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Original Article

Santichatngam's Colonic Injury Prediction Score (SCOPES) for Decision Making in Colonic Injury Due to Trauma

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Abstract

Objective: Santichatngam's Colonic Injury PrEdiction Score (SCOPES), which was developed in 2017, can assist in surgical decision making for colonic injury, i.e., whether primary repair can be performed or diversion is needed. The aim of the present study was to demonstrate the validity and utility of SCOPES for appropriate surgical decision making in at least grade 3 colonic injury.

Patients and Methods: Medical records of patients with colonic injury who were treated at Maharat Nakhon Ratchasima Hospital from October 1st, 2013 to September 30th, 2019, were reviewed. Two versions of SCOPES were created. Both versions consisted of four factors. In SCOPES version I, if only 1 factor were present, then primary repair is recommended. In SCOPES version II, in the presence of at least 2 major factors, or 1 major factor plus at least 1 minor factor, then a diversion procedure is recommended. The SCOPES recommendation was compared to a reference standard, which was determined by successful operative management and peer review.

Result: The SCOPES version I has a sensitivity of 81%, specificity of 86%, positive likelihood ratio of 5.7, positive predictive value of 96%, and accuracy of 82% for primary repair. The SCOPES version II has a sensiti-vity of 43%, specificity of 100%, positive likelihood ratio over 10, positive predictive value of 100%, and accuracy of 90% for colonic diversion. Application of SCOPES was useful in decision making in 74% of patients.

Conclusions: The present study demonstrated that SCOPES has good validity and utility in terms of recommending appropriate management. The use of SCOPES in clinical practice may have some advantages over clinical judgment alone.

Keywords: Clinical prediction score, Colonic injury

Introduction

One of the most common abdominal injuries is colonic injury.[1-5] Recent scientific evidence supports routine primary repair for nondestructive colonic injury (AAST Colon Injury Scale Grade I-II) irrespective of the presence or absence of risk factors.[2,6-8] Colonic diversion is performed based on the principles of damage control surgery in hemodynamically unstable patients. However, many surgeons still consider colonic diversion as a safer procedure in most high-risk colonic injury.[9,10]

Santichatngam's Colonic Injury PrEdiction Score (SCOPES), which was developed in 2017, can assist in surgical decision making in colonic injury.[11] SCOPES can help decide whether primary repair or diversion

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procedure should be performed based on four factors: delayed time to surgery (greater than 6 hours); left sided colonic injury, gross fecal contamination, and presence of concomitant duodenal or ureteral injury. If at least 2 of these factors are present, colonic diversion is recommended. SCOPES (with a cut-off of at least 2 positive factors or score greater than 4.87) was shown to have a sensitivity of 88%, and specificity of 83% for predicting colonic diversion. The post-test probability of diversion for a positive SCOPES was 84% for the sample studied, and the post-test probability of diversion for a negative SCOPES was 12% for the same sample.[11]

Wattakawanch and Santichatgnam studied colonic injury patients of all severity at Maharat Nakhon Ratchasima Hospital from 2013 through 2017 (4 years), and found SCOPES to have low positive predictive value but high sensitivity, specificity, negative predictive value in predicting primary repair.[12] From multicenter studies and meta-analyses, routine diversion is not recommended.[5,13] The aim of the present study was to determine the validity and utility of SCOPES for appropriate surgical decision making in colonic injury.

Patients and Methods

In the present retrospective study, information from the medical records of patients who were diagnosed with colonic injury (ICD 10th ed.; S365), at Maharat Nakhon Ratchasima Hospital (MNRH) between October 1st, 2013 and September 30th, 2019 (6 years) was obtained. The study was approved by Ethical Committee of the MNRH. Patients were included if they were over 15 years and underwent exploratory laparotomy for abdominal trauma during the same admission with findings of colonic injury grade 3 or higher.[8] They were excluded if they underwent damage control surgery or if the injury was iatrogenic.

Information abstracted included baseline demographic data and clinical characteristics including type of injury, underlying diseases, time to operation, colonic injury score (CIS) according to the American college of surgeons (ACS),[8] degree of fecal contamination, sites of colonic injury, grade of duodenal or ureteral injury,[14-15] damage control surgery, details of operative procedure, and operative complications.

Patients were categorized into two groups according to initial operative management and postoperative complications. The first group included patients who were treated with primary repair (including primary closure of defects and/or resection with re-anastomosis) with no postoperative complications, i.e. anastomotic leakage or intraabdominal abscess. The second group included patients who were treated with primary repair but had postoperative complications and patients who were treated by diversion. The patient's condition and operative notes were reviewed by two certified trauma surgeons.

The peer review process with consensus agreement between both surgeons was used to establish the reference standard for decision-making in the present study: patients were categorized into proper or appropriate primary repair and diversion groups. Patients who had successful primary repair, by definition, had correctly underwent proper management. When both peer reviewers disagreed with the actual operative decision, the peer reviewers' opinion was considered more appropriate.

