# Inflammation-based scores as a common tool for prognostic assessment in patients with heart failure or cancer

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**Background.** Inflammation-based scores are widely tested in cancer and have been evaluated in cardiovascular diseases including heart failure. We aimed to broaden knowledge by investigating the impact of established inflammation-based scores on disease severity and survival in patients with stable heart failure with reduced ejection fraction (HFrEF) and paralleling results to an intra-institutional cohort of treatment naïve cancer patients.

**Patients and Methods.** Chronic HFrEF patients and treatment naïve cancer patients were prospectively enrolled. Comorbidities and laboratory data at baseline were assessed. The neutrophil-to-lymphocyte ratio (NLR), the monocyte-to-lymphocyte ratio (MLR), the platelet-to-lymphocyte ratio (PLR) as well as the prognostic nutritional index (PNI = albumin × total lymphocyte count) were calculated. Association of scores with disease severity and impact on overall survival were determined. Interaction analysis was performed for the different populations.

**Tab.1 Baseline Characteristics.**

| | HFrEF study-population (n=443) | Oncologic study-population (n=375) | P-value |
|---|---|---|---|
| Age, median years (IQR) | 64 (53-72) | 62 (53-71) | 0.299 |
| Male sex, n (%) | 325 (73) | 149 (40) | <0.001 |
| BMI, kg/m² (IQR) | 26.6 (23.8-30.2) | 25.18 (22.59-29.02) | <0.001 |
| Systolic BP, mmHg (IQR) | 130 (114-146) | 138 (125-150) | <0.001 |
| Heart rate, bpm (IQR) | 71 (62-80) | 73 (65-83) | 0.042 |
| **NYHA functional class** | | | |
| NYHA I, n (%) | 68 (15) | - | - |
| NYHA II, n (%) | 178 (40) | - | - |
| NYHA III, n (%) | 164 (37) | - | - |
| NYHA IV, n (%) | 9 (2) | - | - |
| **Cancer disease stage*** | | n = 348* | |
| Stage I, n (%) | - | 64 (18) | |
| Stage II, n (%) | - | 41 (12) | |
| Stage III, n (%) | - | 94 (27) | |
| Stage IV, n (%) | - | 149 (43) | |
| **Laboratory parameters** | | | |
| Hemoglobin, g/dL (IQR) | 13.3 (12.1-14.6) | 13.4 (12.1-14.3) | 0.611 |
| Platelet count, G/L (IQR) | 225 (178-261) | 258 (203-305) | <0.001 |
| Leucocytes, G/L (IQR) | 8.14 (6.33-9.06) | 7.20 (5.71-9.62) | 0.243 |
| Neutrophils, G/L (IQR) | 5.8 (4.6-7.3) | 4.6 (3.3-6.4) | <0.001 |
| Monocytes, G/L (IQR) | 0.7 (0.6-0.9) | 0.5 (0.4-0.7) | <0.001 |
| Lymphocytes, G/L (IQR) | 1.5 (1.1-2.0) | 1.4 (1.0-1.8) | 0.003 |
| Bilirubin, mg/dl (IQR) | 0.73 (0.41-0.89) | 0.56 (0.41-0.74) | 0.277 |
| LDH, U/l (IQR) | 213 (174-230) | 187 (162-230) | 0.015 |
| Albumin, g/l (IQR) | 43.3 (40.3-45.7) | 42.5 (39.4-44.9) | 0.002 |
| Creatinine, mg/dl (IQR) | 1.44 (0.96-1.56) | 0.87 (0.76-1.02) | <0.001 |
| NT-proBNP, pg/mL (IQR) | 2053 (842-4345) | 133 (70-297) | <0.001 |
| **Prognostic scores/ratios** | | | |
| NLR, - (IQR) | 3.8 (2.6-5.7) | 3.3 (2.1-5.4) | 0.001 |
| MLR, - (IQR) | 0.5 (0.4-0.7) | 0.4 (0.3-0.6) | <0.001 |
| PLR, - (IQR) | 145 (110-202) | 179 (129-269) | <0.001 |
| PNI, - (IQR) | 65 (46-86) | 58 (40-81) | 0.002 |

BMI – body mass index; BP – blood pressure; bpm – beats per minute; IQR – interquartile range; LDH – lactate dehydrogenase; NT-proBNP – N-terminal pro B-type natriuretic peptide; MLR – monocyte-to-lymphocyte ratio; NLR – neutrophil-to-lymphocyte ratio; NRI – nutritional risk index; PLR – platelet-to-lymphocyte ratio, NYHA – New York Heart Association; PNI – Prognostic Nutritional Index.

