DOI: 10.4274/terh.galenos.2022.82473
J Tepecik Educ Res Hosp 2022;32(1):142-6

CLINICAL RESEARCH / KLİNİK ARAŞTIRMA

Predicting Resection in Incarcerated Hernia with Simple Markers

İnkarsere Fıtıklarda Rezeksiyonu Basit Belirteçlerle Öngörme

Mehmet Üstün, Göksever Akpınar

University of Health Sciences Turkey, İzmir Tepecik Education and Research Hospital, Clinic of General Surgery, İzmir, Turkey

Cite as: Üstün M, Akpınar G. Predicting Resection in Incarcerated Hernia with Simple Markers. J Tepecik Educ Res Hosp 2022;32(1):142-6

Abstract

Objective: This study analyzes the resection prediction power of simple markers derived from complete blood count and blood chemistry.

Methods: Data from 196 patients who underwent emergency surgery for incarcerated hernia between the January 2013 and the December 2018 were retrospectively analyzed. The patients with femoral hernia (n=19) were further excluded from the statistical analysis to prevent the interference of hernia type on resection decision. The patients were divided into two groups according to their resection status.

Results: Demographic data were similar in both groups. The calculated cut-off value for neutrophil/lymphocyte ratio (NLR) was 5.8175 with sensitivity of 83.7% and specificity of 51.2 NLR was found to have the strongest predictive value with (Odds ratio=5.38 and p-value=0.001).

Conclusion: Elevated NLR level can be used as a predictive biomarker to predict the need for resection in incarcerated abdominal wall hernias.

Keywords: Hernia, surgery, resection, lymphocyte, neutrophil

Öz

Amaç: Bu çalışma, tam kan sayımı ve kan biyokimyasından elde edilen basit belirteçlerin rezeksiyon tahmin gücünü analiz etmeyi amaçlamaktadır.

Yöntem: Ocak 2013 ile Aralık 2018 arasında inkarsere fıtık nedeniyle acil ameliyat edilen 196 hastanın verileri geriye dönük olarak analiz edildi. Femoral fıtığı olan hastalar (n=19) ayrıca fıtık tipinin rezeksiyon kararına müdahalesini önlemek için istatistiksel analize dahil edilmedi. Hastalar rezeksiyon durumlarına göre iki gruba ayrıldı.

Bulgular: Demografik veriler her iki grupta da benzerdi. Nötrofil/lenfosit oranı (NLO) için hesaplanan cutoff değeri 5,8175, duyarlılık %83,7 idi (Odds oranı=5,38 ve p-değeri=0,001). NLO en güçlü prediktif değer olarak bulundu.

Sonuç: Yüksek NLO değeri, inkarsere karın duvarı fıtıklarında rezeksiyon ihtiyacını tahmin etmek için öngörücü bir biyobelirteç olarak kullanılabilir.

Anahtar Kelimeler: Fıtık, cerrahi, rezeksiyon, lenfosit, nötrofil

Address for Correspondence/Yazışma Adresi: Mehmet Üstün MD, University of Health Sciences Turkey, İzmir Tepecik Education and Research Hospital, Clinic of General Surgery, İzmir, Turkey
Phone: +90 232 469 69 69 **E-mail:** dr.m.ustun@gmail.com
ORCID ID: orcid.org/0000-0003-2646-5239

Received/Geliş tarihi: 25.11.2021
Accepted/Kabul tarihi: 15.01.2022

Introduction

Incarcerated hernia is a surgical emergency that may ultimately lead to organ resection. Bowel frequently gets incarcerated in the hernia sac and strangulation is reported as the second most common cause of bowel obstruction[1–3].

Strangulation, which is a diagnosis that relies on clinical evaluation, determines the need for resection in the event of incarceration. The manual reduction is a common clinical practice in the management of incarcerated hernia that bears the catastrophic risk of sending a devitalized bowel segment into the peritoneal cavity. Thus, predicting strangulation and the need for resection is crucial by using establishing an algorithm for managing these patients. The literature lacks proper predictors of strangulation and this may cause uncertainty in the management of the patients, especially when manual reduction is an option[4]. Various diagnostic markers are currently being studied to set a reliable tool for predicting strangulation in the event of incarceration. Among these neutrophil/lymphocyte ratio (NLR) and hyponatremia is suggested as novel markers for predicting strangulation[5].

This study analyzes resection prediction power of simple markers derived from complete blood count (CBC) and blood chemistry (BC) that are readily available virtually in all medical facilities throughout the world.

