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GAVIN PUBLISHERS

Journal of Surgery

Sugihara H, et al. J Surg: JSUR-1149.

Research Article

DOI: 10.29011/2575-9760. 001149

Preoperative Clinical Factor of Small Intestinal Necrosis Caused by Intestinal Strangulation

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Citation: Sugihara H, Miyanari N, Haga Y, Kinoshita S, Hara Y, et al. (2018 Preoperative Clinical Factor of Small Intestinal Necrosis Caused by Intestinal Strangulation. J Surg: JSUR-1149. DOI: 10.29011/2575-9760. 001149

Received Date: 22 June, 2018; **Accepted Date:** 03 July, 2018; **Published Date:** 09 July, 2018

Abstract

Background: Intestinal necrosis induced by strangulation is life-threatening, thus it is important to do operation before leading to intestinal necrosis. The purpose of this study is to find preoperative clinical factor whether intestinal resection is needed in patients of intestinal strangulation.

Methods: 184 patients diagnosed with intestinal strangulation during operation were focused from April 2008 to March 2016. Among 184 patients, 98 patients were resected intestine and 86 patients were not resected. Preoperative clinical factors for Resection Group (RG) and Non-Resection Group (NRG) were compared retrospectively.

Results: In univariate analysis, patients in RG were older and had higher proportion of female, Systemic Inflammatory Response Syndrome (SIRS), severe American Society of Anesthesiologists (ASA), White Blood Cell (WBC), C-Reactive Protein (CRP), Base Excess (BE), Lactate, and closed loop on computed tomography. In a logistic regression analysis age, sex, BE, Lactate, closed loop was identified significant factors. Each of these variables was assigned a score of 1, except for close loop which was scored 2. The Receiver Operating Characteristic (ROC) curve analysis of the score revealed a great discriminatory ability for the system (AUC: 0.821).

Conclusion: We identified an independent risk factor for intestinal resection in patients of intestinal strangulation. The scoring system is very simple and might be planning surgical procedure and postoperative care in patients with intestinal strangulation.

Keywords: Intestinal Necrosis; Intestinal Strangulation; The Scoring System

Introduction

Intestinal strangulation is an intestinal obstruction associated with ischemia of the intestinal tract. Previous studies reported that clinical signs, laboratory findings, CT finding, and a combination of these parameters are important factors to distinguish intestinal strangulation or simple small bowel obstruction [1-3]. But it is difficult to detect intestinal strangulation at the beginning. Furthermore, the ischemic intestine became necrosis, thus it is an indication for emergency operation because it would become fatal if it develops from perforation to peritonitis [4]. Upregulation of lactate was reported as a good predictive factor for bowel strangulation and associated with intestinal ischemia using mouse model [5,6]. Nonetheless, surgeons often have trouble in distinguishing ischemia of the intestine from an intestinal necrosis before operation. Thus, we conducted this study to find preoperative clinical factors whether the intestinal resection is needed and to find the new prediction model for the intestinal necrosis.

Patients and Methods

Between April 2008 and March 2016, 315 patients underwent due to Small Bowel Obstruction (SBO) operation at

the Department of Surgery, Kumamoto Medical Center. Among these, 131 patients were diagnosed as adhesive SBO, 184 patients diagnosed as intestinal strangulation. Among 184 patients of intestinal strangulation, 98 patients needed to resect intestine, 86 patients did not need resection. All patients resected intestine were proved intestinal necrosis at a pathological diagnosis. Data was collected immediately after arriving at the Emergency room or the Surgery outpatient clinic. Recorded variables: age, sex, time between the onset of symptoms and arrival at the first visit, vital signs (systolic and diastolic arterial blood pressures, heart rate, breathing rate, and body temperature), symptoms and physical examination findings, laboratory findings, imaging features, types of management, time between arrival and operation, operative findings, etiology of obstruction, incidence and causes of bowel ischemia, necrosis, and perforation, hospital stay. The associations between the clinical factors and the intestinal necrosis were retrospectively analyzed in the development dataset.

