Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.JournalofSurgicalResearch.com

# Validation of the anatomic severity score developed by the American Association for the Surgery of Trauma in small bowel obstruction

*Yaser M.K. Baghdadi, MD, MSc, David S. Morris, MD, Asad J. Choudhry, MBBS, Cornelius A. Thiels, DO, Mohammad A. Khasawneh, MBBS, Stephanie F. Polites, MD, Naeem Goussous, MD, Donald H. Jenkins, MD, and Martin D. Zielinski, MD**

*Division of Trauma, Critical Care, and General Surgery, Department of Surgery, Mayo Clinic, Rochester, Minnesota*

ARTICLE INFO

*Article history:*
Received 11 October 2015
Received in revised form
14 March 2016
Accepted 29 April 2016
Available online 10 May 2016

*Keywords:*
Small bowel obstruction
Standardized severity scoring system
Emergency general surgery, Outcomes
Acute care surgery

ABSTRACT

*Background:* The anatomic severity schema for small bowel obstruction (SBO) has been described by the American Association for the Surgery of Trauma (AAST). Although acknowledging the importance of physiological and comorbid parameters, these factors were not included in the developed system. Thus, we sought to validate the AAST-SBO scoring system and evaluate the effect of adding patient's physiology and comorbidity on the prediction for the proposed system.

*Methods:* Patients aged ≥18 y who were treated for SBO at our institution between 2009 and 2012 were identified. The physiology and comorbidity as well as the AAST anatomic scores were determined, squared, and added to calculate the score that we termed Acute General Emergency Surgical Severity-Small Bowel Obstruction (AGESS-SBO). The area under the receiver operating characteristic (AUROC) curve analyses were performed for the AAST anatomic score and compared with the AGESS-SBO score as a predictor for inhospital mortality, extended hospital stay, and inhospital complications.

*Results:* A total of 351 patients with mean age of 66 ± 17 years were identified, of whom 145 (41%) underwent operation to treat bowel obstruction. Extended hospital stay (>9 d) occurred in 86 patients (25%), inhospital complications in 73 (21%), and inhospital mortality in eight patients (2%). The median (interquartile range [IQR]) AAST anatomic score was 1 point (IQR: 1-2), physiology score was 0 point (IQR: 0-1), and comorbidity score was 1 point (IQR: 1-3); for overall median AGESS-SBO score of 5 points (IQR: 3-13). The AUROC curve analyses demonstrated that the AGESS-SBO system with measures of presenting physiology, comorbidities in addition to AAST anatomic criteria could be beneficial in predicting key outcomes including inhospital mortality (AUROC curve: 0.80 *versus* 0.54, $P = 0.03$).

*Conclusions:* The AAST anatomic score is a reliable system, which assists care providers to categorize SBO. Adding physiology and comorbidity parameters to the described anatomic criteria can be helpful in predicting the outcomes including mortality. Further studies

Presentation: Poster presentation, the 28th EAST (The Eastern Association for the Surgery of Trauma) Annual Scientific Assembly in Lake Buena Vista, Florida, January 13-17, 2015.

* *Corresponding author*. Division of Trauma, Critical Care and General Surgery, St. Mary's Hospital, Mayo Clinic, Mary Brigh 2-810, 1216 Second Street SW, Rochester, MN 55902. Tel.: +1507 255-2923; fax: +1507 255-9872.
E-mail address: zielinski.martin@mayo.edu (M.D. Zielinski).

0022-4804/$ – see front matter 
http://dx.doi.org/10.1016/j.jss.2016.04.076

evaluating its usefulness in research and quality improvement purposes across institutions are still required.



## Background

Small bowel obstruction (SBO) represents a significant health care burden in the United States.[1] Numerous studies have been performed in an attempt to standardize treatment protocols[2-7] but, due in part, to the high degree of variability in disease severity and presentation, as well as extreme heterogeneity in terminology and management paradigms, consensus regarding best practice has been elusive. The comparison of treatment protocols and the evaluation of their outcomes remain challenging. The presence of a systematic tool that incorporates anatomic factors in addition to measures of physiology and patient comorbid disease at presentation is critical. Without such a system, the ability to accurately measure outcomes to ensure optimized outcomes is limited.

