Medit Vet J, 9(2): 295-298, 2024

Research Article

Cats with systemic ınflammatory response syndrome: granulocyte/lymphocyte ratio in hypothermia and hyperthermia conditions

Ramazan Yıldız[1]

[1]Department of Internal Medicine, Faculty of Veterinary Medicine, Burdur Mehmet Akif Ersoy University, Burdur, Türkiye

Key Words:
cats
granulocyte-lymphocyte ratio
SIRS

Received : 2 April 2024
Revised : 25 May 2024
Accepted : 27 May 2024
Published : 31 August 2024
Article Code : 1463329

Correspondence:
R. YILDIZ
(ramazanyildiz@mehmetakif.edu.tr)

ORCID
R. YILDIZ : 0000-0001-5772-0891

This study was supported by the Burdur Mehmet Akif Ersoy University Scientific Research Projects Coordination Unit (BAP, Project No: 0619-MP-19).

ABSTRACT

Systemic inflammatory response syndrome (SIRS) is a conceptual framework developed to underscore the significance of systemic inflammation activation in precipitating organ dysfunction in cases of sepsis. This study endeavors to explore the interplay between hyperthermia, hypothermia, and the granulocyte-to-lymphocyte ratio (G/L) in feline patients diagnosed with SIRS. A total of 25 cats positive for SIRS were included in the study. The groups were determined as G1: ≤37.8 °C (n=8), G2: ≥39.7 °C (n=11) and G3: ≥40.0 °C (n=6). The G/L ratio has no statistical difference was found between G1 and G2, but G3 was found to have a statistically higher G/L ratio than G1 and G2. In conclusion, our findings suggest a potential association between temperature dysregulation and altered G/L ratios in feline SIRS cases. These results contribute to our understanding of the inflammatory response in cats and may inform future diagnostic and therapeutic strategies.

INTRODUCTION

Systemic inflammatory response syndrome (SIRS) stands as a pivotal concept acknowledging the widespread activation of inflammation, a significant contributor to the organ failure observed in cases of sepsis. Although commonly associated with sepsis, SIRS encompasses a spectrum of pathological conditions that trigger the release of endogenous mediators, leading to systemic inflammation. These conditions range from trauma and burns to major surgical procedures and pancreatitis, potentially resulting in multiple organ failure, shock, and mortality, depending on the severity of the inflammatory cascade. It is crucial to note that SIRS is characterized as a clinical syndrome rather than a distinct disease entity. The proposed diagnostic criteria involve four clinical parameters: hypothermia or hyperthermia, leukocytosis or leukopenia, tachycardia or bradycardia, and tachypnea. Timely recognition of systemic inflammation and prompt intervention directed at the underlying pathology are critical in managing the diverse manifestations of the inflammatory response (Purvis and Kirby, 1994; Brady et al., 2000).

Complete blood count (CBC) and the ratio values of CBC parameters are widely used in the diagnosis and follow-up of SIRS and sepsis in veterinary field as well as in human medicine (Oncel et al., 2012). The neutrophil-lymphocyte ratio (NLR) serves as an inflammatory biomarker, offering valuable insights into systemic inflammation levels. Derived from the ratio of absolute neutrophil count to absolute lymphocyte count, the NLR offers a simple evaluation without incurring supplementary expenses on standard complete blood count analyses routinely performed in hospital settings. Extensively studied across a spectrum of conditions including cancer, community-acquired pneumonia, and sepsis, NLR has demonstrated utility as a prognostic indicator (de Jager et al., 2010; Lanziotti et al., 2016). In studies on adult humans, NLR is used to determine the presence and severity of sepsis. This ratio is an indicator of inflammation and can be used to predict septicemia (de Jager et al., 2010). The objective of this study was to assess the relation between hyperthermia and hypothermia and the granulocyte-to-lymphocyte ratio (G/L) in cats positive for SIRS, furthermore, our secondary objective is to establish a foundation for subsequent research endeavors in this area.

