

# Septic shock patients admitted to the intensive care unit with higher SOFA score tend to have higher incidence of abdominal compartment syndrome – a preliminary analysis

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## Abstract

**Background:** Intra-abdominal hypertension (IAH) is relatively frequent in critical patients. According to the most recent consensus of the World Society of Abdominal Compartment Society (WSACS), there are no predictive factors for IAH diagnosis. Risk factors are the only motivators to date for early IAH diagnosis. Abdominal compartment syndrome (ACS) is defined as sustained intra-abdominal pressure (IAP) maintained above 20 mm Hg (> 3 kPa), with or without abdominal perfusion pressure below 60 mm Hg (< 8 kPa), associated with a new organ dysfunction. Sepsis is a recognized cause of secondary ACS, but to date there is no correlation with admission SOFA (sequential organ failure assessment) score and ACS onset incidence. The objective of the present study is to determine the profile of extra-abdominal septic shock patients with IAH/ACS admitted to the intensive care unit (ICU) and correlating with admission SOFA score. Better understanding of this population may bring to light clinical predictive factors for IAH/ACS early diagnosis.

**Methods:** In this observational study IAH/ACS incidence was correlated with SOFA score calculated at ICU admission. The study enrolled all critically ill patients more than 18 years old admitted to the Medical Intensive Care Unit (MICU) of a university teaching hospital between April and October 2016, who had been diagnosed with extra-abdominal septic shock, according to the Surviving Sepsis Campaign and SEPSIS-3.

**Results:** Twenty-five patients were evaluated during 10 hospitalization days. The average age was  $51.13 \pm 16.52$  years, and 64% of the patients were male. Most patients (76%) had pneumonia. On admission, the SOFA score was  $6.54 \pm 2.71$ . Mortality rate in the population studied was 52%. The incidence of IAH was 43.5%, while the incidence of ACS in the IAH population was 28%. SOFA admission score in patients with the diagnosis of ACS was of  $8.42 \pm 1.27$ . In this study SOFA score higher than 7 is correlated with IAH, with an accuracy of 68.8% ( $P < 0.03$ ).

**Conclusions:** The incidence of ACS in patients with extra-abdominal septic shock admitted to a university teaching hospital MICU was higher than those found in the literature. Higher admission and consecutive SOFA score of more than 7 was associated with higher ACS incidence and higher mortality rate.

**Key words:** intra-abdominal hypertension, diagnosis, septic shock, sepsis, intensive care unit.

Anestezjologia Intensywna Terapia  
2019; 51, 5: 377–379

Otrzymano: 02.05.2019,  
zaakceptowano: 30.06.2019

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Intra-abdominal hypertension (IAH) is relatively frequent in critically ill patients. According to the most recent consensus of the World Society of Abdominal Compartment Society (WSACS), there are no predictive factors for IAH diagnosis. To date, risk factors are the only indicators for early IAH diagnosis. Abdominal compartment syndrome (ACS) is defined as sustained intra-abdominal pressure (IAP) maintained above 20 mm Hg (> 3 kPa), with or without abdominal perfusion pressure below 60 mm Hg (< 8 kPa), associated with a new organ dysfunction. Sepsis is a recognized cause of secondary ACS, but to date there is no correlation with admission SOFA (sequential organ failure assessment) score and ACS onset incidence. IAH and ACS are most frequently studied in trauma victims or in patients submitted to abdominal surgery, with only a few studies concerning intensive care unit (ICU) patients with non-surgical pathologies [1]. The objective of the present study is to determine the profile of extra-abdominal septic shock patients with IAH/ACS admitted to the Medical Intensive Care Unit (MICU) in correlation with admission SOFA score. Better understanding of this population may bring to light the clinical predictive factors for early diagnosis and treatment of IAH/ACS [2]. The SOFA score is used to determine the stage of organ dysfunction and mortality risk in ICU patients. High SOFA score and sustained non-treated ACS may increase the mortality rate due to a persistent hypoperfusion state.

## METHODS

This is an institutional review board approved observational study (17031113.0.0000.5404), which enrolled all adult critically ill patients admitted to the university teaching hospital ICU between April and October 2016, diagnosed with septic shock according to the Surviving Sepsis Campaign and SEPSIS-3 criteria [3, 4]. Patients treated outside the ICU, those hospitalized for more than 48 hours before ICU admission, those with concomitant abdominal infections and patients without a Foley catheter were excluded. In addition, whenever during the study period the medical team decided to remove the urinary catheter, the patient was also excluded.

TABLE 1. Study inclusion criteria

A	Diagnosis of septic shock according to SEPSIS-3 and Surviving Sepsis criteria
B	Patients treated in the intensive care unit
C	Intensive care unit patients admitted from the emergency department (not transferred from another ward)
D	Absence of abdominal infections
E	Presence of urinary catheter
F	Patients 18 years of age or older

Patients who did not sign the informed consent form were excluded as well. IAP was measured according to the WSACS consensus at end-expiration, with the patient in the supine position and with the transducer zeroed at the level of the midaxillary line. Intra-abdominal pressure was measured at bedside with a pressure transducer (Abviser, ConvaTec), in order to avoid possible human bias at pressure measurement. IAP/ACS was managed according to the WSACS consensus [2]. SOFA score was measured daily in all enrolled patients.

Statistical analysis was performed with Microsoft Excel 2011.

