**Lymphocyte-to-monocyte Ratio and Risk of Hemorrhagic Transformation in Patients with Acute Ischemic Stroke**

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**Supplementary Table 1** Demographic and clinical characteristics of the included and excluded patients

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| --- | --- | --- | --- | --- |
| Characteristics | Patients included  N=1005 | Patients excluded  N=338 | *P* | Healthy controls  n=100 |
| Age, mean (SD ) | 63.0 (14.6) | 65.1 (13.6) | 0.125 | 64.8 (15.9) |
| Male, n (%) | 651 (64.8) | 204 (60.4) | 0.144 | 60 (60.0) |
| Hypertension, n (%) | 523 (52.0) | 190 (56.2) | 0.184 |  |
| Diabetes, n (%) | 231 (23.0) | 63 (18.6) | 0.095 |  |
| Dyslipidemia, n (%) | 39 (3.9) | 10 (3.0) | 0.434 |  |
| AF, n (%) | 91 (9.1) | 53 (15.7) | 0.001 |  |
| Prior stroke or TIA, n (%) | 175 (17.4) | 60 (17.8) | 0.887 |  |
| Smoking, n (%) | 432 (43.0) | 127 (37.6) | 0.081 |  |
| Alcohol consumption, n (%) | 321 (31.9) | 86 (25.4) | 0.025 |  |
| Baseline NIHSS, median (IQR ) | 4 (2-9) | 10 (4-17) | <0.001a |  |
| SBP, mmHg, mean (SD ) | 146.18 (23.57) | 142.04 (22.87) | 0.005 |  |
| DBP, mmHg, mean (SD ) | 85.78 (14.41) | 82.48 (14.43) | <0.001 |  |
| Platelet, mean (SD ) | 176.03 (63.46) | 172.55 (92.97) | 0.523 |  |
| Lymphocyte, mean (SD ) | 1.51 (0.68) | 1.32 (0.64) | <0.001 |  |
| Monocyte, mean (SD ) | 0.40 (0.18) | 0.45 (0.19) | <0.001 |  |
| PLR, mean (SD ) | 137.40 (78.13) | 154.28 (104.80) | 0.002 |  |
| LMR, median (IQR ) | 3.89 (2.81-5.30) | 2.89 (2.07-4.20) | <0.001a | 4.36 (3.16-5.59) |
| Glucose, mmol/L, mean (SD ) | 8.09 (3.61) | 7.87 (3.09) | 0.302 |  |
| Creatinine, umol/L, mean (SD ) | 81.69 (46.70) | 82.33 (37.48) | 0.820 |  |

AF, atrial fibrillation; TIA, transient ischemic attack; NIHSS, National Institutes of Health Stroke Scale; SBP, systolic blood pressure; DBP, diastolic blood pressure; PLR, platelet-to-lymphocyte ratio; LMR, lymphocyte-to-monocyte ratio; SD, standard deviation; IQR, interquartile range;

a Mann-Whitney U test;

