Original Research

Clinical value of the neutrophil/lymphocyte ratio in diagnosing adult strangulated inguinal hernia

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HIGHLIGHTS

- This research is the first research on diagnosing strangulated inguinal hernia.
- The cutoff point generated in this study may be of future benefit in stratifying incarcerated inguinal hernia patients.
- Use of neutrophil/lymphocyte ratio in clinical diagnosis may improve the prognosis of patients with strangulated inguinal hernia.

ARTICLE INFO

ABSTRACT

Background: Diagnosis of incarcerated inguinal hernia (IIH) is not difficult, but currently, there are no diagnostic criteria that can be used to differentiate it from strangulated inguinal hernia (SIH). This research aimed to evaluate the clinical value of the neutrophil/lymphocyte ratio (NLR) in diagnosing SIH.
Methods: We retrospectively analyzed 263 patients with IIH who had undergone emergency operation. The patients were divided into two groups according to IIH severity: group A, patients with pure IIH validated during operation as having no bowel ischemia; group B, patients with SIH validated during operation as having obvious bowel ischemia, including bowel necrosis. We statistically evaluated the relation between several clinical features and SIH. The accuracy of different indices was then evaluated and compared using receiver operating characteristic (ROC) curve analyses, and the corresponding cutoff values were calculated.
Result: Univariate analysis showed eight clinical features that were significantly different between the two groups. They were then subjected to multivariate analysis, which showed that the NLR, type of hernia, and incarcerated organ were significantly related to SIH. ROC curve analysis showed that the NLR had the largest area under the ROC curve.
Conclusion: Among the different clinical features, the NLR appears to be the best index in diagnosing SIH.

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1. Introduction

Inguinal hernia is a common clinical condition, especially among the elderly, and surgery remains the only treatment option [1,2]. Incarcerated inguinal hernia (IIH) is one of the most frequent acute abdomen disorders, and most patients with IIH need emergency operation. If timely treatment is not administered, the bowel may become strangulated, which can lead to possible complications such as bowel necrosis, perforation, and secondary peritonitis and which can be life-threatening in extreme cases. Strangulated inguinal hernia (SIH) is the second most common cause of bowel obstruction and the primary cause in patients with intestinal obstruction with no history of laparotomy [3,4]. Early diagnosis and surgery are the most important factors that improve IIH prognosis, especially for SIH, and thus reduce risk of bowel resection [4,5]. If some hospitals are unable to conduct emergency operations, manual reduction can be tried in patients with IIH who do not have bowel strangulation. Currently, without a definite standard, the differential diagnosis of IIH and SIH depends on incarceration time, symptoms, abdominal signs, and surgical experience [6]. We performed this retrospective study to evaluate the relationship of different indices with SIH and thus determine which clinical index can be used in diagnosing SIH.

2. Methods

2.1. Patient selection

We retrospectively evaluated the data of 311 patients with IIH who presented to the emergency surgical department of our hospital from January 2009 to March 2016. Patients with inadequate information (18), those whose bowel was not the incarcerated organ (26), and those with other complications found during operation (4) were excluded. A total of 263 patients were finally included in this research. Incarceration was defined as irreducibility of a hernia, and a strangulated hernia was defined as an irreducible hernia with objective signs of ischemia or gangrene.

2.2. Data collection and analysis

Patients were divided into two groups (group A, patients with pure IIH validated during operation as having no bowel ischemia; group B, patients with SIH validated during operation as having obvious bowel ischemia, including bowel necrosis), and we analyzed the receiver operating characteristic (ROC) curve to determine the cutoff values for different indices including age, body mass index (BMI), white blood cell (WBC) count, neutrophils, temperature, neutrophil/lymphocyte ratio (NLR), platelet, and prothrombin time. Patient body temperature was measured using an ear thermometer. The best cutoff value was determined according to the Youden index [7]. The area under the ROC curve (AUC) for each clinical feature was calculated, and the clinical features with the largest AUCs had the highest value.