Statistical Analysis

Categorical variables between the groups were analyzed by the Chi-square test. The Mann-Whitney U test was used to test continuous variables. A stepwise regression analysis was performed with factors found to be significantly associated with the intestinal necrosis based on the univariate analysis results. For statistical analyses, we used the JMP (Version 10, SAS Institute) and SAS software programs (Version 10, SAS Institute). A two-tailed P value of < 0.05 was considered statistically significant.

Results

During the study period, a total of 184 patients with intestinal strangulation underwent emergency operation. Among these, 98 patients were resected the intestine (resection group; RG), 86 patients were not resected (non-resection group; NRG). The characteristics of study populations are summarized in (Table 1).

	RG n = 98	NRG n = 86	P value
Age (years)	77.7 ± 12.2	72.2 ± 13.6	<0.01
Sex (Male : Female)	35 / 63	48 / 38	<0.01
Surgical history(Yes/No)	63 / 35	65 / 21	0.10
Body mass index	20 ± 3	21 ± 3	0.06
Time to operation(hours)	24.2 ± 30.0	23.7 ± 21.1	0.90
Temperature (degree)	36.6 ± 0.8	36.7 ± 0.7	0.36
Systolic blood pressure(mmHg)	137 ± 33	136 ± 25	0.70
Pulse（bpm）	89 ± 24	83 ± 18	0.09
Respiration rate(rate/min)	23 ± 6	21 ± 5	0.09
SIRS (Yes/No)	47 / 51	22 / 64	<0.01
ASA (I/ II / III-IV)	2 / 45/ 51	5 / 51/ 30	<0.05

Table 1: Characteristics of study populations: The characteristics of both resection group (RG) and Non-Resection Group (NRG) are summarized.

The average age of the patients was older in RG than in NRG (77.7 years vs 72.2 years p<0.01). Female was more compared with male in RG than in NRG (p<0.01). The surgical history and the time to operation were not associated with the intestinal necrosis. The proportion of patients in SIRS and severe ASA was higher in RG than in NRG (P<0.01, p<0.05, respectively). The examination findings and the surgical findings are shown in (Table 2).

	RG n = 98	NRG n = 86	P value
WBC (x10^2/ul)	120 ± 55	103 ± 44	<0.05
CRP (mg/dl)	4.7 ± 7.5	1.5 ± 3.0	<0.001
LDH (IU/l)	248 ± 82	220 ± 47	<0.01
CK (IU/l)	176 ± 316	97 ± 87	<0.05
BE	-1.1 ± 5.3	0.8 ± 4.2	<0.05
Lactate	3.3 ± 2.5	1.9 ± 1.5	<0.001
Ascites (Yes/No)	84 / 14	64 / 22	0.06
closed loop (Yes/No)	76 / 22	33 / 53	<0.001
Operation time (min)	98 ± 28	76 ± 36	<0.001
Bleeding (gram)	88 ± 153	49 ± 127	0.06

Table 2: Examination findings and Surgical findings: The examination findings and the surgical findings are shown.

WBC, CRP, LDH, and CK in peripheral blood were higher in RG than in NRG ($p<0.05$, $p<0.001$, $p<0.05$, respectively). Base Excess was lower, and Lactate was higher in arterial blood gas ($p<0.05$, $p<0.001$, respectively). The proportion of closed loop intestine in CT examination was higher in RG than in NRG. Operation time was longer in RG than in NRG ($p<0.001$). Univariate analysis and multivariate analysis of preoperative data in RG compared with that in NRG is shown in (Table 3).

	Univariate analysis			Multivariate analysis		
	P value	OR	95% CI	P value	OR	95% CI
Age (71≧)	<0.001	3.5	1.8 ~ 6.8	<0.05	2.6	1.1 ~ 6.7
Sex (Female)	<0.01	2.3	1.3 ~ 4.1	<0.05	2.2	1.0 ~ 5.0
SIRS (Yes)	<0.01	2.7	1.4 ~ 5.0	0.68	1.2	0.5 ~ 3.4
ASA (III-IV)	<0.05	2.0	1.1 ~ 3.7	0.86	1.1	0.5 ~ 2.6
WBC (≦40x10^2/ul or 120x10^2/ul≧)	<0.001	3.4	1.9 ~ 6.4	0.05	2.7	1.0 ~ 7.6
CRP (0.4mg/dl≧)	<0.01	2.3	1.3 ~ 4.1	0.07	2.1	1.0 ~ 4.6
LDH (220IU/l≧)	0.11	1.6	0.9 ~ 2.9			
CK (85IU/l≧)	0.52	1.2	0.7 ~ 2.2			
BE (-0.6≦)	<0.001	3.3	1.7 ~ 6.2	<0.05	2.4	1.0 ~ 6.0
Lactate (1.8 ≧)	<0.001	4.2	2.2 ~ 7.8	<0.05	3.4	1.1 ~ 6.3
closed loop (Yes)	<0.001	5.5	2.9 ~ 10.6	<0.001	6.3	2.8 ~ 15.1