**Supplementary Table 2** Characteristics of patients with and without PH

|  |  |  |  |
| --- | --- | --- | --- |
| **Characteristics** | Without PH  N=957 | With PH  N=48 | *P* |
| Age, mean (SD ) | 62.8 (14.7) | 66.7 (13.4) | 0.073 |
| Male, n (%) | 627 (65.5) | 24 (50.0) | 0.028 |
| Time from stroke onset to admission, hours, median (IQR) | 48 (10-96) | 9.5 (4-48) | 0.002 |
| Hypertension, n (%) | 505 (52.8) | 18 (37.5) | 0.039 |
| Diabetes, n (%) | 222 (23.2) | 9 (18.8) | 0.475 |
| Dyslipidemia, n (%) | 39 (4.1) | 0 (0.0) | 0.297 |
| AF, n (%) | 80 (8.4) | 11 (22.9) | 0.002 |
| Prior stroke or TIA, n (%) | 169 (17.7) | 6 (12.5) | 0.358 |
| Previous antiplatelet, n (%) | 71 (7.4) | 3 (6.3) | 0.797 |
| Smoking, n (%) | 416 (43.5) | 16 (33.3) | 0.166 |
| Alcohol consumption, n (%) | 309 (32.3) | 12 (25.0) | 0.291 |
| Baseline NIHSS, median (IQR ) | 4 (2-9) | 11 (8-17) | <0.001a |
| SBP, mmHg, mean (SD ) | 146.47 (23.70) | 140.54 (20.38) | 0.089 |
| DBP, mmHg, mean (SD ) | 85.78 (14.40) | 85.81 (14.80) | 0.988 |
| Platelet, mean (SD ) | 176.80 (63.19) | 160.85 (67.44) | 0.089 |
| Lymphocyte, mean (SD ) | 1.53 (0.68) | 1.31 (0.61) | 0.028 |
| Monocyte, mean (SD ) | 0.40 (0. 18) | 0.40 (0.19) | 0.954 |
| PLR, mean (SD ) | 136.88 (77.76) | 147.61 (85.55) | 0.354 |
| LMR, median (IQR ) | 3.91 (2.86-5.30) | 3.28 (2.27-4.54) | 0.030a |
| LMR tertiles |  |  | 0.069 |
| 1st tertile, n (%) | 308 (93.1) | 23 (6.9) |  |
| 2nd tertile, n (%) | 329 (95.9) | 14 (4.1) |  |
| 3rd tertile, n (%) | 320 (96.7) | 11 (3.3) |  |
| Glucose, mmol/L, mean (SD ) | 8.10 (3.67) | 7.85 (2.01) | 0.420 |
| Creatinine, umol/L, mean (SD ) | 82.09 (47.28) | 73.81 (32.58) | 0.231 |
| **TOAST classification, n (%)** |  |  | <0.001 |
| Large-artery atherosclerosis | 317 (33.1) | 12 (25.0) |  |
| Small-artery occlusion | 246 (25.7) | 1 (2.1) |  |
| Cardio-embolism | 142 (14.8) | 22 (45.8) |  |
| Undetermined etiology | 220 (23.0) | 11 (22.9) |  |
| Other etiology | 32 (3.3) | 2 (4.2) |  |
| **Treatment after admission, n (%)** |  |  |  |
| Antiplatelet | 916 (95.7) | 36 75.0) | <0.001 |
| Lipid lowering | 916 (95.7) | 42 (87.5) | 0.023 |
| Anticoagulant | 94 (9.8) | 10 (20.8) | 0.028 |
| Reperfusion therapy | 61 (6.4) | 13 (27.1) | <0.001 |

PH, parenchymal hematoma; AF, atrial fibrillation; TIA, transient ischemic attack; NIHSS, National Institutes of Health Stroke Scale; SBP, systolic blood pressure; DBP, diastolic blood pressure; PLR, platelet-to-lymphocyte ratio; LMR, lymphocyte-to-monocyte ratio; TOAST, Trial of ORG 10172 in Acute Stroke Treatment; SD, standard deviation; IQR, interquartile range; Reperfusion therapy refers to thrombosis and endovascular therapy. For LMR levels: Tertile 1: ≤3.116, Tertile 2: 3.117-4.760, Tertile 3: ≥4.761.

a Mann-Whitney U test;

**Supplementary Table 3** Multivariate logistic analysis to identify the association between LMR levels and PH

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Unadjusted |  | Model 1 |  | Model 2 |  | Model 3 |  |
| OR (95%CI) | *P* | OR (95%CI) | *P* | OR (95%CI) | *P* | OR (95%CI) | *P* |
| LMR per1-unit increase | 0.830 (0.699-0.986) | 0.034 | 0.802 (0.673-0.956) | 0.014 | 0.853 (0.720-1.010) | 0.066 | 0.860 (0.727-1.017) | 0.078 |
| LMR Tertile 1 | Reference |  | Reference |  | Reference |  | Reference |  |
| Tertile 2 | 0.570 (0.288-1.127) | 0.106 | 0.549 (0.275-1.094) | 0.088 | 0.689 (0.333-1.423 | 0.314 | 0.698 (0.326-1.494) | 0.354 |
| Tertile 3 | 0.460 (0.221-0.960) | 0.039 | 0.407 (0.192-0.862) | 0.019 | 0.512(0.233-1.126) | 0.096 | 0.562 (0.249-1.268) | 0.165 |