MATERIALS and METHODS

The study group consisted of 25 cats with systemic inflammatory response syndrome (SIRS). All these groups were admitted to Burdur Mehmet Akif Ersoy University Animal Hospital for different diseases and the hemogram parameters of the cats showing SIRS symptoms were examined during routine examination. Blood samples for hemogram analysis were collected from the patients' cephalic veins during routine clinical examinations. A tube containing ethylenediaminetetraacetic acid (K_3EDTA) was used for hemogram measurements. Granulocytes (GRA) and lymphocytes (LYM) levels were me-

To cite this article:
Yıldız R. Cats with systemic ınflammatory response syndrome: granulocyte/lymphocyte ratio in hypothermia and hyperthermia conditions. Medit Vet J. 2024; 9(2): 295-298.

asured using the Abacus Junior Vet device (Diatron MI Ltd., Hungary). Among these parameters, the ratios of granulocyte count to lymphocyte count (G/L) were calculated and the differences in animals with different body temperatures were revealed. The groups were determined as G1: ≤37.8 °C (n=8), G2: ≥39.7 °C (n=11) and G3: ≥40.0 °C (n=6).

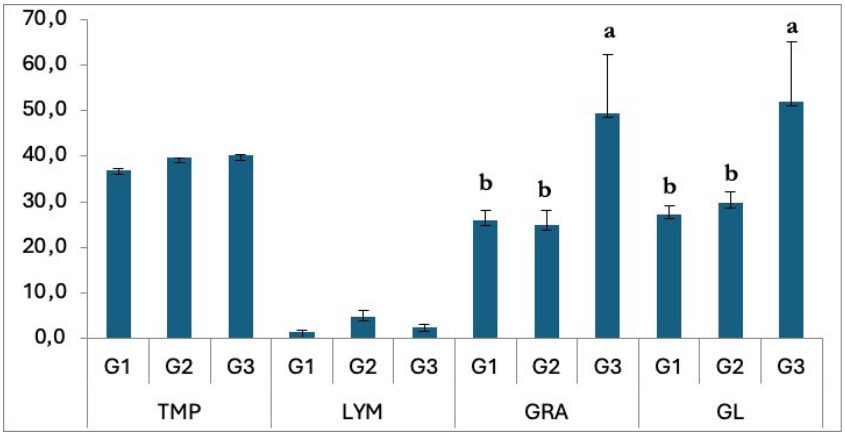

Figure 1. Statistical variations in body temperature, lymphocyte count, granulocyte count, and the granulocyte-to-lymphocyte ratio between the groups (Mean±SEM). TMP (Temperature), LYM (Lymphocyte), GRA (Granulocyte) and GL (Granulocyte/Lymphocyte Ratio), different letters (a, b, c) were set as statistically significant (p <0.05) at graph.

For the inclusion criteria of cats diagnosed with SIRS undergoing hemogram parameter examination, the study encompassed cases exhibiting systemic inflammation along with abnormal body temperature, bradycardia and/or tachycardia, and tachypnea. SIRS criteria, as outlined by Brady et al. (2000), comprised: (1) abnormal body temperature (≤37.8 or ≥39.7 °C); (2) tachycardia (≥225 beats/min) or bradycardia (≤140 beats/min); (3) tachypnea (≥40 respirations/min); and (4) White Blood Cell (WBC) abnormalities (WBC ≥19500 or ≤5000 k/μL or band neutrophils ≥5%).

Statistical analysis

All data were presented as mean and standard errors (mean ± SEM). Normal distribution preconditions were assessed using the Kolmogorov–Smirnov test. One-way ANOVA (Posthoc Tukey) was employed to analyze the statistical differences in parameters between groups using SPSS 22.0 software (USA). A p-value < 0.05 was considered statistically significant.

RESULTS

The study showed that all cats met at least 3 SIRS criteria. Common clinical symptoms included hypothermia or hyperthermia, weakness, depressed appearance, lack of appetite, hyperemic or pale mucous membranes, prolonged capillary refill time and weak pulse, changes in respiratory rate, and increasing heart rate. The body temperature of G1, G2 and G3 were 37.01, 39.71 and 40.22, respectively (Figure 1). The lymphocyte (LYM) level showed no statistically significant difference between the groups. Neither the granulocyte (GRA) count nor the granulocyte-to-lymphocyte (G/L) ratio exhibited any statistical difference between G1 and G2. However, G3 demonstrated a statistically significant higher level (p < 0.05) in both GRA count and G/L ratio compared to G1 and G2 (Figure 1).