Materials and Methods

Patients

Data from 196 patients who underwent emergency surgery for incarcerated hernia between the January 2013 and the December 2018 were retrospectively analyzed. Patients who had organs incarcerated other than bowel were excluded from the study. After exclusion; data from 159 patients were retrospectively analyzed. Demographics and hernia type, results of CBC and BC and the need for resection was recorded for each patient. Ratios such as NLR and platelet/lymphocyte ratio (PLR) were calculated from the aforementioned values.

Femoral hernia was significantly frequent it the resection group (p=0.002), thus patients with femoral hernia (n=19) were further excluded in the statistical analysis to prevent the interference of hernia type on resection decision. All of the remaining 140 patients underwent emergent hernia repair either with (n=49) or without (n=91) bowel resection. Patients were divided into two groups according to their resection status and then these two groups were statistically compared.

Approval from the İzmir Tepecik Education and Research Hospital, Institutional Research Ethics Board was obtained (decision number 2019/6-5, date: 10.04.2019).

Statistical Analysis

A receiver operating characteristic (ROC) curve analysis taking resection as an endpoint was run for all continuous variables. Variables with a significant area under the curve (AUC) (age, white blood cell count, neutrophil count, serum sodium level and NLR) were further analyzed with Youden index to set a cutoff value for each (71.5, 15.5, 12.05, 125.5, and 5.81 respectively). Then, these variables were recoded into categorical variables according to these calculated cut-off values.

Fisher's exact t-test was used for univariate analysis of the variables and logistic regression was used for multivariate analysis.

Results

There were 77 male and 63 female patients. The most common type of hernia was inguinal hernia (n=69, 49.3%) which was followed by incisional hernia (n=50, 35.7%). Table 1 shows the frequencies for each patient group.

The mean age for the whole patient population was 66.1 (range: 30-102, standard deviation: 14.7). Patients who underwent resection were significantly older than the patients without resection (p=0.02). The average leucocyte count white blood cells (WBC) per cubic milliliter was 12.415 in the whole patient population. Similarly, patients who underwent resection positively separated from the population by using neutrophil count (p=0.013). Average neutrophil count per cubic milliliter was 9829, and as expected parallel to WBC, it was significantly higher in the resection group (p=0.009). Average serum sodium level was 136.18 mEq/L, however it showed no significant difference between the groups (p=0.43). Lastly, the average NLR for patient population was 9.93. Again, patients in the resection group had significantly higher ratios compared to the patients without the resection group (p=0.03). Table 2 summarizes and compares the means for continuous variables between the patient groups.

Following the univariate analysis for the continuous variables, a ROC curve analysis was conducted for the parameters that showed a significant difference between the groups. The AUC in the ROC curve analysis was significant for age, neutrophil count, NLR and PLR. A Youden index analysis was employed for these parameters. The calculated cut-off value for NLR

was 5.8175 with sensitivity of 83.7% and specificity of 51.2%. Similarly, the cutoff value for PLR was 329.1883 (sensitivity 36.7%, specificity 87.5%) and for the neutrophil count was 9.15 (sensitivity 46.9%, specificity 80%). Lastly, the calculated cutoff value for age was 70 years.

In the univariate analysis of these three variables, NLR was found to have the strongest predictive value with an odds ratio of 5.38 and a p-value of 0.001. See Table 3 for the univariate analysis for these three variables.

NLR was the only parameter that that significantly predicted resection (p=0.036) in the multivariate analysis.

Table 1. Frequency table for the patient groups

	Resection		
	No	**Yes**	**p-value**
Sex			
Male	51	26	0.859
Female	40	23	
Type of hernia			
Inguinal	46	23	0.683
Incisional	31	19	0.307
Umbilical	13	6	0.736
Obturator	1	1	0.654
Age ≥71.5*			
No	62	22	**0.011**
Yes	29	27	
WBC ≥15.5*			
No	77	30	**0.003**
Yes	14	19	
Neutrophil ≥12.05*			
No	73	28	**0.005**
Yes	18	21	
Sodium ≤125.5*			
No	89	49	0.542
Yes	2	0	
NLR ≥5.81*			
No	48	12	**0.001**
Yes	43	37	

*Calculated cut-off value with Youden index analysis.
NLR: Neutrophil/lymphocyte ratio, WBC: White blood cells

Discussion

Up to 10% of population is reported to develop some kind of abdominal hernia during lifetime[6] and 5 to 35% of these abdominal wall hernias require emergency repair due to strangulation[7,8]. Another 10 to 15% of the patients with strangulated hernia require bowel resection[1,8]. The rate of bowel resection is quite high (n=49, 37.9%) than reported in the literature among the patient population in this study. This discrepancy with the literature can be explained by a selection bias as the patients who had organs incarcerated other than bowel were excluded from in this study.

