male. A total of 119 operations and 50 surgical procedures were performed. The overall mortality rate was 20.6% (n=7). Complications developed in %53 (n=18) of the patients. Mortality was higher in upper GIS leaks (6/20 versus 1/14 patients). Areas under the curve calculated by ROC curve analysis for APACHE II, SAPS II and P-POSSUM were 0.958, 0.955 and 0.931, respectively. The highest values for sensitivity (100%) and specivity (85.2%) together were reached in APACHE II, when cut off value for it was set to 20.5. The SAPS II and P-POSSUM physiology scores were correlated with overall hospital stay (p=0.022 r=0.438 and p=0.001 r=0.609 respectively), but this correlation was not found for APACHEE II score (p=0.085 r=0.337). However, all three scoring systems provided clear estimation of ICU stay duration.*
CONCLUSION: *We suggest that, in secondary peritonitis patients reserved for planned relaparotomy, APACHE II is more reliable for prediction of mortality and P-POSSUM scoring system is more reliable for prediction of overall hospital stay duration.*

KEY WORD: APACHE II, P-POSSUM, Peritonitis, SAPS II

Introduction

Secondary peritonitis related intra-abdominal sepsis is a difficult problem for the surgeons. Although there are numerous surgical strategies, antibiotic treatments and intensive care unit facilities, mortality rate of this disease has not decreased below 30% [1].
The management includes peritoneal debridement and lavage, resections, ostomies, or drainage tubes for source control if necessary [2,3]. At the initial operation, severity of the peritonitis brings most surgeons to a decision point; to left the abdomen open, or to close the abdomen for planned or on-demand relaparotomy. There are studies in the literature indicating that repetitive relaparotomy strategy is more commonly used than open abdomen

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in recent years [4,5]. However, it is still controversial whether to perform a planned or an on-demand laparotomy.

Several scoring systems are being used for assessing the severity of disease and predicting mortality in critically ill patients. On the other hand, there is no reliable data regarding which scoring system is preferable for the prediction of mortality for these patients.

The first aim of this study was to discuss the factors affecting mortality in patients with severe intra-abdominal sepsis treated with planned relaparotomy. The secondary aim was to compare APACHE II, P-POSSUM and SAPS II scoring systems to allow identification of high-risk patients.

Material and Methods

This retrospective study was performed in the Surgery Clinic of Numune Training and Research Hospital after ethics committee approval. A series of 34 patients who had intra-abdominal sepsis and treated with planned relaparotomy between January 2009 and January 2012 were included the study. The exclusion criteria were having primary peritonitis, and peritonitis related to mesenteric vascular occlusions, abdominal traumas, acute pancreatitis and case files with incomplete data. Data including the source of the peritonitis, type and number of surgical procedures, number of planned relaparatomies, microbiology surveillance, total intensive care unit (ICU) and hospital stay duration, number of intubated days, morbidity, mortality and data necessary for APACHEE II, P-POSSUM and SAPS II scoring systems were used.

Assessing Disease Severity

APACHEE II, SAPS II, P-POSSUM scores and estimated mortality ranges at admission were calculated by using the calculator in http://www.sfar.org for each patient.

Planned Relaparotomy

Relaparotomies were performed every 36 to 48 hours after the initial laparotomy to inspect, drain, lavage, and perform other necessary abdominal interventions for residual peritonitis or foci. The sequence of planned relaparotomies was terminated when a macroscopically clean abdomen was found at relaparotomy.

Statistical Analysis

SPSS 18.0 package program was used in statistical analysis. Categorized and numeric data was summarized with number and percentages, and mean and standard deviation (median and minimum and maximum where necessary), respectively. Chi square test was used for mortality comparison of categorical data. For mortality comparison of numeric data, in independent groups, in the state of hypothesis admission, T test and in the state of hypothesis rejection, Mann Whitney U test was used. Logistic regression was used for multidimensional modeling of factors affecting mortality. Receiver Operator Characteristic (ROC) curve analysis was used for classification success and cut off points for mortality assessment scores. Cox regression analysis was used for factors affecting on mortality. Correlation between hospitalization duration and numeric data was analyzed using Spearman correlation coefficient. Univariate general linear models were used for identification of parameters affecting hospitalization duration. Statistical significance level was set at alpha = .05 for all tests.

Results

A total of 38 patients underwent planned relaparotomy for secondary peritonitis between 2009 and 2012 were analyzed. Due to missing data 4 case files were excluded.

