



Assessment of Platelet-to-Lymphocyte and Neutrophil-to-Lymphocyte Ratios in Laparoscopy and Open Surgery

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Abstract

Background: The management of inflammation is of great importance in both laparoscopy and open surgery. In these surgical applications, assessment of the Neutrophil-Lymphocyte Ratio (NLR) and the platelet-to-lymphocyte ratio (PLR), which are indicators of inflammatory events, may be beneficial for the surgeon.

Methods: A post-hoc analysis was made of the data of 74 abdominal laparoscopy patients. For each patient, the preoperative characteristics, injury types, NLR and PLR values, and postoperative condition were recorded.

Results: A total of 30 patients (44.8%) survived with an abdominal deep organ injury. Due to the insufficiency or incompatibility of laparoscopy, transfer to open surgery was made in 74 cases. In the correlation analysis of all the continuous variables, while NLR showed a positive relation with PLR ($r=0.932$; $p<0.00001$), this correlation was not seen with lactate values. Both NLR and PLR were significantly increased in the open surgery cases compared to the laparoscopic cases ($p=0.029$ and $p=0.047$, respectively).

Conclusion: Assessing NLR and PLR levels in patients with penetrating abdominal trauma may provide cost-effective and easy-to-use information about abdominal inflammation. The higher NLR and PLR values suggest necessity for open surgery instead of laparoscopic surgery.

Keywords: Neutrophil-to-lymphocyte ratio; Platelet-to-lymphocyte ratio; Penetrating abdominal trauma; Laparoscopy

Abbreviations

NLR: Neutrophil to Lymphocyte Ratio; PLR: Platelet to Lymphocyte Ratio; SD: Standard Deviation; SPSS: Statistical Program for Social Sciences; TNF: Tumor Necrosis Factor; USA: The United States of America; WBC: White Blood Cells

Background

Laparoscopic procedures performed by an experienced surgeon provide successful results in abdominal surgery [1]. In many types of operations, there are fewer side effects of laparoscopy, especially, in terms of bleeding and infection [2]. Less tissue damage at the site of surgery facilitates easier and faster healing for patients [3]. Intra-abdominal adhesions, which can develop post open surgery and cause life-long distress for many patients, are less common after laparoscopic surgeries [4].

Recent studies have shown that the ratios of both platelet (PLR) and neutrophil count to lymphocyte count (NLR) are indicative of systemic inflammation. They have also been associated with the prognosis of many systemic and chronic inflammatory diseases and malignancies [5-7]. These ratios have been reported to be correlated with parameters, such as TNF-alpha and interleukins, which play a critical role in the process of inflammation [8]. It is thought that these hematological parameters can provide powerful preliminary information in respect of the surgical approach to a case. The inflammatory sensitive properties of these parameters can assist in the decision to apply an open or closed surgical approach. The aim of this study was to evaluate the preoperative NLR and PLR values of patients who were hospitalized with abdominal trauma and underwent open or laparoscopic surgery.

Methods

Approval for this single-center retrospective study was granted by the Local Ethics Committee.

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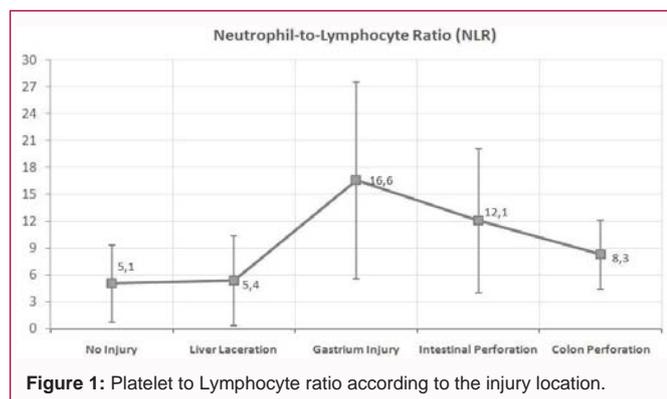


Figure 1: Platelet to Lymphocyte ratio according to the injury location.