Two versions of SCOPES were created. SCOPES version I consisted of four risk factors: delayed time to surgery (i.e., greater than 6 hours); left sided colonic injury (grade 3 or higher); gross fecal contamination; and concomitant duodenal or ureteral injury (grade 3 or higher). If only one risk factor were present, primary repair is recommended. SCOPES version II consisted of the same four risk factors, but with an added hierarchy. Gross fecal contamination and concomitant duodenal or ureteral injury are considered major risk factors. Delayed time to surgery and left side colonic injury are considered minor risk factors. Colonic diversion is recommended in the presence of 2 major risk factors, or 1 major plus at least 1 minor factor.

Operative management as recommended by both versions of SCOPES was compared to the reference standard. The "accuracy" (agreement) indices of SCOPES were in terms of sensitivity, specificity, positive likelihood ratio and overall accuracy, with corresponding 95% confidence intervals (95% CI).

Results

From October 1st, 2013 to September 30th, 2019 (6 years), there were 250 patients who were diagnosed with colonic injury. Of these, 39 patients were deemed eligible for the study by the inclusion and exclusion criteria. Two of 32 patients in the actual primary repair group developed anastomotic leakage. Two of 7 patients in the actual diversion group developed intraabdominal collection (See Table 1).

Table 1 Clinical characteristics of patients (N = 39)

Characteristics	Summary
Age (years): mean (SD)	36.8 (16.0)
Sex (male : female): number (%)	4 (10) : 35 (90)
Underlying disease: number	
Hypertension	4
Diabetes mellitus	1
Chronic obstructive pulmonary disease	2
Human immunodeficiency virus infection	1
Colonic management: number (%)	
Primary repair	32 (82)
Diversion procedure	7 (18)

Peer review was done on 9 patients (7 in the actual diversion group and 2 in the actual primary repair group who had complications). Thus, the reference standard categories consisted of 32 appropriate primary repairs: 30 actual successful primary repairs and 1 actual repair with complications, along with 1 actual diversion in which peer review suggested primary repair; and 7 appropriate diversions: 6 actual diversions with 1 in which peer review suggested diversion in an actual primary repair with complications (See Table 2).

The accuracy indices for SCOPES version I were as follows. The sensitivity was 82% (95% CI: 63.6% to 92.8%); the specificity was 86% (95% CI: 42.1% to 99.6%); the positive likelihood ratio was 5.7 (95% CI: 0.92 to 35), which is a moderate effect; the positive predictive value was 96% (95% CI: 81.0% to 99.9%); and the accuracy 82% (95% CI: 66.5% to 92.5%) (See Table 3).

Table 2 Comparison between actual management of patients and peer review (N = 39)

		Actual Colonic management	
		Diversion procedure	Primary repair
Reference Standard (peer review)	Diversion procedure	6	1
	Primary repair	1	31

Table 3 SCOPES version I for primary repair (N = 39)

		Reference standard		Sensitivity (for primary repair)	Specificity (for primary repair)	Accuracy (for primary repair)	Positive predictive value	LR+
		Diversion	Primary repair					
SCOPES version I	Diversion Procedure	6	6	81%	86%	82%	96%	5.7 (moderate effect)
	Primary repair	1	26					

LR+: positive likelihood ratio

The accuracy indices for SCOPES version II were as follows. The sensitivity was 43% (95% CI: 9.89% to 81.6%); the specificity was 100% (95% CI: 89.1% to 100%); the positive likelihood ratio was greater than 10 (i.e., not calculable due to 0 value in one cell); the positive predictive value was 100% (95% CI: 29.2% to 100%); and the accuracy 90% (95% CI: 75.8% to 97.1%). (See Table 4).

Both versions may potentially help surgeon make appropriate decisions in 74% of all patients (95% CI: 57.9% to 87.0%). This was the proportion of patients with only one factor present, or those with 2 or more major factors or with 1 major factor and at least 1 minor factor. The remaining 26% of patients were those with exactly 2 minor factors, in whom the decision to perform primary repair or colonic diversion may both be appropriate.

Table 4 SCOPES version II for diversion procedure (N = 39)

		Reference standard		Sensitivity (for diversion)	Specificity (for diversion)	Accuracy (for diversion)	Positive predictive value	LR+
		Diversion	Primary repair					
SCOPES version II	Diversion Procedure	3	0	43%	100%	90%	100%	> 10 (strong effect)
	Primary repair	4	32					

LR+: positive likelihood ratio

Discussion

The aim of the present study was to present accuracy indices (i.e., the agreement with peer-reviewed decisions) of SCOPES to aid in decision making in the treatment of patients with colonic injury due to trauma. Currently, meta-analyses and multicenter studies do not recommend routine diversion.[5,13,14,16-20] Colonic injuries are often managed on an individual-patient basis, with a wide variation in results, which may be due to the absence of management guidelines.[21] If these injuries are not treated appropriately, severe complications and even death can occur.