In 34 patients, the mean age was 46 (16-76 years) and 73.5 % (n=25) were male. A total of 119 operations and 50 surgical procedures were performed, the median number of operations and surgical procedures were 3 (2-15) and 1 (1-6) respectively. Upper gastrointestinal system (GIS) and lower GIS related secondary peritonitis ratio was 59% (n=20) and 41% (n=14), respectively. The overall mortality rate was 20.6% (n=7). Complications developed in %53 (n=18) of the patients with pneumonia and acute renal failure as the most common complications detected (n=7, n=6 respectively).

The overall median ICU stay was 4 days (1-82 days) and the median hospital stay was 21 days (1-150 days). It was found that, patients with upper GIS tract related sources had significantly longer ICU and overall hospital stays (Table I). Additionally, the length of ICU stay was associated with duration of mechanical ventilation (p=0.002 r=0.754) and number of relaparotomies

Table I - *Source of peritonitis.*

	Lower GIS Mean±SD Med (Min-Max)	**Upper GIS Mean±SD Med (Min-Max)**	**P**
Overall hospital stay	23,77±9,44 22 (15-48)	43.36±34.57 35 (17-150)	**0.029**
ICU stay	3±1,87 2 (1-7)	14.71±20.7 9 (2-82)	**0.002**

(p=0.030 r=0.426). The overall hospital stay period was associated with duration of ventilation (p=0.010 r=0.659).

Successful source control was achieved in 90% of patients (n=30). However, three patients (3/7) in whom the source control was achieved successfully, died of pneumonia, as a complication. In other four patients (4/7) who died, multiple organ failure (MOF) due to septic shock was the cause.

The mean age was 42 years (16-71 years) in survivors and 62 years (21-76 years) in non-survivors. It was found that the impact of "age" on survival is significant

Table II - *Demographics and clinical outcomes.*

	Surviver Mean±SD Med (Min-Max)	**Nonsurviver Mean±SD Med (Min-Max)**	**P**
Age	43.22±14.82 42 (16-71)	59.43±17.75 62 (21-76)	**0.019**
Gender			
M	19 (%70.37)	6 (%85.71)	0,644
F	8 (%29.63)	1 (%14,29)	
Overall hospital stay	33.93±27,17 25 (15-150)	7.86±5,81 8 (1-15)	**<0.001**
Length of ICU stay	9.07±15.85 4 (1-82)	5.14±4.67 4 (1-15)	0.803
Mechanical ventilation duration	4.29±6.87 1 (0-25)	3±1,63 2 (1-5)	0.255
Number of relaparatomies	2.77±2.44 2 (2-14)	1.57±0.53 2 (1-2)	**0.030**
Number of surgical procedures	1.52±1.31 1 (1-6)	1.29±0.49 1 (1-2)	0.803
Source of peritonitis			
Lower GIS	13 (%48.15)	1 (%14.29)	0.198
Upper GIS	14 (%51. 85)	6 (%85.71)	
Number of additional diseases	1.5±0.53 1.5 (1-2)	1.83±1.33 1 (1-4)	0.999

Table III - *Scores in patients at the admission.*

	Surviver Mean±SD Med (Min-Max)	**Nonsurviver Mean±SD Med (Min-Max)**	**P**
APACHE II score	15.56±4.93 16 (6-26)	25.71±3.82 26 (21-33)	**<0.001**
SAPS II score	34,85±10,78 37 (15-51)	59,57±10,92 61 (45-73)	**<0,001**
P-POSSUM physiology score	29±7.02 27 (22-52)	44.86±8.19 47 (35-56)	**<0.001**
P-POSSUM Operative severity score	20.56±3.85 21 (13-30)	23.86±5.24 24 (17-33)	0,069

TABLE IV - *ROC curve analysis for classification success and cut off points for mortality assessment scores.*

	AUC*	*P*	Cut off point	Sensitivity	Specificity
APACHE II Score	0,958	**<0.001**	20.5	**100**	**85.2**
SAPS2 Score	0.955	**<0.001**	44	100	74.1
			49	85.7	88.9
P-POSSUM Physiology Score	0.931	**<0.001**	34.5	100	81.5
POSSUM Operative Severity Score	0.683	0,142	—	—	—

*AUC: Area Under Curve

(p=0.019). Sex, length of ICU stay, number of relaparatomies, number of surgical procedures, and number of additional diseases were not associated with mortality. Mortality was higher in upper GIS leaks (6/20 versus 1/14 patients), but there weren't any statistically significant differences (p=0.198) (Table II).