NLR is a well-studied inflammatory biomarker in bowel ischemia that is readily available in virtually all medical centers throughout the world[9,10]. Moreover, NLR is emerging as a novel marker predicting the clinical severity of incarcerated hernias[5,11]. However the cut-off value for this biomarker is still a debate as various values reported in different studies[5,11]. The calculated cut-off value for NLR in this study was 5.8175 (sensitivity 83.7% and specificity 51.2%), which is close to the value reported by Zhou et al.[5] and almost 4 times higher than the reference value reported by Lee et al.[12]. NLR was the only variable that significantly predicted bowel resection in univariate and multivariate analyses (p values 0.001 and 0.036 respectively). Nevertheless, NLR was the most powerful predictor of bowel resection with and odds ratio of 5.38.

Similarly, PLR is another emerging marker of inflammation that has been studied in various diseases[13-17]. A study by Köksal et al.[18] covering 102 patients that evaluate resection prediction power of hemogram parameters, shows a significant increase in absolute neutrophil count,

Table 2. Comparison of continuous variables between the groups

Variable	No resection (n=96)	Resection (n=63)	p-value
Age	64.39 (30-102)	70.08 (46-93)	0.017
Sodium (mEq/L)	136.36 (122-142)	135.49 (127-142)	0.139
Neutrophil (x1000/mm^3)	8.96 (2.10-23.80)	11.29 (2.50-29.70)	0.001
Platelet (x1000/mm^3)	280.41 (61-563)	307.52 (110-1051)	0.138
NLR	8.35 (0.9-87.5)	12.79 (1.81-54)	0.012
PLR	234.18 (61.82-1700)	376.58 (51.67-2860)	0.015

NLR: Neutrophil/lymphocyte ratio, PLR: Platelet/lymphocyte ratio

Table 3. Univariate analysis of the variables

Variable	Odds ratio	95% confidence interval	p-value
NLR ≥5.8175	5.388	2.245-12.928	0.0001
PLR ≥329.1883	4.065	1.684-9.810	0.002
Neutrophil ≥9.15	3.538	1.615-7.751	0.002

NLR: Neutrophil/lymphocyte ratio, PLR: Platelet/lymphocyte ratio

platelet distribution width, PLR and NLR in the patients who eventually need resection, however the study fails to set a cut-off value[18]. Another study by Peksoz et al.[19] in 2021 has shown that NLR, WBC, neutrophil count, NLR, urea, creatinine, and total bilirubin values significantly increase intestinal ischemia and creatinine, total bilirubin, indirect bilirubin, phosphorus and lactate dehydrogenase are significant predictors of resection.

Low serum sodium level has also been defined in various studies as a predictive factor in predicting necrosis in soft tissue infections, intestinal ischemia in children with volvulus, and intestinal ischemia in small bowel obstructions[20-22]. In their series of 163 cases published in 2019, Keeley et al. defined hyponatremia as an independent predictive factor for intestinal ischemia[4]. This is the first study to identify hyponatremia as a predictive factor for ischemia in incarcerated hernias. Based on this result, we also included the serum sodium level in the parameters we investigated, but no predictive relationship was found between the serum sodium level and the need for resection in this study.

Conclusion

In conclusion; elevated NLR level can be used as a predictive biomarker to predict the need for resection in incarcerated abdominal wall hernias.

