AI-DRIVEN DIGITAL MORPHOMETRY OF LEUKOCYTE SUBTYPES: ESTABLISHING REFERENCE INTERVALS IN A HEALTHY POPULATION

[1]T.E. KUZNETSOVA, [2]E.A. KASHOLKINA, [3]V.V. SHUSTOV, [4]M.A. GODKOV

[1,2,3,4]N.V. Sklifosovsky Research Institute for Emergency Medicine, Russia
[1,2,4]Russian Medical Academy of Continuous Professional Education, Russia
E-mail: [1]KuznetsovaTE@sklif.mos.ru, [2]KasholkinaEA@sklif.mos.ru, [3]ShustovVV@sklif.mos.ru, [4]GodkovMA@sklif.mos.ru

Background and Aim: AI-driven digital microscopy enables high-throughput, quantitative assessment of cellular morphology. This study aimed to measure a comprehensive panel of cellular and subcellular parameters across granulocytes (segmented neutrophils, eosinophils, basophils) and agranulocytes (lymphocytes, monocytes) in a healthy population for establishing the reference intervals (RI).

Materials and Methods: We examined 71 healthy volunteers aged 42±11 years. Peripheral venous blood samples were collected into K_2EDTA vacuum tubes (ZMT, Russia). Within 4 hours of collection, all samples were processed using CAL 6000 hematological station for cell analysis and its integrated slidemaker/stainer module SC-120 (Mindray, Shenzhen, China). The slides were then stained using Romanowsky-Giemsa stain. Digital morphological analysis was performed on the Vision Hema (West Medica, Vienna, Austria).RI were determined at 2.5th and 97.5th percentiles in accordance with CLSI guidance document EP28-A3c.

Results:

Parameter	SegmentedNeutrophil (n=13272)	Eosinophil (n=487)	Basophil (n=92)	Lymphocyte (n=3223)	Monocyte (n=1259)
Cell Area (µm²)	87.2-178.3	111.8-204.6	94.8-173.2	64.4-179.9	129.4-262.0
Mean Cell Diameter (µm)	6.0-15.2	10.6-16.5	5.0-15.3	7.7-15.1	7.0-18.5
Cell FormFactor	2.3-3.3	2.2-3.1	2.3-3.0	2.3-3.1	2.3-3.1
Cell Eccentricity	0.3-0.8	0.3-0.9	0.3-0.8	0.2-0.8	0.2-0.8
Nucleus Area (µm²)	36.1-70.2	37.6-69.9	44.1-83.0	38.4-97.1	66.6-123.6
MeanNucleusDiameter (µm)	5.5-9.2	5.7-9.3	4.4-10.5	5.2-11.0	7.0-12.4
NucleusBrightness	45.5-77.8	49.0-78.5	41.0-66.6	44.0-75.3	51.4-89.1
NucleusOptical Density	0.5-0.8	0.5-0.7	0.6-0.8	0.5-0.8	0.5-0.7
NucleusFormFactor	1.1-1.8	1.1-1.7	1.1-1.6	1.0-1.4	1.1-1.6
NucleusEccentricity	0.4-0.9	0.5-0.9	0.3-0.9	0.3-0.8	0.3-0.8
Cytoplasm Area (µm²)	46.2-116.0	66.6-140.8	44.5-111.4	24.4-91.7	50.4-155.4
CytoplasmBrightness	165.4-203.0	138.1-171.6	136.5-169.0	167.1-216.0	156.7-195.2
CytoplasmOpticalDensity	0.1-0.2	0.2-0.3	0.2-0.3	0.1-0.2	0.1-0.2
Nucleus/Cell Ratio	0.3-0.5	0.3-0.4	0.4-0.6	0.4-0.7	0.4-0.7
Nucleus/CytoplasmRatio	0.5-1.0	0.4-0.8	0.5-1.3	0.8-2.1	0.6-1.8

Table 1. RI for leukocyte subsets quantitative digital microscopy parameters.

Conclusions:This RI lays the groundwork for incorporating quantitative digital morphology into standard hematology practice, enabling more objective and reproducible assessment of cellular morphology.

Keywords - Reference Intervals, Quantitative Digital Microscopy, LeukocyteSubsets