The average APACHE II, SAPS II and P-POSSUM physiology scores of non-survivors at the administration were significantly higher than those of survivors' (Table III). For estimating mortality in patients, areas under the curve calculated by ROC curve analysis for APACHE II, SAPS II and P-POSSUM were 0.958, 0.955 and 0.931, respectively. As cut off point set to 20.5 for APACHE II, sensitivity (100%) and specivity (85.2%) results gained together in it were the highest values among scoring systems (Table IV). The SAPS II and P-POSSUM physiology scores were correlated with overall hospital stay (p=0.022 r=0.438 and p=0.001 r=0.609 respectively), but this correlation was not found for APACHEE II score (p=0.085 r=0.337). However, all three scoring systems provided clear estimation of ICU stay duration (Table V).

Discussion

THERAPY

In severe peritonitis there is a diffuse inflammatory response caused by the extending infection [6]. Surgical debridement and drainage is the aim in the initial operation in order to decrease the bacterial and toxic load. However it is generally not completely effective because of the anatomical structure of the abdominal cavity. Because of the formation of locular pockets of pus, approximately %20-40 of patients require re-exploration [7]. The strategy that waiting for relaparotomy until the development of persistent infection is called as "laparatomy on demand". Wittmann et al. and Grunau et al. reported that the mortality rate following "wait and see" strategy is lower than planned relaparatomies[8,9]. On the other hand, there are studies showing that the outcomes of these two strategies were similar [10,11] Meta-analysis studies comparing these methods describe these inconclusive evidences with heterogeneity, non-randomized allocation, and small size of the studies [12]. Our study included only a planned relaparatomy group, thus we didn't compare with patients undergone laparatomy on demand. However, overall mortality rate in our study was lower than the results reported in the literature (20.6% versus 21-77% mortality) [8-12].

Patients in our study had severe peritonitis with high APACHEE II, SAPS II and P-POSSUM scores. All of the patients were followed in ICU for at least one day (1-82 days, median 4 days). The same broad-spectrum antibiotic regimen was administered at the admission to all patients and changed after the culture results were required. A group of patients underwent extensive multiple operations. We know that peritoneal washing suppresses the peritoneal defense mechanisms and likewise a surgical trauma is immunosuppressive [13]. Infection may find a new chance to persist [7]. Because of these facts, we additionally continued the antibiotic therapy for 7 days after the final closure. A prospective study showed that if the source was associated with end or lateral duodenal leak, source control was more problematic [7]. In our study, we found similar results to that; source control was more difficult in upper gastrointestinal system related sources than ones related with other locations. In upper gastrointestinal leaks, collected fluid volume may exceed the tube drainage or intraabdominal defense mechanisms' containment capacity. We found that patients with upper gastrointestinal system leak had longer ICU and hospital stay than ones with peritonitis related with other areas. Although the mortality was higher in upper gastrointestinal system leaks (6/20 versus 1/14 patients), we did not find any significant differences between mortality rates due to the limited number of patients.

Some authors reported that, type of illness, success of source control, occurrence of complications are the main independent determinants of mortality [7,10]. In our cases successful source control was achieved in 90% of patients (n=30) and 27 of them have survived. In whom the source control was achieved successfully, died of pneumonia, as a complication. In other four patients (4/7) who died, MOF due to septic shock was the cause.

Koperna et al. showed that patients over 70 years of age are at high risk for developing persistent intraabdominal infections that causes high mortality [10]. The mean age of non-survivors was 59.5±17.75 and it was found that the impact of age on survival is statistically significant (p=0.019).

Table V - *Correlations between scoring systems and ICU stay*

	Correlation Coefficient (*r*)	*P*
APACHE II score	**0.488**	**0.010**
SAPS II score	**0,495**	**0,009**
P-POSSUM physiology score	**0.688**	**<0.001**
P-POSSUM Operative severity score	0.191	0.340

Preoperative Risk Estimation

Secondary peritonitis developing in elder people doesn't respond well to therapy and has high mortality rates. It is suggested that these facts are due to decreased physiological reserves and accompanying diseases [10,14,15]. Simultaneous occurrences of hepatic and renal disorders, immune suppression and malignities increase mortality [14,16]. Mortality remains high in patients with multiple organ failure [10]. Delay of surgical intervention is another factor increasing complication risk in secondary peritonitis [17]. Effectively proven in prediction of mortality in patients with secondary peritonitis, APACHE II scoring system is a disease severity evaluation scoring system and estimation includes age and chronic disease data. And it is very effective for predicting mortality in patients with secondary peritonitis [18,19]. P-POSSUM is an objective and appropriate scoring system for risk-adjusted comparative general surgical audit and a good predictor of mortality in patients undergoing emergency laparotomy [20]. Additionally, APACHE II and POSSUM scoring systems are useful tools helping surgeons to identify patient groups at high risk for complications [21]. On the other hand, SAPS II is usually favored in surgical ICUs due to its quickness and easiness, with requiring a small amount of data [22].