* In 348/379 patients tumor stage was assessed by the respective treating oncologist and was indicated for all patients excluding those with myeloproliferative neoplasms.

**Results.** A total of 818 patients (443 HFrEF and 375 cancer patients) were enrolled. Baseline characteristics are presented in *Table* 1. In HFrEF, there was a strong association between all scores and disease severity reflected by NT-proBNP and NYHA class (p≤0.001 for all). In oncologic patients, association with tumor stage was significant for PNI only (p=0.035). In both disease entities, all scores were associated with all-cause mortality in Cox regression analysis (p≤0.014 for all scores). Kaplan Meier analysis confirmed the discriminatory power of all scores in the HFrEF and the oncologic study-population, respectively (log-rank p≤0.026 for all scores) (*Figure* 1A&B). A significant interaction with disease (HFrEF vs. cancer) was observed for PNI ($p_{interaction}$=0.013) or PLR ($p_{interaction}$=0.005) respectively, with higher increase in risk per inflammatory score increment for HFrEF.

**Fig.1.** **Kaplan Meier estimates for overall survival in stable HFrEF (A) or treatment naïve cancer (B) according to prognostic scores**. Assessed for within-population tertile strata. Curves were compared by the log-rank test.
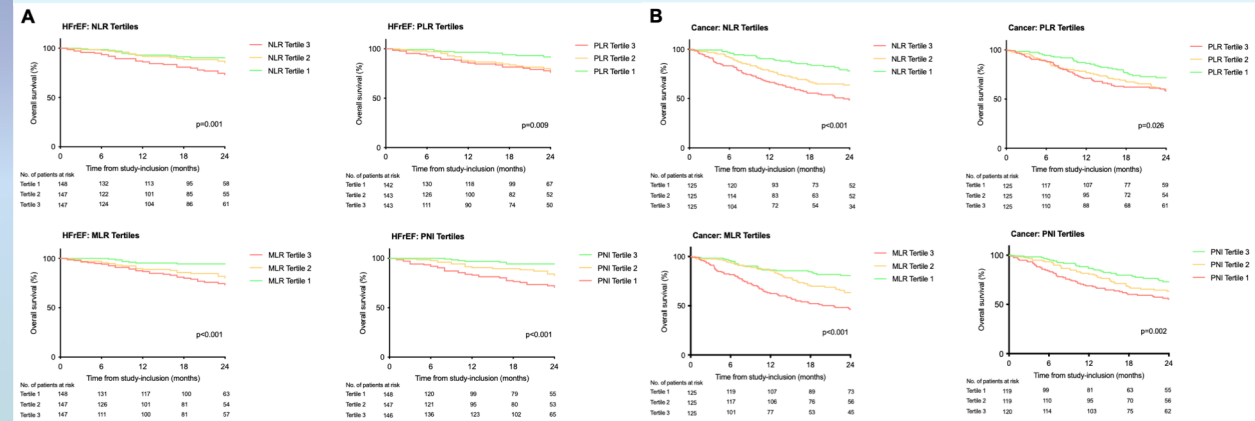


**Conclusion.** The inflammatory scores NLR, MLR, PLR and PNI are associated with severity of disease in HFrEF and with survival in HFrEF similarly to cancer patients. For PNI and PLR the association with outcome was even stronger in HFrEF than in malignant disease. This relationship underscores the significance of proinflammatory response on prognosis and reaffirms similarities between systemic diseases heart failure and cancer.

No conflict of interest to declare.