Editorial

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Obtaining Reliable CBC Results in Clinical Laboratories

The complete blood count (CBC) is one of the most commonly requested clinical laboratory tests. It provides important information on blood cell numbers, hematocrit, Hb concentration, red blood cell indices, and leukocyte types. Hematology laboratories routinely utilize automated hematology analyzers to obtain CBC results. Since the advent of electronic cell counters in the 1960s, multiple technologies, including electrical impedance, optical flow cytometry, and cytochemical staining, have been used in automated analyzers. With the introduction of new principles and advances in software, hematology analyzers have undergone remarkable technological evolution, and the range of applicable samples is expanding [1–3]. Although appropriately quality-controlled and properly operated hematology analyzers generate accurate CBC results for nearly all specimens, every laboratory encounters some specimens that yield no or inaccurate results [4, 5].

Given the importance of the CBC, numerous review articles, book chapters, and case reports have been published on the erroneous results of various CBC parameters, and a myriad of new information is being reported [6–10]. In their review article in this issue, Gulati, *et al*. [11] provide an overview of how to recognize unreliable CBC results, how to identify the potential underlying causes, and ways to obtain reliable results. The authors present essential and up-to-date knowledge in a concise manner.

Known causes of unreliable CBC results are grouped as interfering substances and abnormal cells or cellular phenomena [11]. Several methods of recognizing unreliable CBC results are described, including automated or manual review of analyzer-generated flags, delta check failures, review based on expectation or predefined quality control rules, visual inspection of the blood specimen tube, and blood smear examination [11]. Detailed examples of unreliable automated CBC results and methods for obtaining reliable results are provided for each listed cause; for interfering substances: lipemia, hemolysis, hyperbilirubinemia, red cell agglutinins, white cell agglutinins, platelet agglutinins, hyperproteinemia/paraproteinemia, cryoproteinemia, organisms, hyperglycemia, adipose tissue fragments/flat globules, fibrin clumps, small clots in the specimen tube; and for abnormal cells or cellular phenomena: red cell fragments/schistocytes, extremely microcytic red cells, lysis-resistant red cells, hyperleukocytosis, giant platelets, cytoplasmic fragments of leukocytes, platelet satellitosis, nucleated red blood cells, megakaryocytes, and non-hematopoietic cells [11]. For each example, a general description, the impact on CBC parameters, methods for recognizing unreliable results, methods for obtaining reliable results encompassing multiple approaches, including sample processing and calculational methods, and example cases with initial and re-run CBC results are described in detail based on the literature or the authors' experiences.

As the authors suggest in their conclusions, for analyzer-specific information on what may adversely affect CBC results, laboratory professionals should consult the operating manual provided by the manufacturer; however, the well-organized and concise problem-solving methods described in their review for problems commonly encountered in clinical laboratories will be

of great help. In future, we expect the development of an artificial intelligence-assisted platform for the detection of unreliable CBC results.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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REFERENCES

1. Buttarello M and Plebani M. Automated blood cell counts: state of the art. Am J Clin Pathol 2008;130:104-16.
2. Park SJ, Yoon J, Kwon JA, Yoon SY. Evaluation of the CellaVision advanced RBC application for detecting red blood cell morphological abnormalities. Ann Lab Med 2021;41:44-50.
3. Cho J, Oh J, Lee SG, Lee YH, Song J, Kim JH. Performance evaluation of body fluid cellular analysis using the Beckman Coulter UniCel DxH 800, Sysmex XN-350, and UF-5000 automated cellular analyzers. Ann Lab Med 2020;40:122-30.
4. Zandecki M, Genevieve F, Gerard J, Godon A. Spurious counts and spurious results on haematology analysers: a review. Part I: platelets. Int J Lab Hematol 2007;29:4-20.
5. Zandecki M, Genevieve F, Gerard J, Godon A. Spurious counts and spurious results on haematology analysers: a review. Part II: White blood cells, red blood cells, haemoglobin, red cell indices and reticulocytes. Int J Lab Hematol 2007;29:21-41.
6. Lippi G, Blanckaert N, Bonini P, Green S, Kitchen S, Palicka V, et al. Haemolysis: an overview of the leading cause of unsuitable specimens in clinical laboratories. Clin Chem Lab Med 2008;46:764-72.
7. Gulati G, Song J, Florea AD, Gong J. Purpose and criteria for blood smear scan, blood smear examination, and blood smear review. Ann Lab Med 2013;33:1-7.
8. Zeng SG, Zeng TT, Jiang H, Wang LL, Tang SQ, Sun YM, et al. A simple, fast correction method of triglyceride interference in blood hemoglobin automated measurement. J Clin Lab Anal 2013;27:341-5.
9. Rim JH, Chang MH, Oh J, Gee HY, Kim JH, Yoo J. Effects of cold agglutinin on the accuracy of complete blood count results and optimal sample pretreatment protocols for eliminating such effects. Ann Lab Med 2018;38:371-4.
10. Lardinois B, Favresse J, Chatelain B, Lippi G, Mullier F. Pseudothrombocytopenia—a review on causes, occurrence and clinical implications. J Clin Med 2021;10:594.
11. Gulati G, Uppal G, Gong J. Unreliable automated CBC results: causes, recognition, and resolution. Ann Lab Med 2022;42:515-30.

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