A prospective study was undertaken to evaluate APACHE II, SAPS I, Sepsis score, MOF, TISS-28 and MPI scoring systems in prediction of outcome in patients with perforative peritonitis. It showed that APACHE II is superior in prediction of the outcome above other tested scoring systems [23]. A French prospective observational multicenter study suggested that a SAPS II score>38 was predictive of death due to secondary non-postoperative peritonitis [24]. Izhizuka et al. compared APACHE II, SOFA and POSSUM and noted that POSSUM is an optimal predictor of mortality following emergency surgery for colorectal perforation with 87.5% sensitivity [25]. Aforementioned studies, including literature, report various superiorities of different scoring systems. This may be due to differences of secondary peritonitis treatment approaches.

In this study, we chose patients undergone planned relaparotomy as a treatment strategy. In our study, APACHE II, SAPS II and P-POSSUM scoring systems were found to be successful and close in power for prediction of mortality. However, the highest values for sensitivity (100%) and specivity (85.2%) together were reached in APACHE II, when cut off value for it was set to 20.5.

Conclusion

As a result, we suggest that, in secondary peritonitis patients reserved for planned relaparotomy, APACHE II is more reliable for prediction of mortality and P-POSSUM scoring system is more reliable for prediction of overall hospital stay duration. However, for more dependable results, it is a fact that prospective, multi-centered studies with large patient series are required.

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Riassunto

La prima finalità di questo studio è quello di discutere i fattori che incidono sul tasso di mortalità nei pazienti con grave sepsi intra-addominale trattati con una relaparotomia programmata. La seconda finalità era quella di mettere a confronto il punteggio secondo i sistemi APACHEE II, P-POSSUM e SAPS II nel consentire l'identificazione dei pazienti ad alto rischio.

Sono stati arruolati nello studio 34 pazienti affetti da sepsi intraaddominale e trattati con una relaparotomia tra il gennaio 2009 e il gennaio 2012. Sono stati messi a confronto la sorgente della peritonite, il tipo e numero delle procedure chirurgiche, il numero delle relaparotomie pianificate, la sorveglianza microbiologica, la durata totale del ricovero in unità di terapia intensiva (ICU) e in degenza ordinaria, la durata in giorni dell'intubazione, la morbilità e la mortalità. Sono stati confrontati il punteggio APACHEE II, SAPS II, P-POSSUM e l'ambito stimato della mortalità al ricovero.

Tra i risultati l'età media dei pazienti era di 46 anni (tra 16 e 76) ed il 73,5% (n=25) si trattava di sesso maschile. Erano state eseguite un totale di 119 operazioni e 50 procedure chirurgiche. L'incidenza globale della mortalità è stata del 20,6% (n=7 pazienti); complicanze si sono verificate nel 53% dei casi (n=18 pazienti).

La mortalità è stata più elevata in caso di deiscenze del tratto gastrointestinale superiore (6/20 contro 1/14 pazienti). L'area sotto la curva calcolata con l'analisi ROC per APACHE II, SAPS II e P-POSSUM era rispettivamente 0.958, 0.955 e 0.931.

Il valore più elevato per sensibilità (100%) e specificità (85,2%) associate sono state raggiunte in APACHE II se il valore di cut off veniva posto a 20,5.

Il punteggio fisiologico SAPS II e P-POSSUM era correlato con la durata complessiva della degenza (rispettivamente p=0.022 r=0.438 e p=0.001 r=0.609), ma questa correlazione non è stata riscontrata per il punteggio APACHEE II (p=0.085 r=0.337). ad ogni modo tutti e tre i sistemi di punteggio hanno provvisto una chiara stima della durata di permanenza della unità di terapia intensiva (ICU).
Quale conclusione si indica che nei pazienti con peritonite secondaria destinati ad una relaparotomia programmata APACHE II è più affidabile nel prevedere la mortalità mentre il sistema di punteggio P-POSSUM è più affidabile nella previsione della complessiva durata della degenza intra-ospedaliera.

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