Table 3: Univariate and Multivariate analysis: Univariate analysis and multivariate analysis of preoperative data in RG compared with that in NRG is shown.

The significant factors were age, sex, SIRS, ASA, WBC, CRP, BE, Lactate, closed loop in univariate analysis. Furthermore, the significant factors were age, sex, BE, Lactate, closed loop in multivariate analysis. Based on a logistic regression analysis, the following five variables were selected: age (over 71 years), female, BE (under 0.3), Lactate (over 1.8), closed loop. Each of these variables was assigned a score of 1, except for close loop which was scored 2 to obtain a total of 6 according to the odds ratio (Table 4).

Score	1	2
Age	71≧	
Sex	Female	
BE	-0.6≦	
Lactate	1.8 ≧	
Closed loop		Yes

Score	RG n = 98	NRG n = 86
0	1	5
1	1	21
2	11	26
3	18	14
4	23	15
5	23	5
6	21	0

Table 4: Risk score for intestinal resection and Scattering in accord with Prediction scoring system. A) The Prediction Scoring (PS) system for intestinal resection in intestinal strangulation was shown. The score was distributed for each of these variables: age (over 71 years), 1; female, 1; BE (under 0.3), 1; Lactate (over 1.8), 1; closed loop, 2; **B)** The scattering was shown by total points which each score was added up.

Scattering in accord with the prediction scoring system is shown Table4, and the patients with higher points in this system tend to be resected the intestine. The prediction scoring system for intestinal resection in intestinal strangulation was demonstrated based on a stepwise regression analysis. The Receiver Operating Characteristic (ROC) curve analysis revealed a great discriminatory ability for the system (AUC: 0.821) (Figure1).

Figure1. ROC curve for Prediction scoring system

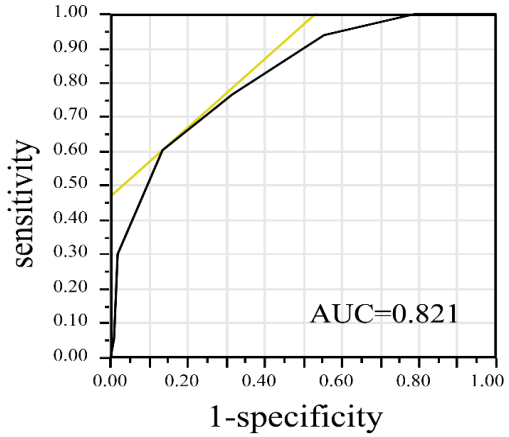

Figure 1: The Receiver Operating Characteristic (ROC) curve analysis was shown and revealed a great discriminatory ability for the PS system (AUC: 0.821)

Discussion

Intestinal strangulation is defined as ischemia of intestinal tract due to SBO. It was regarded as an indication for an emergency surgical treatment. If the ischemic intestine was left without operation, the intestine became necrosis, leading to perforation and peritonitis [4]. Therefore, it is important to diagnose it as soon as possible before intestinal necrosis. Various clinical data vary if the intestine occurred intestinal strangulation. LDH, CK, and lactate elevates due to hypoperfusion of the intestinal tissue after progression to ischemia [7]. Especially, increase of lactate was reported as a good predictive factor for bowel strangulation and associated with intestinal ischemia using mouse model [5,6]. On the other hand, there were not different WBC and CRP levels between patients with conservative management and those with surgical treatment, thus WBC and CRP may not be useful to detect bowel ischemia [8-10].