## RESULTS

From a total of 201 patients admitted to the MICU during the study period, twenty-five patients were included in the study, of whom 16 were male (64%). The average age was  $51.4 \pm 16.52$  years, varying from 18 to 74 years. Pulmonary infection was the most common diagnosis ( $n = 19$  or 76%). Three patients presented with blood stream infection (12%), two patients with skin infection (8%), and one patient with icteric-hemorrhagic fever syndrome (4%). Admission SOFA score was  $6.54 \pm 2.71$ . Overall mortality rate was 52%.

Among all patients included in the study, ten developed intra-abdominal hypertension, resulting in 43.5% incidence. Seven of those (28%) developed abdominal compartment syndrome, and five out of seven died, with ACS-related mortality of 71.4%. Among those who evolved with ACS, five were male (71.4%), with average age of  $42.57 \pm 16.67$  years. Pneumonia was the diagnosis in four cases (57.1%); there was one case of blood stream infection (14.3%), and one case of icteric-hemorrhagic fever syndrome (14.3%). In patients with ACS, SOFA score at ICU admission was  $8.42 \pm 1.27$ . In this study SOFA score higher than 7 is correlated with IAH, with an accuracy of 68.8% ( $P < 0.03$ ). Figure 1 presents the ROC curve for the SOFA cut-off with the observed accuracy.

## DISCUSSION

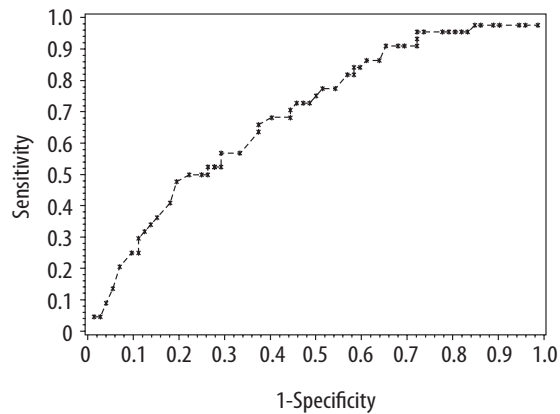
In 2004, the results of the first IAH multicentre epidemiological study conducted in a mixed population were published and revealed the occurrence of IAH in 58.8% of cases [5]. A few years later Reintam-Blaser *et al.* [6] investigated 563 mechanically ventilated ICU patients to determine the incidence of IAH development – the authors found out that IAH was present in 32.3% of patients, and 1.1% of them evolved to ACS [6].

In the present study, the data show IAH prevalence compatible with the world literature, with 43.5% of the patients developing intra-abdominal

hypertension. On the other hand, we found an incidence of 28% of ACS in the studied group. This result may be a consequence of the study selection criteria, inasmuch as the study was conducted in a single institution and excluded some of the ICU patients, including only those who were extremely ill.

The data obtained follow the trend in the world literature, which indicate that patients with higher SOFA scores benefit from IAP monitoring [7]. In the present study patients diagnosed with septic shock admitted with higher SOFA scores seem to have a higher tendency to develop ACS; however, studies with a larger population sample are needed to confirm this trend. The mortality rate herein was significantly high in patients with ACS. Five out of seven patients died. It is fair to mention that ACS was not the direct cause of death, but certainly it played an important role in this process. The awareness of the problem and early diagnosis of IAH/ACS are important so the medical team can treat these pathologies in an early phase and improve abdominal organs' perfusion as soon as possible. Elevated IAP and specifically an ACS-related decrease in perfusion rate, especially in critical condition, is an important factor for worsening prognosis and eventually can lead to an increase of the mortality rate. Current treatment of septic shock, besides antibiotics, is based on fluid therapy and vasopressors as treatment of a distributive hypoperfusion state. This modality by itself increases the risk of IAH/ACS development. In another words, septic shock patients with higher SOFA score, with already existing severe tissue hypoperfusion, may have higher mortality when associated with another hypoperfusion factor such as ACS. This correlation was observed herein. Considering the fact that admission SOFA score has an expected admission mortality rate of 21.5% to 33.3%, the authors of this study found a mortality rate as high as 52%, which may be correlated with associated ACS. Herein, SOFA score higher than 7 is correlated with IAH, with an accuracy of 68.8% ( $P < 0.03$ ). This statement by itself is a warning for clinicians not to forget to measure IAP in all critically ill extra-abdominal septic patients with a SOFA score higher than 7.

Despite the fact that there are no existing predictive factors for IAH diagnosis, except for the risk factors, new technologies are already being used in the management of IAH. Recently, a study demonstrated the usefulness of bedside ultrasound for the management of critically ill patients with elevated IAP [8]. Accordingly, we believe that soon new studies will demonstrate clinical, laboratory and respiratory parameters as possible predictors of IAH, which in view of the observed differences among the admission SOFA scores of patients who



**FIGURE 1.** ROC curve demonstrating SOFA score cut-off point > 7 with an accuracy of 68.8%

developed ACS would possibly be used in addition to other parameters.

## CONCLUSIONS

The incidence of ACS in patients with extra-abdominal septic shock admitted to the university teaching hospital MICU was higher than that found in the literature. Higher admission and consecutive SOFA score, with values higher than 7, were associated with higher ACS incidence and higher mortality rate.

## ACKNOWLEDGEMENTS

1. Financial support and sponsorship: none.
2. Conflict of interest: none.

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