Chapter 5 Qualitative Abnormalities in Myeloid Cells-Nuclear Abnormalities

Mindray Morphology Corner | Series Course-// WBC

Understand the classification of abnormal nuclear morphology in myeloid cells, learn the morphological characteristics of abnormal nuclei in myeloid cells, and recognize the diseases associated with these nuclear abnormalities.

In the previous articles, we learned that myeloid cells can be classified into the granulocytic, megakaryocytic, and erythroid lineages. In this article, we will focus on the granulocytic lineage, while nuclear abnormalities of the megakaryocytic and erythroid lineages will be introduced in future articles.

In Chapter 4, we explored the cytoplasmic changes that occur in abnormal myeloid granulocytes. You may now be wondering what changes can occur in their nuclei. Let's take a closer look at these fascinating nuclear abnormalities!

When structural or morphological abnormalities occur in the nuclei of developing or mature granulocytes (primarily neutrophils), this phenomenon is termed nuclear dysgranulopoiesis. Identifying these abnormal nuclear morphologies and calculating their percentages is clinically crucial for the recognition and diagnosis of hematological disorders. Under international consensus guidelines, detecting these abnormal nuclear features in 10% or more of the granulocytic lineage serves as a diagnostic hallmark for myeloid neoplasms, such as Myelodysplastic Syndromes (MDS).

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1. What is myeloid nuclear abnormality?

In normal neutrophils, its size: 10–14 μm, nucleus: 2–5 lobes, linked by thin threads (nuclear segmentation). And the cytoplasm: pale, filled with specific granules (refer to Chapter 2 Normal Myeloid Development and Morphology).

Under pathological conditions, abnormalities in nuclear structural proteins, defects in DNA replication and repair, and clonal gene mutations can cause the nucleus to take on various "unconventional" shapes. Dysgranulopoiesis is characterized primarily by nuclear hyposegmentation (pseudo-Pelger-Huët anomaly) or hypersegmentation, as well as ring-shaped nuclei.

Let's turn the spotlight on these three major categories of cells together!

2. What are the types of nuclear abnormalities in the myeloid cells?

2.1 Hyposegmentation

Named Pseudo-Pelger-Huët anomaly. Pelger–Huët anomaly was first reported by Karel Pelger in 1928 and recognized as a hereditary leukocyte anomaly by Gauthier Huët in 1931. The

nucleus has fewer lobes, it looks as though the granulocyte is wearing a pair of large sunglasses, so you can also playfully call it the "Sunglasses Bro." Please be careful to briefly differentiate this from eosinophils.

Considering seen in MDS, MDS/MPN, changes after Chemoradiotherapy, or Pelger-Huët Anomaly (if merged with other lineage abnormalities). Studies have shown that, compared with MDS patients with normal granulocytic maturation, MDS patients with dysgranulopoiesis exhibit decreased NEU-X values. NEU-X reflects the complexity of intracellular components. When the NEU-X value decreases, morphological examination may reveal reduced cytoplasmic granulation and decreased nuclear segmentation, which corresponds to pseudo–Pelger-Huët (P-H) anomaly. The location is upper and left side of Neutrophil in scattergram.

- Morphological Characteristics: The nucleus presents with only 1 lobe (unsegmented; round, oval, or peanut-shaped) or 2 lobes (bilobed; typically dumbbell-shaped or spectacle-like, connected in the middle by an extremely fine strand of chromatin).
- Nuclear Chromatin State: despite the reduced nuclear segmentation, the chromatin must exhibit a highly condensed, coarse, and mature state (distinguishing it from true immature granulocytes or band neutrophils)。