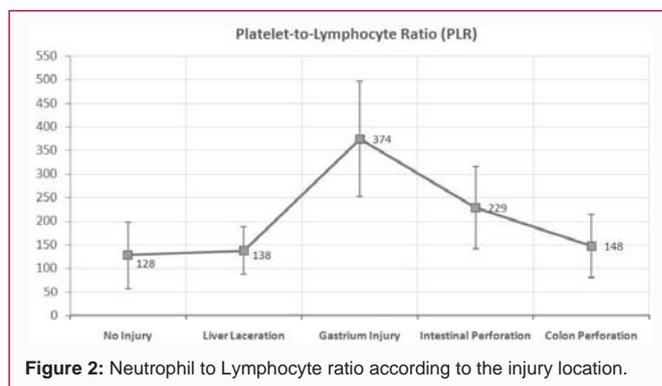


Figure 2: Neutrophil to Lymphocyte ratio according to the injury location.

Table 1: Demographics with significance according to whether GIS injury existed or not.

Parameters	Yes	No	P
Age (years)	31 ± 11	29 ± 10	0,568
Gender (M/F)	25 / 8	32 / 9	0,258
SBP (mmHg)	121 ± 10	108 ± 10	0,001
DBP (mmHg)	79±3	76 ± 4	0,023
Pulse	88 ± 6	93 ± 6	0,016
WBC	11.8 ± 4,5	15 ± 5,7	0,166
NEUT	8.7 ± 3,1	11.2 ± 4,8	0,143
LYMP	2.3 ± 0,9	2 ± 1,3	0,258
PLT	254 ± 155	254 ± 70	0,907
Hematocrit	38.1 ± 3,9	35.5 ± 4,4	0,421
Lactate	1.91 ± 0,5	3.26 ± 1,5	0,009
PLR	128 ± 68	212 ± 99	0,245
NLR	5.1 ± 2,2	10.6 ± 4,9	0,161
Fluid leakage	272 ± 188	819 ± 449	0,001
Liquid Support	1906 ± 633	2423 ± 312	0,001
Hospital Stay	4 ± 1	7 ± 1	0,0001

Informed consent was obtained from all patients. The study included 74 patients who had no major systemic disease and underwent non-scheduled surgery because of abdominal trauma-related, gastric, hepatic, pancreatic, intestinal, or colorectal injuries. Preoperative data (blood pressure, pulse, etc.) and the NLR and PLR values (1 day preoperatively) were recorded for each patient together with lactate (indicative of ischemia or hypoxemia) and other hemogram parameters (neutrophil, WBC, etc.) and perioperative data, such as fluid leakage, fluid support, and hospital stay. Venous blood samples were analyzed in a full automatic haemogram analyzer (Abbott Cell-Dyn 1800 automated hematology analyzer, Illinois, USA) to count blood cells. After measurements of lymphocytes, platelets, and neutrophils, the NLR and PLR were calculated manually using those values. A CARE Diagnostics device was used to measure the lactate levels (Ecotwenty, CARE diagnostic Productions, Möllersdorf, Römerstr, Austria).

Data obtained in the study were analyzed using SPSS vn.21.0 for Windows software. All variables showing normal distribution were given as mean ± Standard Deviation (SD), and those not conforming to normal distribution as percentage and median values. Data including the demographics of the groups examined using the Mann-Whitney-U test. The Kruskal Wallis test was used in the post-

hoc analysis of tests for the injury types. Pearson correlation analysis was used to evaluate the linear relationship between two continuous variables in the NLR and PLR correlation analyses. A value of $p < 0.05$ was accepted as statistically significant.

Results

All patient details are given in Table 1 with p values. The mean age of the whole patient group was 30.4 ± 10.3 years (range, 17 to 55 years). Of 74 patients, 33 (44.8%) were survivors with an abdominal deep organ injury (perforation in the colon, 10; perforation in the small intestine, 13; stomach, 5; liver laceration, 5). In total, 26 patients underwent open surgery due to the insufficiency of or incompatibility with laparoscopy.