Controversy exists regarding the standard treatment for colonic injury in trauma.[20] SCOPES version I consisted of four factors: delayed time to surgery (greater than 6 hours), left sided colonic injury (grade 3 or more), gross fecal contamination, and concomitant duodenal or ureteral injury (grade 3 or more). If only one factor is present, primary repair is recommended. In the present study, SCOPES version I using this criterion had a sensitivity of 81%, specificity 86% for (peer-reviewed) primary repair, and a positive likelihood ratio of 5.7, which is a moderate increase in the likelihood of primary repair. The probability of an appropriate decision for primary repair for SCOPES version I when only one factor is present was 96%. Decision making using SCOPES version I was consistent with previous studies.[5,13,14,16]

SCOPES version II consisted of the same four factors as in SCOPES I, but delayed time to surgery and left sided colonic injury were considered minor factors, while gross fecal contamination and concomitant duodenal or ureteral injury were considered major factors. In the presence of 2 major factors or 1 major factor plus at least 1 minor factor, colonic diversion is recommended. SCOPES version II using these criteria had high specificity (100%), and possibly high positive likelihood ratio for the appropriate decision to perform colonic diversion. The probability of appropriate decision to perform colonic diversion using the SCOPES II criteria was 100%. Decision making using SCOPES II was also consistent with previous studies.[1,5,17-20]

Thus, SCOPES version I may assist in the decision to perform primary colonic repair, whereas SCOPES version II may assist in the decision to perform diversion procedures. Both versions may assist in correct decision making in 74% of all patients. However, 26% of patients will not be covered by both versions of SCOPES (i.e., those with 2 minor factors). Surgeons need to make their

own decisions by themselves in this situation, which is consistent with current recommendations.[14,21-22] SCOPES versions I and II are valid and possibly a useful and reliable tool for decision making in colonic injury due to trauma, perhaps more so than using clinical judgment alone.

Conclusion

SCOPES versions I and II are expected to help surgeons make appropriate surgical decisions in colonic injury due to trauma. The present study also recommends that routine colostomy should not be performed.

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บทคัดย่อ

Santichatngam's Colonic Injury Prediction Scores เพื่อช่วยตัดสินใจรักษาการบาดเจ็บของลำไส้ใหญ่

ปริญญา สันติชาติงาม, พบ.

กลุ่มงานศัลยกรรม โรงพยาบาลมหาราชนครราชสีมา จังหวัดนครราชสีมา

ความเป็นมา: ภาวะการบาดเจ็บของลำไส้ใหญ่พบได้บ่อย การศึกษาในปัจจุบันไม่แนะนำให้ผ่าตัด routine colostomy การศึกษาของปริญญา สันติชาติงาม เผยแพร่ในปี 2560 ใช้ Santichatngam's Colonic Injury PrEdiction Score (SCOPES) ช่วยในการตัดสินใจในการผ่าตัดรักษา primary repair หรือ diversion การศึกษาต่อมาพบว่า SCOPES มี positive predictive value ต่ำ แต่มี sensitivity, specificity และ negative predictive value สูงในการแนะนำผ่าตัด primary repair วัตถุประสงค์ของการศึกษานี้มีขึ้นเพื่อศึกษาประโยชน์ของการใช้ SCOPES ทั้ง versions I และ II สำหรับผู้ป่วยที่มีการบาดเจ็บของลำไส้ใหญ่เกรด 3 หรือมากกว่า

วิธีการศึกษา: ศึกษาย้อนหลังในผู้ป่วยที่ได้รับการรักษาที่โรงพยาบาลมหาราชนครราชสีมา ช่วงเวลา 1 ตุลาคม 2556 ถึง 30 กันยายน 2562 โดยนำ SCOPES ทั้ง 2 versions มาวิเคราะห์ ซึ่งพิจารณาจากปัจจัย 4 ประการ สำหรับ SCOPES version I หากพบว่ามีเพียง 1 ปัจจัย จะแนะนำ primary repair สำหรับ SCOPES versions II ถ้าพบว่ามีมากกว่า 1 major factor หรือพบ 1 major factor ร่วมกับ 1 minor factor หรือมากกว่า จะแนะนำผ่าตัด diversion

ผลการศึกษา: สำหรับ SCOPES version I มีค่าความไว 81%, ความจำเพาะ 86%, positive likelihood ratio 5.7, positive predictive value 96%, ความแม่นยำ 82% สำหรับการผ่าตัด primary repair ส่วน SCOPES version II มีค่าความไว 43%, ความจำเพาะ 100%, positive likelihood ratio มากกว่า 10, positive predictive value 100%, ความแม่นยำ 90% สำหรับผ่าตัด diversion การใช้ SCOPES อาจช่วยตัดสินใจในการรักษาผู้ป่วยบาดเจ็บลำไส้ใหญ่ได้ถึง 74%

สรุปผลการศึกษา: ผลการศึกษานี้แสดงให้เห็นว่า SCOPES อาจเหมาะสมและได้ประโยชน์ สำหรับนำไปใช้ประกอบการตัดสินใจผ่าตัดการบาดเจ็บลำไส้ใหญ่ โดยอาจมีข้อดีเหนือกว่าการใช้วิจารณญาณทางคลินิกเพียงอย่างเดียว