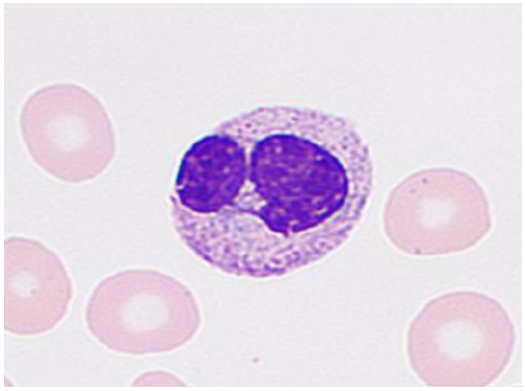


Figure 1.1

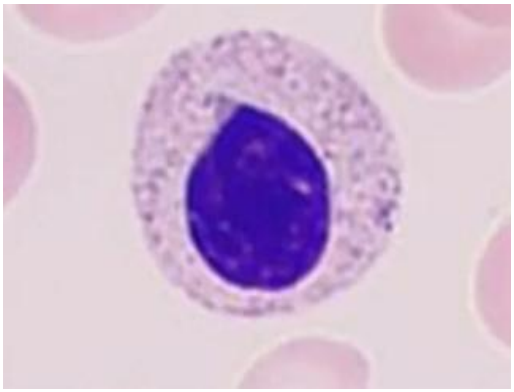


Figure 1.2

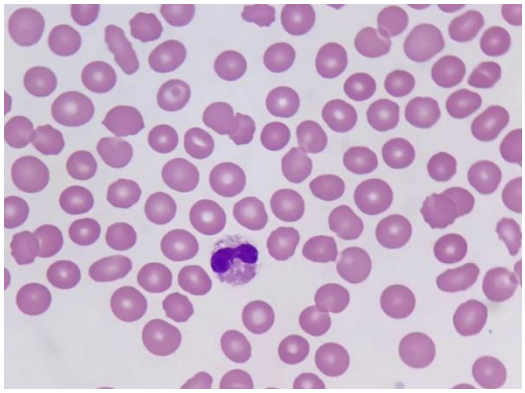


Figure 1.3

Figure 1.4

Figure 1.1&1.2&1.3 Pseudo-Pelger- Huët anomaly- Neutrophil

2.2 Since it is called "Pseudo"-Pelger-Huët anomaly, what exactly is the true Pelger-Huët anomaly?

Key Points for Differentiation	True Pelger-Huët Anomaly (Congenital/Benign)	Pseudo-Pelger-Huët Anomaly (Acquired/Malignant)
Proportion of Abnormal Cells	Extremely high; virtually all neutrophils present with bi-lobed or single-lobed nuclei.	Variable proportion; typically co-exists with normal cells (a mixture of normal and dysplastic neutrophils).
Diagnostic Value	Congenital Pelger-Huët anomaly is an autosomal dominant genetic disorder, caused by mutations in the LBR gene (lamin B receptor gene), which affects the structural integrity of the nuclear membrane.	Observed in myelodysplastic neoplasms (MDS), leukemia, agranulocytosis, certain severe infections, myelofibrosis, and following the use of certain medications, among others

In short, Pseudo-Pelger-Huët anomaly shares the exact same nuclear morphology as true Pelger-Huët anomaly. But true Pelger-Huët Anomaly (PHA) is a rare, congenital and inherited, whereas Pseudo-Pelger-Huët anomaly is acquired.