Ethics

Ethics Committee Approval: Approval from the İzmir Tepecik Education and Research Hospital, Institutional Research Ethics Board was obtained (decision number 2019/6-5, date: 10.04.2019).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: M.Ü., G.A., Design: M.Ü., G.A., Data Collection or Processing: M.Ü., G.A., Analysis or Interpretation: M.Ü., G.A., Literature Search: M.Ü., G.A., Writing: M.Ü., G.A.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Kulah B, Kulacoglu IH, Oruc MT, et al. Presentation and outcome of incarcerated external hernias in adults. Am J Surg 2001;181:101-4.
2. Koizumi M, Sata N, Kaneda Y, et al. Optimal timeline for emergency surgery in patients with strangulated groin hernias. Hernia 2014;18:845-8.
3. Akçakaya A, Alimoğlu O, Hevenk T, Baş G, Sahin M. [Mechanical intestinal obstruction caused by abdominal wall hernias]. Ulus Travma Derg 2000;6:260-5.
4. Keeley JA, Kaji A, Kim DY, Putnam B, Neville A. Predictors of ischemic bowel in patients with incarcerated hernias. Hernia 2019;23:277-80.
5. Zhou H, Ruan X, Shao X, Huang X, Fang G, Zheng X. Clinical value of the neutrophil/lymphocyte ratio in diagnosing adult strangulated inguinal hernia. Int J Surg 2016;36:76-80.
6. Ruhl CE, Everhart JE. Risk Factors for Inguinal Hernia among Adults in the US Population. Am J Epidemiol 2007;165:1154-61.
7. Derici H, Unalp HR, Bozdag AD, Nazli O, Tansug T, Kamer E. Factors affecting morbidity and mortality in incarcerated abdominal wall hernias. Hernia 2007;11:341-6.
8. Ozbagriacik M, Bas G, Basak F, et al. Management of strangulated abdominal wall hernias with mesh; early results. North Clin Istanb 2015;2:26-32.
9. Aktimur R, Cetinkunar S, Yildirim K, Aktimur SH, Ugurlucan M, Ozlem N. Neutrophil-to-lymphocyte ratio as a diagnostic biomarker for the diagnosis of acute mesenteric ischemia. Eur J Trauma Emerg Surg 2016;42:363-8.
10. Rivera Núñez MA, Rodríguez Gijón L, Tung Chen Y, Martí de Gracia M, Buitrago Weiland G, Díez Tascón A. Neutrophil-to-lymphocyte ratio and mesenteric ischemia: can it predict the etiology of mesenteric ischemic at computed tomography? Emerg Radiol 2019;26:515-21.
11. Xie X, Feng S, Tang Z, Chen L, Huang Y, Yang X. Neutrophil-to-Lymphocyte Ratio Predicts the Severity of Incarcerated Groin Hernia. Med Sci Monit 2017;23:5558-63.
12. Lee JS, Kim NY, Na SH, Youn YH, Shin CS. Reference values of neutrophil-lymphocyte ratio, lymphocyte-monocyte ratio, platelet-lymphocyte ratio, and mean platelet volume in healthy adults in South Korea. Medicine (Baltimore) 2018;97:e11138.
13. Toprak E, Bozkurt M, Dinçgez Çakmak B, et al. Platelet-to-lymphocyte ratio: A new inflammatory marker for the diagnosis of preterm premature rupture of membranes. J Turk Ger Gynecol Assoc 2017;18:122-6.
14. Grilz E, Posch F, Königsbrügge O, et al. Association of Platelet-to-Lymphocyte Ratio and Neutrophil-to-Lymphocyte Ratio with the Risk of Thromboembolism and Mortality in Patients with Cancer. Thromb Haemost 2018;118:1875-84.
15. Toda M, Tsukioka T, Izumi N, et al. Platelet-to-lymphocyte ratio predicts the prognosis of patients with non-small cell lung cancer treated with surgery and postoperative adjuvant chemotherapy. Thorac Cancer 2018;9:112-9.
16. Durmus E, Kivrak T, Gerin F, Sunbul M, Sari I, Erdogan O. Neutrophil-to-Lymphocyte Ratio and Platelet-to-Lymphocyte Ratio are Predictors of Heart Failure. Arq Bras Cardiol 2015;105:606-13.

17. Stojkovic Lalosevic M, Pavlovic Markovic A, Stankovic S, et al. Combined Diagnostic Efficacy of Neutrophil-to-Lymphocyte Ratio (NLR), Platelet-to-Lymphocyte Ratio (PLR), and Mean Platelet Volume (MPV) as Biomarkers of Systemic Inflammation in the Diagnosis of Colorectal Cancer. Disease Markers 2019;2019:6036979.
18. Köksal H, Ateş D, Nazik EE, Küçükosmanoğlu İ, Doğan SM, Doğru O. Predictive value of preoperative neutrophil-to-lymphocyte ratio while detecting bowel resection in hernia with intestinal incarceration. Ulus Travma Acil Cerrahi Derg 2018;24:207-10.
19. Peksöz R, Karaıslı S, Erözkan K, Ağırman E. The role of basic blood parameters in determining the viability of intestinal tissue in incarcerated hernias. Int J Clin Pract 2021;75:e14664.
20. Lin YP, Lee J, Chao HC, et al. Risk factors for intestinal gangrene in children with small-bowel volvulus. J Pediatr Gastroenterol Nutr 2011;53:417-22.
21. Wong CH, Khin LW, Heng KS, Tan KC, Low CO. The LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) score: a tool for distinguishing necrotizing fasciitis from other soft tissue infections. Crit Care Med 2004;32:1535-41.
22. O'Leary MP, Neville AL, Keeley JA, Kim DY, de Virgilio C, Plurad DS. Predictors of Ischemic Bowel in Patients with Small Bowel Obstruction. Am Surg 2016;82:992-4.