In the correlation analysis of all continuous variables, NLR showed a positive relationship with PLR ($r=0.932$; $p < 0.00001$), this correlation was not seen in the lactate values. There was no significant correlation between other parameters and PLR or NLR. Both NLR and PLR were significantly elevated in the open surgery cases compared to the laparoscopic cases ($p=0.029$ and $p=0.047$, respectively). Similar behavior was indicated in the type of abdominal injury, which was seen at the highest levels in the stomach (Figure 1,2). This increase was not statistically significant due to the high standard deviation values.

Discussion

Open surgery and a laparoscopic approach provide two very different clinical outcomes, which will be of great importance for patients in the future. Recent studies have shown that PLR and NLR could be beneficial in showing inflammatory-related diseases [1]. The current study can be considered of value in respect of demonstrating whether the preoperative NLR and PLR values are potentially different in open and laparoscopic surgery due to the inflammation. Laparoscopy for gastrointestinal perforations has a shorter incision length resulting in less morbidity and shorter hospitalization, compared with an open surgery [2-4]. A laparoscopic procedure in colon repair is probably the first clinical approach, particularly where feasible in terms of surgeon experience [5]. Intra-abdominal adhesions that may develop after open surgery and cause lifelong distress in many patients are seen less often after laparoscopic surgery [6,7]. This is due to the difference in inflammatory reactions that are seen during trauma in these two approaches. In a study by Bleir et al. a laparoscopic approach was reported to be advantageous in terms of both shorter operating time and hospital stay [8]. Similarly, Coimbra reported hospital stays to be shorter in a laparoscopic approach compared to laparotomy [9]. In the current study, postoperative hospital stay was longer following open surgery than for laparoscopic

operations.

Hematological parameters are known to show inflammatory conditions in cases of penetrating abdominal trauma. In recent reports, NLR has been shown to be a predictor of inflammation and helpful in predicting gastrointestinal system problems [10]. Markar et al. suggested NLR as a cautionary parameter for possible appendicitis [11]. Another study measured high NLR levels in cases of pediatric vasculitis with accompanying bleeding of gastrointestinal organs [12]. Park et al. suggested that bleeding originating from the gastrointestinal system was associated with a high NLR value [13]. The current study results support these reports of NLR. Higher NLR values were determined in patients with severe problems such as high levels of fluid loss requiring fluid support, and prolonged hospital stay. The NLR was found to be significantly higher in cases treated with open surgery compared to those applied with laparoscopy, which supports the view of higher levels of inflammatory events in open surgery.

Although there have been few studies on this subject, it has been reported that NLR has more diagnostic coherence than traditional diagnostic laboratory tests, which only include white blood cells [14]. A high PLR value indicates a reduced number of lymphocytes or an increasing number of platelets. In many different cases, platelets can secrete inflammatory mediators such as growth factors and consequently both stimulate tumor angiogenesis and cell growth [15]. As a convenient and cost-effective blood-derived marker, PLR, which takes into account the inflammatory response, immune response, and coagulation status, has been widely investigated as a useful prognostic factor in disease-related digestive system [16]. In the current study, NLR had a positive correlation with PLR, but this correlation was not seen in the lactate values. Both NLR and PLR were determined to be significantly increased in the open surgery cases compared to the laparoscopic cases. Of all the cases treated with open surgery, higher NLR and PLR values were seen in cases with gastric injuries compared to other gastrointestinal locations. That the difference was not statistically significant in this study can be attributed to the small sample size. Limitations of this study can be considered to be the low number of patients and that it was conducted in a single state hospital. Therefore, although a difference was determined in the NLR and PLR values between different injury types, there was no statistical significance. All these results for NLR and PLR need strong validation studies with larger patient numbers.

Conclusion

In conclusion, both NLR and PLR were determined to be significantly increased in open surgery cases compared to laparoscopic cases. Patients with gastric injuries had higher NLR and PLR values than those with other gastrointestinal perforations. The assessment of NLR and PLR levels in patients with penetrating abdominal trauma may provide cost-effective and easy-to-use information about inflammation in the abdominal injury site. We suggest that the higher the NLR and PLR values might point the necessity for open surgery instead of laparoscopic surgery.

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