2.3 Clinical case from Pseudo-Pelger-Huët Anomaly

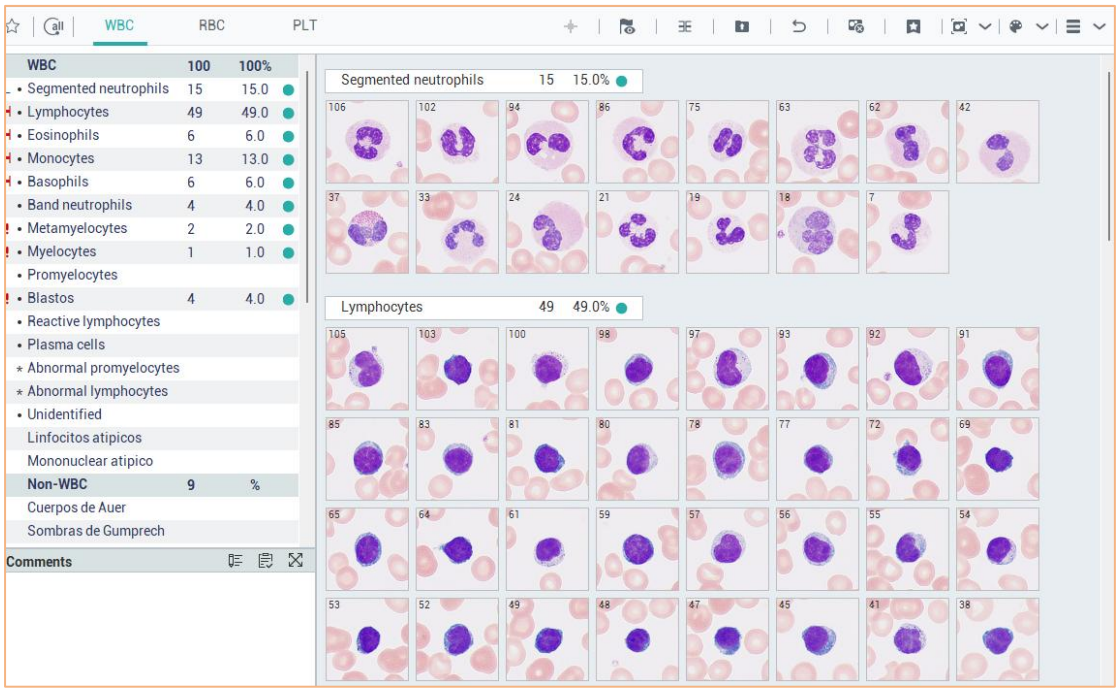
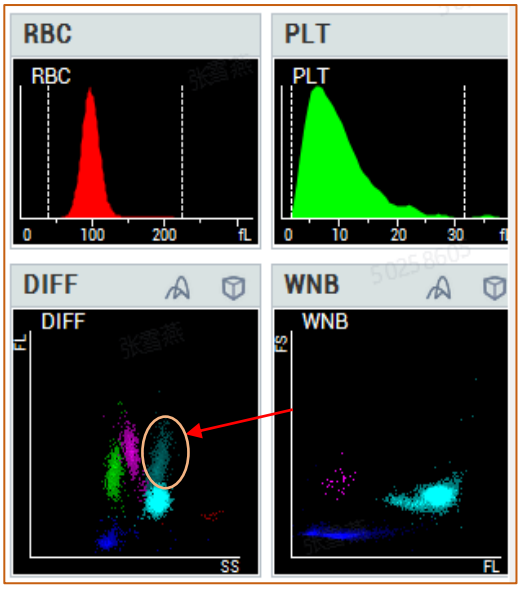
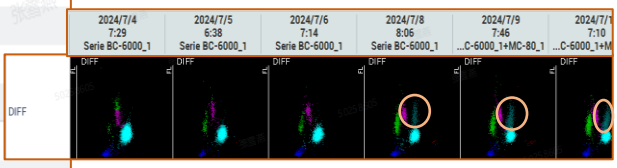
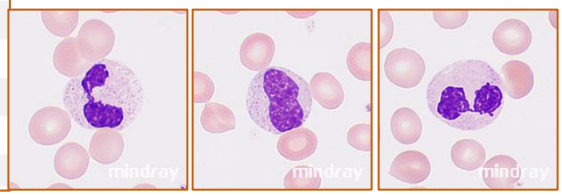


Figure 1.5 True Pelger-Huët Anomaly

STAT	Para.	Flag	Result	Delta(#)	07-09	07-08	Unit
	WBC	&	8.58	1.310	7.27	6.72	10^3/uL
	Neu%	&R	68.0	-2.20	70.2	76.7	%
	Lym%	& L	10.2	0.00	10.2	10.0	%
	Mon%		7.5	0.40	7.1	6.5	%
	Eos%	RL	0.2	-0.10	0.3	0.1	%
	Bas%		0.0	0.00	0.0	0.0	%
	IMG%		14.1	1.90	12.2	6.7	%
	Neu#	&R	5.83	0.730	5.10	5.15	10^3/uL
	Lym#	&	0.88	0.140	0.74	0.67	10^3/uL
	Mon#		0.64	0.120	0.52	0.44	10^3/uL
	Eos#	R	0.02	0.000	0.02	0.01	10^3/uL
	Bas#		0.00	0.000	0.00	0.00	10^3/uL
	IMG#		1.21	0.320	0.89	0.45	10^3/uL
	RBC	L	2.89	0.090	2.80	2.95	10^6/uL
	HGB	L	9.3	0.00	9.3	9.5	g/dL
	Neu-X	R	338.6	-34.50	373.1	361.1	
	Neu-Y	R	481.4	-27.10	508.5	483.2	
	Mon-X		241.1	-10.20	251.3	253.3	
	HCT	L	27.9	1.00	26.9	28.2	%
	MCV		96.6	0.60	96.0	95.6	fL
	MCH		32.1	-1.20	33.3	32.3	pg
	MCHC		33.3	-1.30	34.6	33.7	g/dL
	RDW-CV		13.0	0.00	13.0	13.1	%
	RDW-SD		45.2	0.00	45.2	45.4	fL
	Micro%		0.8	0.00	0.8	0.8	%
	Macro%	H	4.4	0.80	3.6	3.4	%