ROC curve analysis showed that the optimal preoperative NLR cutoff value was 6.41, and the corresponding best sensitivity and specificity values were 0.75 and 0.69, respectively. Hence, we determined that the preoperative NLR cutoff value was 6.5. The cutoff values of the other clinical features were calculated in the same manner. Univariate analysis tested the relation between SIH and clinical features such as temperature ($\leq37°C/>37$ °C), age ($\leq75/>75$ years), BMI ($\leq21/>21$ kg/m^2), sex (female/male), WBC count ($\leq10 \times 10^3/>10 \times 10^3$/mm^3), neutrophils ($\leq8 \times 10^3/$ $>8 \times 10^3$/mm^3), platelet count ($\leq150/>150 \times 10^9$/L), NLR ($\leq6.5/$ >6.5), prothrombin time ($\leq13.5/>13.5$ s), history of previous laparotomy (present/absent), ileus (present/absent), hernia side (left/right), type of hernia (indirect/femoral), and incarcerated organ (small bowel/colon). The clinical features with $P < 0.05$ in univariate analysis were subjected to multivariate analysis to further discriminate the factors related to SIH.

2.3. Statistical analysis

All statistical data were analyzed with the SPSS statistical software (version 21.0; SPSS, Chicago, IL, USA), with the result expressed in median and interquartile range. Intergroup differences were analyzed using the Mann-Whitney U test and χ^2 test. Odds ratios (ORs) and 95% confidence intervals (CIs) were obtained through univariate or multivariate logistic regression test. A P value < 0.05 was regarded as statistically significant.

3. Results

A total of 263 patients were included in this research, with 201 men and 62 women. Group A included 128 IIH patients and group B included 135 SIH patients (76 patients without bowel necrosis and 59 patients with bowel necrosis and undergoing partial enterectomy). The surgical technique utilized for hernioplasty was mesh repair for patients without bowel resection and Bassini or McVay procedure in patients operated emergently with bowel resection.

Patients undergoing partial enterectomy account for 22.4% of all patients. The two groups of patients significantly differed in terms of temperature, WBC count, neutrophils, NLR, prothrombin time, ileus, type of hernia, and incarcerated organ (Table 1).

The continuous variables of the two groups were compared and showed significant differences in terms of WBC count, neutrophils, NLR, and prothrombin time (Table 2).

The univariate analysis showed that temperature, WBC count, neutrophils, NLR, prothrombin time, ileus, type of hernia, and incarcerated organ were associated with SIH (Table 3).

The multivariate analysis showed that NLR, type of hernia, and incarcerated organ were closely related to SIH (Table 4).

The AUC of the NLR was the highest among the three inflammatory markers (NLR, 0.778; WBC, 0.692; neutrophils, 0.724). The sensitivities and specificities of the NLR, WBC, and neutrophils were 75% and 68.9%, 65.2% and 68%, 65.9% and 71.1%, respectively (Fig. 1).

4. Discussion

Inguinal hernia is formed by the extrusion of the viscera in the

Table 1
Clinical features of the patients with incarcerated inguinal hernia (group A) vs. those with strangulated inguinal hernia (group B).

Variable	Group A ($n = 128$)	Group B ($n = 135$)	P value
Age (years)			
≤75	86	78	0.115
>75	42	57	
Sex			
Male	102	99	0.225
Female	26	36	
Temperature (°C)			
≤37	100	89	**0.028**
>37	28	46	
BMI (kg/m^2)			
≤21	49	54	0.555
>21	75	71	
Undetermined	4	10	
WBC count ($\times 10^3$/mm^3)			
≤10	92	59	**<0.001**
>10	36	76	
Neutrophils ($\times10^3$/mm^3)			
≤8	92	51	**<0.001**
>8	36	84	
NLR			
≤6.5	89	34	**<0.001**
>6.5	39	101	
Platelet count ($\times10^3$/mm^3)			
≤150	35	32	0.498
>150	93	103	
Prothrombin time (s)			
≤13.5	74	56	**0.01**
>13.5	52	75	
Undetermined	2	4	
History of previous laparotomy			
Present	39	34	0.339
Absent	89	101	
Ileus			
Present	36	62	**0.003**
Absent	92	73	
Hernia side			
Left	54	49	0.328
Right	74	86	
Type of hernia			
Indirect	99	87	**0.012**
Femoral	24	46	
Direct	5	2	
Incarcerated organ			
Small bowel	104	125	**0.006**
Colon	24	10	

χ^2 test. P values < 0.05 are in bold.
BMI, body mass index; WBC, white blood cell; NLR, neutrophil/lymphocyte ratio.