CORRESPONDENCE

Spurious Leukocyte Counts and an Abnormal Histogram Pattern Due to Fibrin Clumps

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Dear Editor

Spuriously low or high automated WBC counts seen in laboratory practice can cause diagnostic and therapeutic dilemma. WBC histograms and scatterplots may have clues to the presence of an abnormal WBC population or interfering substances [1, 2]. We present a series of 14 patients in whom the automated WBC count was spuriously elevated due to interference by fibrin clumps. These patients were undergoing treatment for various hematological disorders (9 patients were chemotherapy and 5 patients were post bone marrow transplant).

Complete blood count (CBC) was done on BC 3000 plus (Mindray) three-part automated hematology analyzer. In 12 of the 14 patients, daily or alternate day counts were being monitored due to low WBC count. In 10 of the 14 patients, the WBC count reported initially was much higher than the expected rise over 24 h. In four patients, presence of fibrin clumps was suspected on viewing the abnormal WBC histogram pattern. Repeat samples were requested in all 14 patients which showed lower WBC counts compared to initial samples. The initial WBC counts were 2.2–40 times higher than the actual value. Hemoglobin, RBC indices and platelet counts were similar in both samples (Table 1). Peripheral blood smears in all patients showed fibrin clumps at the tail end of the smears (Fig. 1a, b). The manual WBC count estimated from the peripheral smear

conformed to that seen on repeat automated CBC estimation.

The histograms in all patients were abnormal with a straight ascending limb as compared to a rising sloping pattern seen in normal WBC histograms. The straight limb was not seen in the repeat samples. The height of the WBC histogram peak on the Y-axis was also lower in the repeat samples. The descending limb was normal in patients with fibrin clumps (Fig. 1). To study the specificity of the WBC histogram abnormality, we analyzed 1008 consecutive WBC histograms in patients who had simultaneous peripheral smear examination. None of the cases showed the abnormal histogram pattern.

Spuriously high WBC counts can be caused by platelet aggregates, giant platelets, nucleated red blood cells, RBCs with lytic resistance, cryoglobulins, adipose tissue fragments, fibrin clumps and micro-organisms [2–4]. Fibrin clumps is an uncommon cause of spuriously high WBC count and can cause false elevation of WBC counts. We report a previously undescribed abnormality in the WBC histogram due to interference by fibrin clumps. Nine of the patients in our study were in high dependency settings with central lines in place for drug delivery and sampling. Prolonged use of central lines results in localized fibrin precipitates in and around the line ports. While drawing a blood sample, fibrin may be introduced in the sample and can cause interference in automated counts. Slow sample draws and difficult venipuncture may also introduce these in blood samples [5]. Tiny fibrin clumps resulting in spurious WBC counts may be undetected at times. Careful blood smear examination with emphasis to the tail end is also helpful in detecting this artefact. The size and number of fibrin strands being variable in different blood samples, no prediction can be made regarding the degree of WBC rise that may be seen.

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Table 1 The automated CBC parameters in the patients (n = 14)

Patient	Hemoglobin (gm/dl)	Initial WBC count (/cu.mm) (no. of times actual count)	WBC count (/cu.mm)-on repeat sample	Platelet count (/cu.mm)
1	5.9	10,000 (2.2)	4500	43,000
2	8.5	5100 (6.3)	800	38,000
3	9.2	3100 (7.7)	400	71,000
4	9.9	33,000 (11.3)	2900	2,10,000
5	9.4	2400 (24)	100	26,000
6	8.2	600 (6.0)	100	10,000
7	12.7	7600 (6.9)	1100	31,000
8	11.4	12,000 (24.0)	500	64,000
9	6.0	3700 (18.5)	200	29,000
10	9.6	4000 (40.0)	100	59,000
11	8.2	3200 (6.4)	500	33,000
12	10.3	2100 (2.3)	900	43,000
13	9.2	7300 (4.5)	1600	1,39,000
14	8.2	4800 (3.2)	1500	59,000

Fig. 1 Panel on the left shows WBC histograms from a normal person (top) and histograms from patients 11, 13 and 14 (below). Histograms from normal individuals show sloping ascending and descending limbs. Histograms from patients show a straight

ascending limb (arrow) with a sloping descending limb. Repeat samples did not show the abnormality. Blood smear of a patient shows fibrin clumps at the tail-end, **a** ($\times 100$) and **b** ($\times 400$) [Leishman stain]

Since WBC differential scatterplots or histograms may show abnormalities in the presence of fibrin clumps, technical staff and pathologists must be trained to identify them, and request repeat samples to avoid erroneous results that may lead to inappropriate management [1, 2].

Compliance with Ethical Standards

Conflict of interest The author declares that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No patient/subject identifying information has been disclosed in the manuscript. No patient/subject intervention was done and the subjects were not exposed to any risks during the study.

Informed Consent Since the study involved a retrospective review of data only from routine testing offered by the laboratory, separate informed consent was not taken for the study. Repeat sampling was

done as part of routine protocol in case of suspected pre-analytic problem. “For this type of study formal consent is not required.”

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