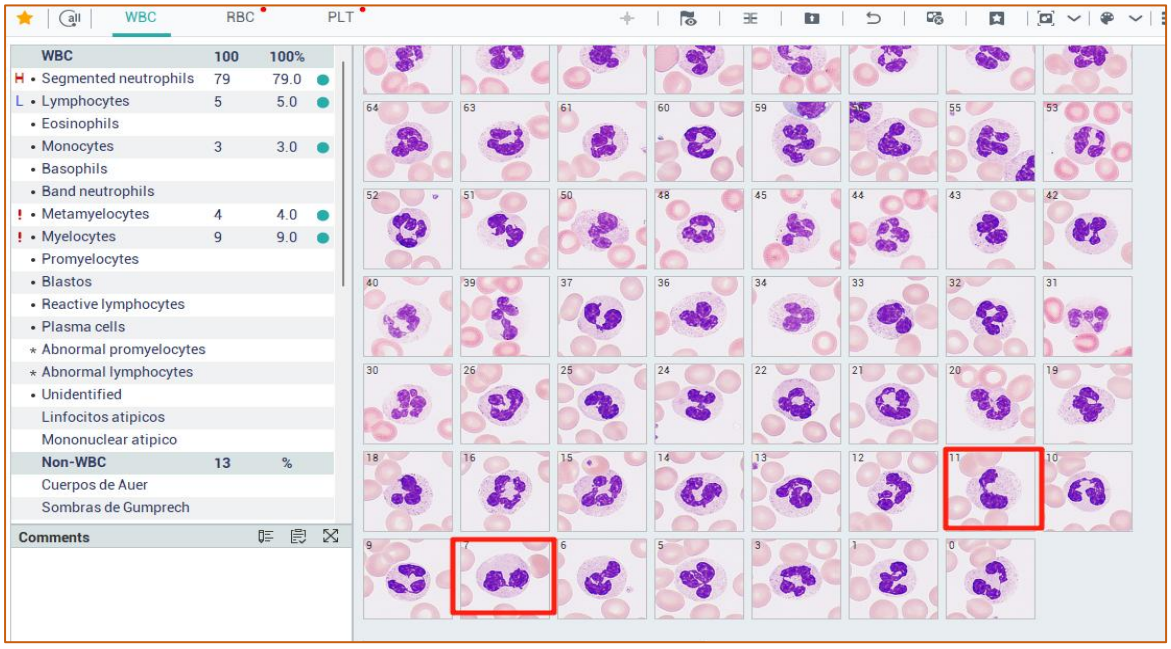


Figure 1.6 Pseudo-Pelger-Huët Anomaly

3.1 Hypersegmentation

Academic name: Nuclear Hypersegmentation, as the cell nuclei are excessively segmented, looking as if a blooming chrysanthemum or multiple nuclei stacked together, sometimes nicknamed the "Afro hair" or "Cluster-nuclei". Consider Megaloblastic Anemia (if merged with macrocytic anemia) or seen after Antimetabolite Therapy.

- Morphological Features: The cell nuclei present as ≥5 lobes. During counting, the lobes must be connected by very fine filaments of chromatin. It is considered a right shift if >1% of neutrophils have ≥ 6 lobes, or ≥3 of neutrophils have ≥ 5 lobes.
- Nuclear Chromatin Status: Despite the abnormal increase in nuclear segmentation, its chromatin must present a state of being highly condensed, coarse, and mature.