To meet this need, the American Association for the Surgery of Trauma (AAST) proposed an anatomic severity scoring criteria for common emergency surgical conditions including SBO.[8,9] Specifically to SBO, a higher score is given to patients with strangulation obstructions and small bowel perforations. This scoring system, based on a consensus of expert opinion, requires validation before widespread implementation. In addition, although the authors of the AAST proposed severity scoring system acknowledged the importance of physiology and preexisting medical conditions in categorizing the severity of an acute care surgery illness, their system did not include the ability to do so.[10-12]

We aimed to validate the AAST-SBO anatomic severity scoring system. We additionally hypothesized that a developed scoring system, termed the Acute General Emergency Surgical Severity—Small Bowel Obstruction (AGESS-SBO), which adds measures of physiology and comorbidities to the existing AAST anatomic score, will support the prediction of mortality when compared with the anatomic score.

## Methods

Institutional review board approval was obtained for all aspects of the current investigation. The study cohort was identified from the medical record for adult patients (≥18 y) between 2009 and 2012 who were diagnosed with SBO. Patients presenting with obstructed hernia or SBO developed during immediate postoperative period (i.e., < 6 wk) were excluded.[13] At our institution, the Gastrografin Challenge protocol was introduced for the management of SBO disease in 2010.[14]

To test whether additional parameters would augment the AAST anatomic criteria, we used parameters obtained on admission for physiology[15] and comorbidities.[12] The AAST anatomic criteria were used to create a score on a scale of 0-5 points per their original intent (Table 1). At our institution, patients included in this study were treated for SBO and had abdomen and pelvic computed tomography (CT) imaging to establish the SBO diagnosis and guide their management (i.e., evaluating signs of strangulation, and features predicting the need of immediate operative exploration).[2,3] CT imaging was used to evaluate these anatomic criteria. We also created two additional scores based on physiology and comorbidities. The physiological score was based on standard definitions of Systemic Inflammatory Response Syndrome (SIRS): 0 point—normal physiology.

- One point (SIRS): systematic response to a clinical insult with presence of two or more of the following criteria at presentation: hyperthermia or hypothermia (temperature > 38°C or <36°C), tachycardia (>90 beats/min), tachypnea (>20 breaths/min or $PaCO_2$ <32 torr [<4.3 kPa]), and leukocytosis or leukopenia (high, >12,000 cells/$mm^3$; low, <4000 cells/$mm^3$; or presence of >10% of immature bands).
- Two points (sepsis): evidence of infection with the presence of SIRS.
- Three points (severe sepsis): sepsis concurrent with organ dysfunction, hypoperfusion, or hypotension (systolic blood pressure < 90 mm Hg).
- Four points (septic shock): sepsis in presence of hypoperfusion and/or hypotension unresponsive to fluid resuscitation.
- Five points (multiple organ dysfunction syndrome): the presence of two or more organ system dysfunction in the presence of sepsis.

The comorbidity score was created based on the Charlson comorbidity index,[12] also on a 0-5 scale. Comorbidities present at the index admission were abstracted from medical records and charts as well. The comorbidities included and the method of calculating Charlson comorbidity index had been described.[12,16] The resulted index was then scored as detailed in the following list:

- Zero point: index of 0 with no comorbidities.
- One point: index of 1 or 2.
- Two points: index of 3 or 4.
- Three points: index of 5 or 6.
- Four points: index of 7 or 8.
- Five points: index of ≥9.

The individual scores were each squared and added together to obtain the AGESS-SBO score. The lower and upper most possible ranges, therefore, sum between zero and 75 points (Table 1). This calculation was done to approximate the Injury Severity Score, a scoring system well known to acute care surgeons as developed by the AAST, and to place more emphasis on the individual component with the highest score. The study cohort was used to develop the system using logistic regression techniques and including the predictors of interest (anatomic, physiological, and comorbidity grades)