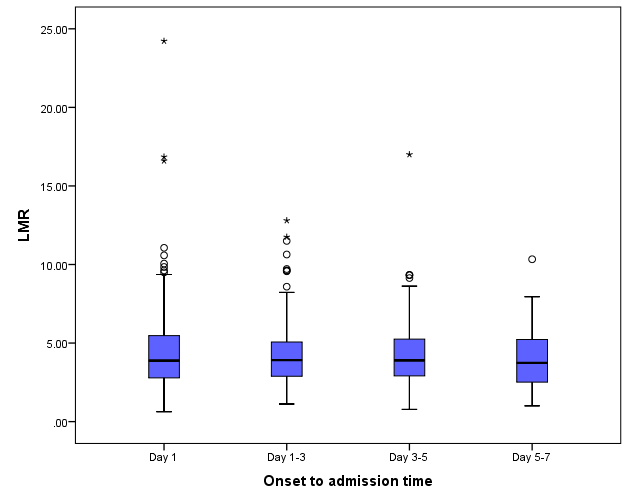
PH, parenchymal hematoma; LMR, lymphocyte-to-monocyte ratio; OR, odds ratio; CI, confidence interval; Model 1 adjusted for age and sex; Model 2, Model 1+ time from stroke onset to admission, platelet, systolic blood pressure, atrial fibrillation, previous antiplatelet, baseline NIHSS score and TOAST classification; Model 3, Model 2+antiplatelet, lipid-lowering, anticoagulant and reperfusion therapy after admission. For LMR levels: Tertile 1: ≤3.116, Tertile 2: 3.117-4.760, Tertile 3: ≥4.761.

**Supplementary Table 4** Baseline characteristics of the previous studies on LMR in patients with stroke

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Author | Patients | Onset to admission time | Sample size | Time of blood collection | Average  age (y) | Male (%) | LMR, median(IQR) | Outcome |
| Park (2017) | AIS | Within 24h | 102 | Day 1 and day 7 | 63 | 53(52.0%) | Day1:  Excellent outcome group: 4.58 ±3.18, non- Excellent outcome group: 3.91±1.86;  Day7:  Excellent outcome group: 3.89 ±1.83, non- Excellent outcome group: 2.72±1.32; | 3-month excellent outcome (mRS 0-1), post-stroke infection (pneumonia and urinary tract infection |
| Ren (2017) | AIS with thrombolysis | Median(IQR):  2.5(2.0-3.0) h | 108 | On admission | 56 | 76(70.4%) | 3.5(2.5-5.4) | Stroke severity, 3-month adverse prognosis (mRS ≥3), sICH (10.2%) |
| Ren (2017) | AIS | Within 72h | 512 | Within 24h after admission | 61 | 314(61.3%) | 3.8(2.5-5.4) | Stroke severity, 3-month poor outcome (mRS ≥3), |
| Switonska (2019) | AIS | NA | 58 | Within 24h after interventions or after stroke diagnosis | 67 | 29(50.0%) | NA | Stroke severity, ischemic stroke comorbidities |
| Qi (2018) | Spontaneous intracerebral hemorrhage | NA | 558 | Within 24h after stroke onset | 57.6 | 368(65.9%) | Neurological deterioration (ND) group: 2.06±1.95, Non-ND group: 3.49±2.37 | Neurological deterioration, 3-month mortality |
| Li (2018) | Cerebral venous sinus thrombosis | NA | 228 | Within 12h after admission | 35.2 | 94(41.2%) | Poor outcome group: 2.3±1.2, good outcome group: 3.2±1.8 | Poor outcomes and death (mRS 3-6) |

AIS: acute ischemic stroke; LMR, lymphocyte to monocyte ratio; IQR, interquartile range; NA, not available; mRS, modified Rankin Scale; sICH, symptomatic intracranial hemorrhage; ND, neurological deterioration.

**Supplementary Figure 1** LMR levels in patients grouped by onset to admission time.

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**Supplementary Figure 2** LMR levels in different HT subtypes classified according to the European Cooperative Acute Stroke Study (ECASS) criteria