DISCUSSION

In response to either infectious or non-infectious stimuli, inflammation initiates a multifaceted interaction involving the humoral and cellular immune response, cytokines, and the complement pathway. This intricate interplay leads to the SIRS when the equilibrium between pro-inflammatory and anti-inflammatory cascades is skewed toward the former (Chakraborty and Burns, 2023). SIRS often triggered by bacterial infection, represents an extensive inflammatory response characterized by the release of multiple cytokines and indicative signs of infection, including fever or hypothermia, elevated heart rate, accelerated respiratory rate, and heightened serum white blood cell count such as the patients in this study. The NLR, a readily available parameter derived from a complete blood count, has emerged as an independent predictor of morbidity and mortality in sepsis (Hwang et al., 2017). In the veterinary field, it is common to use hemogram devices that measure granulocytes and do not distinguish neutrophils. There are not many studies in the veterinary field evaluating G/L and NLR. One of the first studies evaluated dogs with and without septic peritonitis, and no significant difference in NLR was found between dogs that survived and those that died (Hodgson et al., 2018). Gori et al. (2021) discovered that the NLR, in addition to two other leukocyte ratios (BLR: band neutrophil-to-lymphocyte and BNLR: band neutrophil-to-neutrophil-to-lymphocyte) served as robust diagnostic markers, effectively distinguishing between SIRS, septic, and healthy cats. Although the prognostic relevance of BLR and BNLR remains uncertain, the NLR exhibited a correlation with mortality rates in both SIRS and septic feline populations. In the present study, WBC values of all groups were above the normal values for cats. At different body temperatures, the G/L ratio was found to be different, but the highest level (p <0.05) was found in the group with a temperature above 40 degrees (Figure 1). It was determined that the G/L ratio was related to the increase in body temperature indicating the severity of the infection, but did not differ

between hypothermia and moderate body temperature increase. In cats with high G/L ratio in this study, it is observed that there is a pathological process that causes systemic inflammatory response syndrome due to infection or trauma-like condition. As shown in some studies, such as cardiac, pneumonia and chronic renal patients with high NLR, has the potential to have an increased mortality rate (Zahorec, 2020; Huang et al., 2020) however, this study lacks follow-up data on the mortality rate. Moreover, it is important to note that the NLR value is indirectly influenced by circulating concentrations of cortisol and endogenous catecholamines, which have been identified as primary factors (Zahorec, 2020; Buonacera et al., 2022). Elevated blood levels of cortisol can induce neutrophilia and lymphopenia, while fluctuations in catecholamine levels, such as epinephrine, may result in leukocytosis (Margaryan et al., 2017; Chapman, 2018). This pathological mechanism elucidates the elevated G/L ratio observed across all groups and underscores the significant disparity noted in the G3 group with hyperthermia. In a meta-analysis study, NLR levels of complex febrile seizure (FS) patients were found to be significantly higher compared to the simple FS group. It has been pointed out that this result indicates that the level of inflammation is higher in complex FS patients compared to simple FS patients and that inflammation plays a more dominant role in the pathogenesis of complex FS compared to simple FS. This study reported that NLR can be recommended as an inexpensive diagnostic biomarker for FS and may also be useful in differentiating between simple FS and complex FS (Hosseini et al., 2022).

CONCLUSION

In conclusion, it was observed that G/L ratio has the potential to be an important marker in the febrile acute stages of infection. However, it was concluded that studies comparing different body temperature groupings in SIRS, sepsis and septic shock cases would provide more specific and definitive findings.

DECLARATIONS

Ethics Approval

This study was approved by the Burdur Mehmet Akif Ersoy University Animal Experiments Local Ethics Committee (decision no:2019-575).

Conflict of Interest

Authors declare that there are no conflicts of interest for this study.

Consent for Publication

Not applicable.

Author contribution

Idea, concept and design: RY

Data and analysis: RY

Drafting of the manuscript: RY

Critical review: RY

Acknowledgments

This study was supported by the Burdur Mehmet Akif Ersoy University Scientific Research Projects Coordination Unit (BAP, Project No: 0619-MP-19). Thanks to Vet.Hek. Fevzi ALPAT for his support.

REFERENCES

Brady, C.A., Otto, C.M., Van, Winkle., T.J., King, L.G. (2000). Severe sepsis in cats: 29 cases (1986–1998). J Journal of the American Veterinary Medical Association. 217(4), 531-535. https://doi.org/10.2460/javma.2000.217.531.