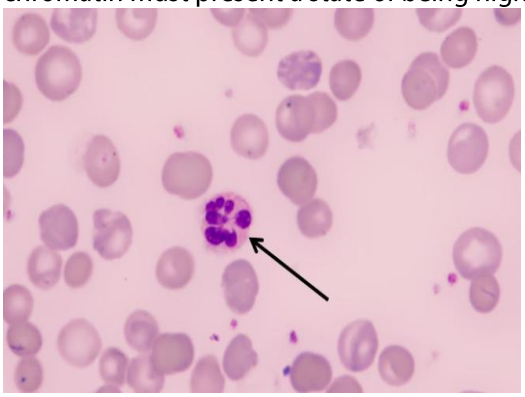


Figure 2.1

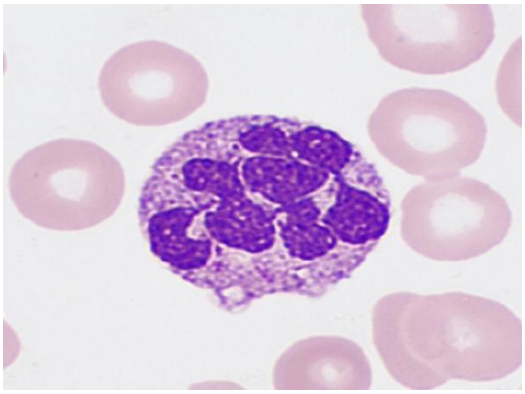


Figure 2.2

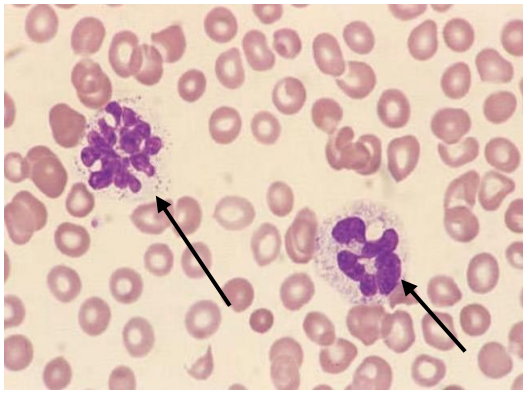


Figure 2.3

Figure 2.4

Figure 2.1&2.2&2.3 Hypersegmentation-Neutrophil

4.1 Ring-Shaped Nuclei

A nuclear abnormality where the nucleus forms a continuous, completely closed, hollow circle

or "donut" shape, enclosing a central pocket of cytoplasm within the mature, condensed chromatin ring.

It represents a severe structural failure in normal nuclear lobulation during cell production (dysgranulopoiesis). It is a key diagnostic hallmark heavily associated with Myelodysplastic Syndromes (MDS) and other myeloid neoplasms, provided it meets the official threshold (≥10% of the lineage).

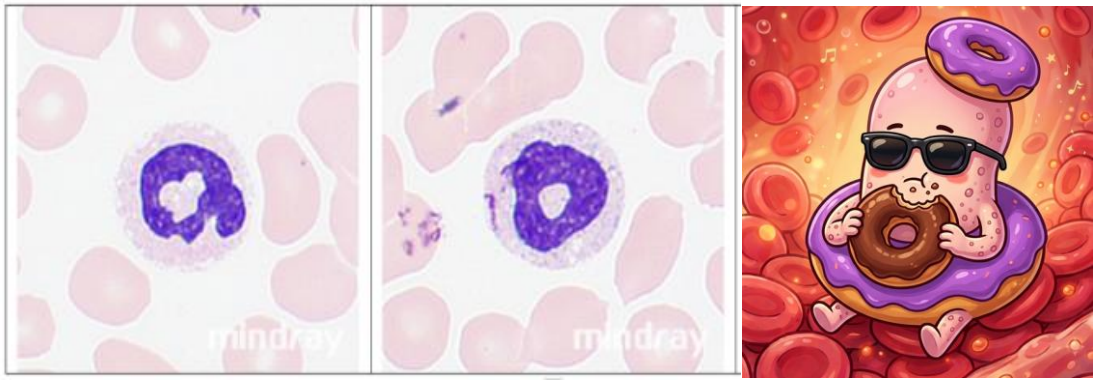


Figure 3.1
Figure 3.1 Ring-Shaped Nuclei Neutrophil

5 Summary

The microscopic detection and quantification of these three distinct nuclear abnormalities serve as critical diagnostic checkpoints in hematopathology to differentiate between nutritional deficiencies, reactive states, primary bone marrow disorders and ect., identifying these cellular anomalies guides clinicians to order targeted secondary testing—such as serum vitamin levels for hypersegmentation, or comprehensive MICM (Morphology, Immunology, Cytogenetics, Molecular) bone marrow panels if clonal dysplasia is suspected—**collectively providing robust evidence for both definitive clinical diagnosis and subsequent therapeutic strategies.**