Past studies reported the utility of CT to make a diagnosis of small bowel obstruction [11,12]. In contrast it is difficult to find small bowel ischemia by CT with sensitivities ranging from 75% to 100% and specificities from 61% to 93% [13,14]**.** It is insufficient to make a diagnosis with intestinal necrosis by single examination, and we should use a combination of various examination which is simple and minimal as much as possible. The current study demonstrated that the various clinical factors were related with intestinal necrosis in intestinal strangulation, and using five factors (age, sex, BE, Lactate, and closed loop) the new prediction scoring system for the intestinal necrosis was constructed. The ROC curve analysis revealed a great discriminatory ability for the system (AUC: 0.821). The system is very simple because of using just data of arterial blood gas and CT, and reliable to detect intestinal necrosis in patients of intestinal strangulation. There are some problems associated with this study. This study was done by single institution and a retrospective analysis, therefore it is necessary to validate the results at multiple institutions in prospective manner.

Conclusion

The current study suggests that the system may help to diagnose an intestinal necrosis.

References

1. Miyauchi T, Kuroda T, Nisioka M, Hashimoto T, Kasamatu T, et al. (2001) Clinical study of strangulation obstruction of the small bowel. The journal of medical investigation : JMI 48: 66-72.

2. Zielinski MD, Eiken PW, Bannon MP, Heller SF, Lohse CM, et al. (2010) Small bowel obstruction-who needs an operation? A multivariate prediction model. World journal of surgery 34: 910-919.

3. Ohira G, Shuto K, Kono T, Tohma T, Gunji H, et al. (2012) Utility of arterial phase of dynamic CT for detection of intestinal ischemia associated with strangulation ileus. World journal of radiology 4: 450-454.

4. Bizer LS, Liebling RW, Delany HM, Gliedman ML (1981) Small bowel obstruction: the role of nonoperative treatment in simple intestinal obstruction and predictive criteria for strangulation obstruction. Surgery 89: 407-413.

5. Tanaka K, Hanyu N, Iida T, Watanabe A, Kawano S, et al. (2012) Lactate levels in the detection of preoperative bowel strangulation. The American surgeon 78: 86-88.

6. Tanaka K, Hashimoto H, Ohki T (2015) Lactate levels in bowel strangulation with experimental animal model. International surgery 100: 240-243.

7. Ciemniewski Z, Zajac T, Wozniak-Skowerska I, Trusz-Gluza M, Giec L (1991) [The importance of the autonomic nervous system for sinus and atrioventricular node function in patients with sick sinus syndrome]. Kardiologia polska 34: 335-341.

8. Block T, Nilsson TK, Bjorck M, Acosta S (2008) Diagnostic accuracy of plasma biomarkers for intestinal ischaemia. Scandinavian journal of clinical and laboratory investigation 68: 242-248.

9. MacVittie TJ, Monroy R, Vigneulle RM, Zeman GH, Jackson WE (1991) The relative biological effectiveness of mixed fission-neutron-gamma radiation on the hematopoietic syndrome in the canine: effect of therapy on survival. Radiation research 128: S29-36.

10. Kanda T, Tsukahara A, Ueki K, Sakai Y, Tani T, et al. (2011) Diagnosis of ischemic small bowel disease by measurement of serum intestinal fatty acid-binding protein in patients with acute abdomen: a multicenter, observer-blinded validation study. Journal of gastroenterology 46: 492-500.

11. Balthazar EJ, Birnbaum BA, Megibow AJ, Gordon RB, Whelan CA, et al. (1992) Closed-loop and strangulating intestinal obstruction: CT signs. Radiology 185: 769-775.

12. Maglinte DD, Howard TJ, Lillemoe KD, Sandrasegaran K, Rex DK (2008) Small-bowel obstruction: state-of-the-art imaging and its role in clinical management. Clinical gastroenterology and hepatology : the official clinical practice journal of the American Gastroenterological Association 6: 130-139.

13. Ha HK, Kim JS, Lee MS, Lee HJ, Jeong YK, et al. (1997) Differentiation of simple and strangulated small-bowel obstructions: usefulness of known CT criteria. Radiology 204: 507-512.

14. Balthazar EJ, Liebeskind ME, Macari M (1997) Intestinal ischemia in patients in whom small bowel obstruction is suspected: evaluation of accuracy, limitations, and clinical implications of CT in diagnosis. Radiology 205: 519-522.