Buonacera, A., Stancanelli, B., Colaci, M., Malatino, L. (2022). Neutrophil to lymphocyte ratio: an emerging marker of the relationships between the immune system and diseases. International Journal of Molecular Sciences. 23,3636. https://doi.org/10.3390/ijms23073636

Chakraborty, R.K., Burns, B. (2023). Systemic Inflammatory Response Syndrome. (In: StatPearls. Treasure Island (FL): StatPearls Publishing. PMID: 31613449.

Chapman, K.E. Glucocorticoids and immunity. In: Encyclopedia of Endocrine Diseases. Edinburgh: Elsevier; (2018). p. 112–20. 10.1016/B978-0-12-801238-3.66151-2

de Jager, C.P., van Wijk, P.T., Mathoera, R.B., de Jongh-Leuvenink, J., van der Poll, T., Wever, P.C. (2010). Lymphocytopenia and neutrophil-lymphocyte count ratio predict bacteremia better than conventional infection markers in an emergency care unit. Critical care (London, England). (14), 192. 10.1186/cc9309

Gori, E., Pierini, A., Lippi, I., Lubas, G., Marchetti, V. (2021). Leukocytes Ratios in Feline Systemic Inflammatory Response Syndrome and Sepsis: A Retrospective Analysis of 209 Cases. Animals (Basel). 1,11(6),1644. https://doi.org/10.3390/ani11061644.

Hodgson, N., Llewellyn, E.A., Schaeffer, D.J. (2018). Utility and Prognostic Significance of Neutrophil-to-Lymphocyte Ratio in Dogs with Septic Peritonitis. Journal of the American Animal Hospital Association. 54(6),351-359. https://doi.org/10.5326/JAAHA-MS-6808

Hosseini, S., Gharedaghi, H., Hassannezhad, S., Sadeghvand, S., Maghari, A., Dastgiri, S., Talebi, M., Khanzadeh, S. (2022). The Impact of Neutrophil-Lymphocyte Ratio in Febrile Seizures: A Systematic Review and Meta-Analysis. BioMed Research International. 11,8472795. https://doi.org/10.1155/2022/8472795.

Huang, Z., Fu, Z., Huang, W., Huang, K. (2020). Prognostic value of neutrophil-to-lymphocyte ratio in sepsis: A meta-analysis. The American Journal of Emergency Medicine. 38, 641–647. https://doi.org/10.1016/j.ajem.2019.10.023

Hwang, S.Y., Shin, T.G., Jo, I.J., Jeon, K., Suh, G., Lee, T.R., Yoon, H., Cha, W.C., Sim, M.S. (2017). Neutrophil-to-lymphocyte ratio as a prognostic marker in critically-ill septic patients. The American Journal of Emergency Medicine. 35(2),234-239. 10.1016/j.ajem.2016.10.055

Lanziotti, V.S., Póvoa, P., Soares, M., Silva, J.R., Barbosa, A.P., Salluh, J.I. (2016). Use of biomarkers in pediatric sepsis:

literature review. Revista Brasileira de Terapia Intensiva. 28(4), 472–482. https://doi.org/10.5935/0103-507X.20160080

Margaryan, S., Hyusyan, A., Martirosyan, A., Sargsian, S., Manukyan, G. (2017). Differential modulation of innate immune response by epinephrine and estradiol. Revista Brasileira de Terapia Intensiva. 30,1–9. 10.1515/hmbci-2016-0046

Oncel, M.Y., Ozdemir, R., Yurttutan, S., Canpolat, F.E., Erdeve, O., Oguz, S.S., Uras, N., Dilmen, U. (2012). Mean platelet volume in neonatal sepsis. Journal of Clinical Laboratory Analysis. 6(6):493-496. https://doi.org/10.1002/jcla.21552

Purvis, D., Kirby, R. (1994). Systemic inflammatory response syndrome: septic shock. Vet Clin North Veterinary Clinics of North America: Small Animal Practice. (24),1225–1247. https://doi.org/10.1016/s0195-5616(94)50136-0

Zahorec, R. (2021). Neutrophil-to-lymphocyte ratio, past, present and future perspectives. Bratislava Medical Journal. 122,474–88. https://doi.org/10.4149/BLL_2021_078