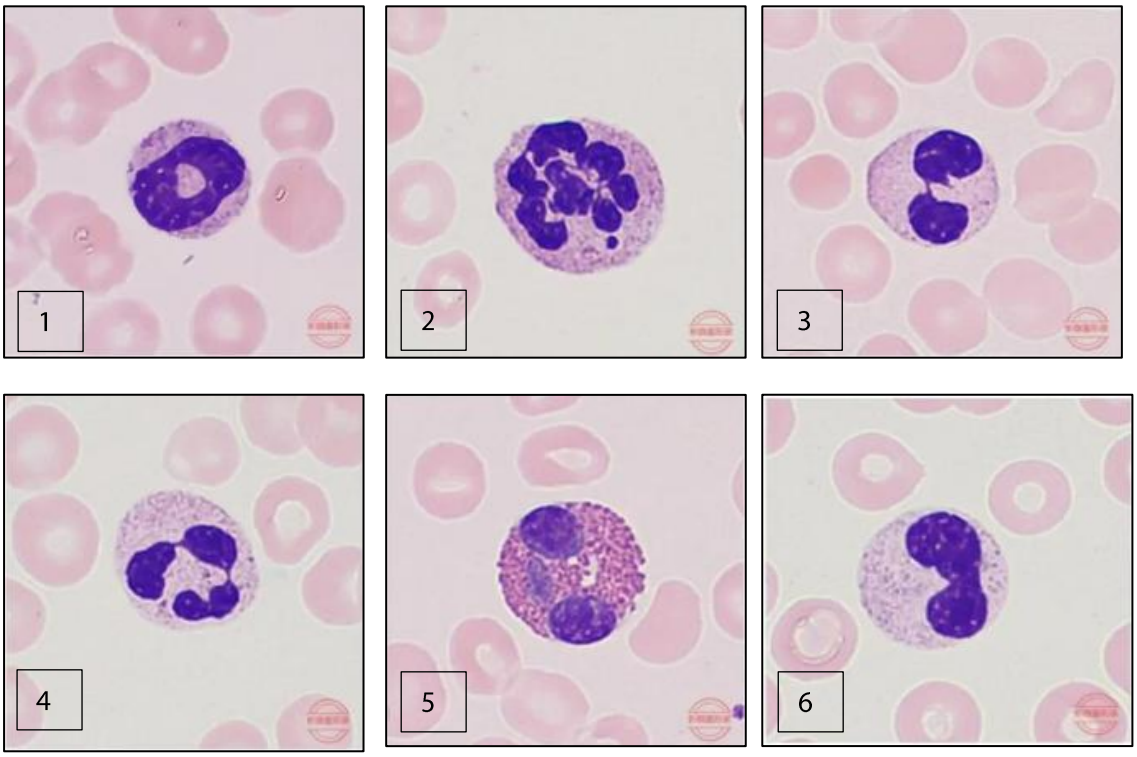
References & Image Sources

References:

1. Kaushansky K, Prchal JT, Levi MM, Roberts I, Thein S, Kipps TJ, eds. *Williams Hematology*. 11th ed. McGraw Hill; 2026.
2. Khoury, J. D., Solary, E., Abla, O., et al. The World Health Organization 2022 classification of myeloid neoplasms: A structural framework for the diagnosis and treatment of clonal myeloid disorders. *Leukemia*, 36(7), 1703–1719. 2022
3. Arber, D. A., Orazi, A., Hasserjian, R. P., et al. International Consensus Classification of Myeloid Neoplasms and Acute Leukemias: Integrating morphologic, immunophenotypic, cytogenetic, and genomic data. *Blood*, 140(11), 1200–1228. 2022
4. Palmer, L., Briggs, C., McFadden, S., Zini, G., Burger, J., Machin, S., & Izak, G. ICSH recommendations for the standardization of nomenclature and grading of peripheral blood cell morphological features. *International Journal of Laboratory Hematology*, 37(3), 287–303. 2015
5. Sun P, Li N, Zhang S, Liu S, Zhang H, Yue B. Combination of NeuX and NeuZ can predict neutrophil dysplasia features of myelodysplastic neoplasms in peripheral blood. *Int J Lab Hematol.* 2023;45(4):522-527.

Images & Technical Support: Some morphology images in this course are derived from analysis by the **Mindray automated digital morphology analyzer MC-80 and** some images are sourced from WeChat official accounts: 析微鉴形录

Practice



[The answers will be at the end of the next chapter]

The answer of last chapter: 1. Auer Rod 2. Vacuolation-neutrophil; 3. Monocyte; 4. Döhle Rod; 5. Hypergranulation-neutrophil (toxic granulation); 6. Faggot Cell

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— Coming Next: **Myeloid cells in haematological neoplasms**—